

Thermal Process Technology



Furnaces and Heat Treatment Systems for

Metals

Plastics, Rubber, Silicone

Fiber Composites, GFK, CFK

Surface Finishing

Brazing, Soldering

Forming, Forging

Drying Processes

Metal Injection Molding, MIM

AMS 2750 D, NADCAP, FDA

Med Tech

Energy Efficiency Technology

www.nabertherm.com

■ Made
■ in
■ Germany



Made in Germany

Nabertherm with 350 employees worldwide have been developing and producing industrial furnaces for many different applications for over 60 years. As a manufacturer, Nabertherm offers the widest and deepest range of furnaces worldwide. 150,000 satisfied customers in more than 100 countries offer proof of our commitment to excellent design, quality and cost efficiency. Short delivery times are ensured due to our complete inhouse production and our wide variety of standard furnaces.

Setting Standards in Quality and Reliability

Nabertherm does not only offer the widest range of standard furnaces. Professional engineering in combination with inhouse manufacturing provide for individual project planning and construction of tailor-made thermal process systems with material handling and charging systems. Complete thermal processes are realized by customized system solutions.

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

Global Sales and Service Network – Close to you

Centralized engineering and manufacturing and decentralized sales and service define our strategy to live up to your needs. Long term sales and distribution partners in all important world markets ensure individual on-site customer service and consultation. There are various reference customers in your neighborhood who have similar furnaces or systems.



Large Test Center for Customers

What furnace is the right choice for this specific process? This question cannot always be answered easily. Therefore, we have set up our modern test center which is unique in respect to size and variety. A representative number of furnaces is available for tests for our customers.

Customer Service and Spare Parts

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

Experience in Many Fields of Thermal Processing

In addition to furnaces for thermal process technology, Nabertherm offers a wide range of standard furnaces and systems for many other thermal processing applications. The modular design of our products provides for customized solutions to your individual needs without expensive modifications.

Table of Contents

	Page
Which Furnace for Which Process?	4
Brazing, Forming, Plastics	8
Retort Furnaces	
Hot-wall retort furnaces up to 1100 °C	10
Cold-wall retort furnaces up to 3000 °C	14
Chamber Dryer, Electrically Heated or Gas-Fired	18
Air Circulation Furnaces	
Air circulation chamber furnaces > 500 liters, electrically heated or gas-fired	20
Air circulation chamber furnaces < 500 liters, electrically heated	24
Air circulation chamber furnaces/ovens with safety technology for solvent-containing charges according to EN 1539 or NFPA 86	26
Air-circulation chamber furnaces with cleanroom technology, electrically heated	27
Ovens up to 300 °C	28
Air circulation bogie hearth furnaces, electrically heated or gas-fired	30
Air circulation ovens with bogie hearth, electrically heated or gas-fired	32
Air circulation pit-type furnaces, electrically heated	33
Pit-Type and Top-Loading Furnaces, Electrically Heated or Gas-Fired	35
Bogie Hearth Furnaces	
Bogie hearth furnaces, electrically heated	36
Bogie hearth furnaces, gas-fired	39
Chamber Furnaces	
Chamber furnaces, gas-fired	40
Chamber furnaces, electrically heated	41
Lift-Top Furnaces, Electrically Heated	44
Charging Devices and Accessories for Chamber and Bogie Hearth Furnaces	46
Quench Tanks	47
Protective Gas and Carburization Systems for Annealing and Hardening	48
Salt-Bath Furnaces for Heat Treatment of Steel or Light Metals, Electrically or Gas-Fired	50
Martempering Furnaces using Neutral Salts, Electrically Heated	51
Furnaces for Continuous Processes	
Rotary hearth furnaces up to 1300 °C with and without air circulation, electrically heated or gas-fired	52
Continuous furnaces, electrically heated or gas-fired	54
Wire and strand annealing furnaces	55
Tempering Plants for Steel and NE-Metals	56
Energy Efficiency Technology	60
AMS 2750 D, NADCAP, FDA	61
Professional Control and Documentation Alternatives	64



Which Furnace for Which Process?

Preheating for Forging

- Press Hardening
- Heating of sheet metals
- Preheating of molds

Hardening, Annealing

- Ageing
 - Austempering
 - Diffusion annealing
 - Pack hardening
 - Recovery annealing
 - Coarse grain annealing
 - Hardening
 - Solution annealing
 - Annealing
 - Recrystallization annealing
 - Stress-relieving
 - Soft annealing

Quenching

- ☐ Water
- ☐ Air
- ☐ Oil
- ☐ Polymer

in Air

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

in Salt Bath

Bogie hearth furnaces

page 36

Bogie hearth furnaces
gas-fired
page 39

Chamber furnaces
gas-fired
page 40

Chamber furnaces

page 41/42

Lift-top furnaces

page 44

Rotary hearth furnaces

page 52

Continuous furnaces
page 54

Air circulation pi
furnaces
page 34

Pit-type and top-loading
furnaces
page 35

Bogie hearth furnaces

page 36

**Bogie hearth furnaces
gas-fired,
page 39**

Chamber furnaces
gas-fired
page 40

Chamber furnaces

Lift-top furnaces

page 44

Rotary hearth furnaces

page 52

Continuous furnaces

page 54

Strand annealing furnaces

page 55

Wire annealing furnaces

page 55

Hot-wall retort furnaces
page 10-13

Cold-wall retort furnaces

page 14

Bogie hearth furnaces with
annealing box
page 36

Chamber furnaces with
annealing box
page 41

Lift-top furnaces with
annealing box
page 44

Rotary hearth furnaces

page 52

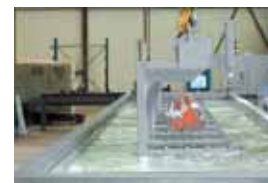
Salt-bath furnaces
page 50



Salt-bath furnace TS 40/30
with exhaust gas collection at
crucible rim, see page 50

Quench tanks
page 47

Water quench tanks
page 56-59



Water quench tank with powerful water-circulation



Annealing furnace with electro-hydraulic lift-door on transportable base for preheating of large steel sheets for the automotive industry, see page 42



NR 150/11 H₂ for operation with hydrogen, see page 10

Tempering, Annealing

Heat Treatment Systems

- Tempering
- Precipitation annealing
- Ageing
- 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
page 18

Air circulation chamber
furnaces > 500 liters
page 20

Air circulation chamber
furnaces < 500 liters
page 24

Air circulation chamber
furnaces with cleanroom
technology, page 27

Air circulation bogie
hearth furnaces
page 30

Air circulation pit-type
furnaces
page 33/34

Pit-type and top-loading
furnaces
page 35

Rotary hearth furnaces
page 52

Continuous furnaces
page 54

Hot-wall retort furnaces
page 10-13

Air circulation chamber
furnaces with annealing
box, page 24

Air circulation chamber
furnaces with annealing
box, page 27

Air circulation bogie
hearth furnaces with
annealing box, page 30

Air circulation pit-type
furnaces with annealing
box, page 33

Rotary hearth furnaces
page 52

Continuous furnaces
page 54

Martempering furnaces
page 51

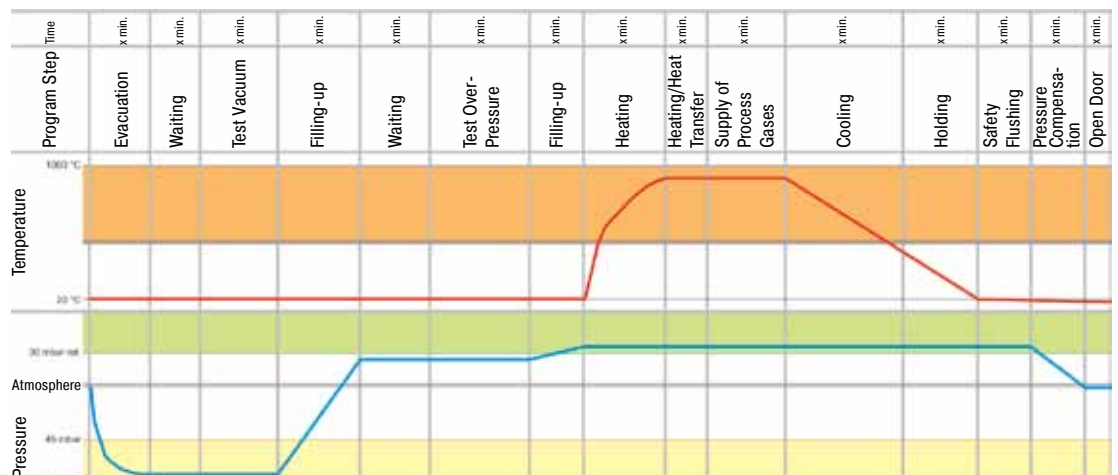
Fully automatic tempering
systems
page 56/57

Manual heat treatment
systems
page 58/59



Manual heat treatment system for hardening of steel rods, see page 59

Process flow chart



Which Furnace for Which Process?

Brazing/Soldering

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

Curing, Tempering, Drying

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

under Protective Gases

Hot-wall retort furnaces
page 10-13

Cold-wall retort furnaces
page 14

Air circulation chamber
furnaces with annealing
box, page 24

Chamber furnaces with
annealing box,
page 41

in Salt Bath

Salt-bath furnaces
page 50

in Vacuum

Hot-wall retort furnaces
page 10-13

Cold-wall retort furnaces
page 14

Solvent Based

Hot-wall retort furnaces
page 10-13

Chamber dryers
page 18

Air circulation chamber
furnaces EN 1539
page 26

Air circulation ovens with
bogie hearth
page 32

Water Based

Chamber dryers
page 18

Air circulation chamber
furnaces
page 24

Ovens
page 28

Air circulation bogie
hearth furnaces
page 30

Air circulation pit-type
furnaces
page 33/34

Rotary hearth furnaces
page 52

Continuous furnaces
page 54



Brazing in a gas-supply box

VHT 40/22-GR with graphite insulation and heating, see page 14

Surface Treatment Thermal/Thermo-Chemical Processes

- Carburizing
- Blueing (e.g. with water steam)
- Nitriding/nitrocarborizing
- Oxidizing
- Deoxidizing under hydrogen

in Salt Bath

Salt-bath furnaces
page 50

under Protective Gases, Reaction Gases

Hot-wall retort furnaces
page 10-13

Cold-wall retort furnaces
page 14

Air circulation chamber
furnaces with annealing
box, page 24

Air circulation bogie
hearth furnaces with
annealing box, page 30

Bogie hearth furnaces with
annealing box
page 36

Chamber furnaces with
annealing box
page 41

Overview
annealing boxes
page 48

in Powders

Hot-wall retort furnaces
page 10-13

Cold-wall retort furnaces
page 14

Air circulation chamber
furnaces
page 24

Bogie hearth furnaces
page 36

Bogie hearth furnaces
gas-fired
page 39

Chamber furnaces
gas-fired
page 40

Chamber furnaces
page 41/42

Lift-top furnaces
page 44

Overview
annealing boxes
page 48

Sintering & Debinding

- Debinding
- MIM
- CIM
- Sintering

under Protective Gases, Reaction Gases or in Vacuum

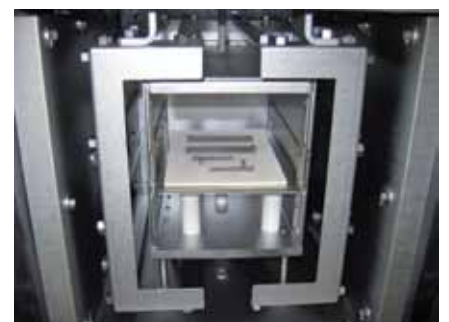
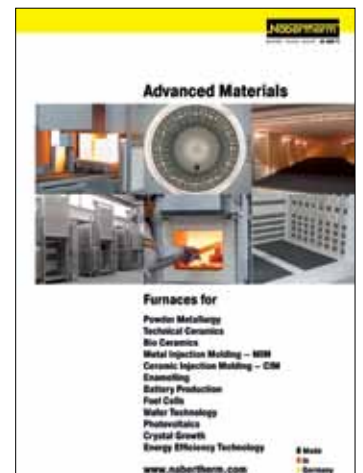
Hot-wall retort furnaces,
page 10-13

Cold-wall retort furnaces,
page 14

Retort furnaces for
catalytic debinding, see
separate catalog:



Blueing of drills in water steam atmosphere in a furnace of the NRA range, see page 12



Sintering of MIM titan parts in a VHT furnace

Brazing, Forming, Plastics



Brazing in annealing box

The furnaces shown in this catalog can be used for various heat treatment processes. Nabertherm has developed interesting solutions for the processes described below as examples:

Brazing

In general, when speaking of brazing we have to distinguish 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: $T_{liq} > 900\text{ °C}$



Hot-wall retort furnace to 1100 °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 air circulation chamber furnace up to 850 °C in a protective gas atmosphere
- Brazing in an annealing box in a chamber furnace up to 1100 °C under a protective gas atmosphere
- Brazing in a chamber retort furnace NR/NRA series under protective gases or reaction gas up to 1100 °C
- Brazing in a high-temperature chamber retort furnace VHT series under protective gases, reaction gases or under vacuum up to 2200 °C
- Brazing in a salt bath up to 1000 °C salt bath temperature
- Brazing or metallizing in a tube furnace up to 1800 °C under protective gases, reaction gases or in a vacuum up to 1400 °C (see separate Advanced Materials catalog)

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.



N 6080/13 S with door-in-door function, isolating transformer and vibration dampers

Pre-Heating for Hot Forming

For traditional hot forming processes such as forging or die forming the piece must first be heated to a defined temperature. From the manufacture of individual parts to serial production, from thin metal sheets to components which are formed in the course of multiple passes – Nabertherm offers a broad range of furnaces and special solutions for these processes.

If, for example, only the ends of long components need to be heated, the furnace can be fitted with closable openings in the door to avoid any heat losses. To protect the operator, an isolating transformer is used which safely conducts away the electrical currents in case of touching the heating elements.

If the furnace is used near a forging hammer which causes strong vibrations, vibration dampers can be installed to separate the furnace from these frequencies. The needs of continuous forging processes are met by appropriate furnace models such as rotary hearth furnaces and continuous furnaces. The advantage of the rotary hearth furnace is its compact size and the charging/discharging of the work piece at one position.

If the task is to form sheet steel, for example in the automotive industry, the furnace needs a large width and depth in relation to its height. For easy charging, the furnaces are provided with a lift door and can, if necessary, be fitted with a charge support adapted for use with the charging stacker.



N 1760/S for pre-heating sheet metal/steel with charge support



DH 2500/S on rails to shuttle between two forging stations

Tempering, Curing, Vulcanization and Degassing of Plastics, Rubber, Silicone, and Fiber Composite Materials

Many plastics and fiber composite materials must be heat-treated for product improvement or to ensure that they have the required product properties. In most cases, chamber dryers or ovens with air circulation are used for the respective process. The following examples outline the processes which these furnaces can perform.

PTFE (polytetrafluoroethylene)

One application is the heat treatment of PTFE. This process can be used to improve the adhesive properties, the mixture hardness or the sliding properties of the coating. In most cases, chamber dryers are used which, depending on the type of plastic, may or may not include safety technology based on EN 1539.

Silicone

One reason why silicone is tempered is to reduce the amount of silicone oil in the silicone to a certain percentage, i.e. to drive it out, in order to meet relevant food regulations. During the tempering process the silicone oil is vented out of the furnace chamber by continuous air exchange. To optimize the temperature uniformity in the furnace chamber, the fresh air supply is pre-heated. Depending on the furnace size, a heat-recovery system with heat exchangers can result in significant energy savings and pay for itself in just a short time.

Parts are prevented from sticking together by keeping them moving in a rotating rack in the oven.

Carbon Composite Materials

These days, carbon composite materials are used in many industries such as automotive, aerospace, wind power, agriculture, etc. Different materials and manufacturing processes require different heat-treatment processes for curing composite materials.

Some of the processes are done in autoclaves. Other materials are heat-treated in chamber dryers or ovens with air circulation. In this case, the composite materials are frequently evacuated in vacuum bags. For this purpose, the furnace is equipped with suitable connections for the evacuation of the air bags.

Pages 6/7 contain a description of which Nabertherm furnace ranges are suitable for tempering and curing of plastics.



Silicone tempering furnace with tightly welded inner box and rotating rack for the charge.



The openings for the vacuum and measurement connections of an air circulation chamber furnace



Chamber dryer KTR 2000 for silicone tempering



Drawer system for charging the furnace on several levels.

Hot-Wall Retort Furnaces up to 1100 °C



NR 50/11 with gas supply package and safety system for hydrogen



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

NRA 12/06 - NRA 430 /11

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

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

Models NRA .../06 with Tmax 650 °C

- Heating elements located inside the retort
- Temperature uniformity up to ± 3 K inside the working chamber from 100 °C - 600 °C
- Retort made of 1.4571
- Gas circulation fan in the back of the retort provides for optimal temperature uniformity



Inside heating in models NRA .../06

Models NRA .../09 with Tmax 950 °C

- Outside heating with heating elements surrounding the retort as well as an additional door heater
- Temperature uniformity up to ± 3 K inside the working chamber from 200 °C - 900 °C
- Retort made of 1.4841
- Gas circulation fan in the back of the retort provides for optimal temperature uniformity



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

Models NR .../11 with Tmax 1100 °C

- Outside heating with heating elements surrounding the retort as well as an additional door heater
- Temperature uniformity up to ± 5 K inside the working chamber from 200 °C - 1050 °C
- Retort made of 1.4841



NR 150/11 H₂ for operation with hydrogen

Standard Equipment for all models

Basic version

- Compact housing in frame design with removable stainless steel sheets
- Controls and gas supply integrated in the furnace housing
- Welded charging supports in the retort or air-baffle box in the furnace with air circulation
- Swivel door hinged on right side with open cooling water system
- Multi-zone control for 950 °C and 1100 °C version, separated by furnace chamber and door. Depending on furnace chamber additionally subdivided into one or several heating zones
- Gas supply system for one nonflammable protective gas with flow meter and solenoid valve, switchable via the control system
- Operation under vacuum up to 600 °C with optional single-stage rotary vane pump (not for models NRA ../06)
- Port for vacuum pump for cold evacuation
- PLC controls with touch panel H 700 for data input (resp. P 300 for 650 °C-version), see page 64

Additional equipment

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



Gas supply system for hydrogen



Vacuum pump for cold evacuation of the retort



Touchpanel H 3700 for automatic version

Hot-Wall Retort Furnaces up to 1100 °C



NR 200/11 H₂ for heat treatment under hydrogen



Charging of the NR 300/06 furnace with a pallet truck

H₂ Version for Operation under Hydrogen

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

- H₂ supply at controlled overpressure of 50 mbar relative
- Certified safety concept
- PLC controls with graphic touch panel H 3700 for data input
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe flushing of furnace chamber with inert gas
- Exhaust gas torch for H₂ afterburning
- Emergency flood container for purging the furnace in case of failure



Emergency flood container and exhaust gas torch for model NR 150/11 H₂

IDB Version for Debinding under Protective Gas or for Pyrolysis Processes

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

- Process control under monitored and controlled overpressure of 50 mbar relative
- Certified safety concept
- PLC controls with graphic touch panel H 1700 for data input
- Monitored gas pre-pressure of the process gas
- Bypass for safe flushing of furnace chamber with inert gas
- Exhaust gas torch for H₂ afterburning



Blueing of drills in water steam atmosphere in a furnace of the NRA range

Model	Tmax °C	Model	Tmax °C	Working chamber dimensions in mm			Useful volume in l	Electrical connection*
				w	d	h		
NRA 17/..	650 or 950	NR 17/11	1100	225	350	225	17	three-phase
NRA 25/..	650 or 950	NR 25/11	1100	225	500	225	25	three-phase
NRA 50/..	650 or 950	NR 50/11	1100	325	490	325	50	three-phase
NRA 75/..	650 or 950	NR 75/11	1100	325	700	325	75	three-phase
NRA 150/..	650 or 950	NR 150/11	1100	450	750	450	150	three-phase
NRA 200/..	650 or 950	NR 200/11	1100	450	1000	450	200	three-phase
NRA 300/..	650 or 950	NR 300/11	1100	570	900	570	300	three-phase
NRA 400/..	650 or 950	NR 400/11	1100	570	1200	570	400	three-phase

*Please see page 70 for more information about mains voltage

SRA 100 - SR 1000

The retort furnaces SR and SRA (with gas circulation) are designed for operation with protective or reaction gases. The furnace is 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. The SR furnaces are available in different versions.

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

Models SR .../11 with Tmax 1100 °C

- Four-side heating outside the retort
- Temperature uniformity up to ± 7 K within the working chamber of 500 °C - 1100 °C
- Retort made of 1.4841
- Top down multi-zone control of the furnace heating

Models SRA .../09 with Tmax 950 °C

Design like models SR.../11 with following differences:

- Atmosphere circulation with powerful fan in the furnace lid provides for optimum temperature uniformity of up to ± 4 K within the working chamber of 200 °C - 900 °C

Standard Equipment (all models)

Design like standard equipment of models NR and NRA

with following differences:

- Charging from above with crane or other lifting equipment from customer
- Hinged lid with opening to the side and with cooling water
- Multi-zone control of the furnace heating from the top down

Additional equipment, see models NR and NRA

H₂ version for operation under hydrogen, see models NR and NRA

IDB version for debinding under protective gas or for pyrolysis processes, see models NR and NRA

Model	Tmax °C	Inside dimensions of alloy retort		Volume in l	Outer dimensions in mm			Supply power/kW	Electrical connection*	Weight in kg
		ø in mm	h in mm		W	D	H			
SRA 100	950	450	600	100	1250	1250	2000	19	three-phase	1000
SRA 200	950	600	800	200	1400	1400	2200	27	three-phase	1300
SRA 300	950	600	1000	300	1400	1400	2400	37	three-phase	1500
SRA 500	950	800	1000	500	1400	1600	2400	46	three-phase	1500
SRA 600	950	800	1200	600	1400	1600	2600	52	three-phase	1600
SRA 800	950	1000	1000	800	1600	1800	2400	70	three-phase	1900
SRA 1000	950	1000	1300	1000	1600	1800	2700	90	three-phase	2200
SR 100	1100	450	600	100	950	950	1200	16	three-phase	800
SR 200	1100	600	800	200	1200	1200	1400	24	three-phase	1100
SR 300	1100	600	1000	300	1200	1200	1600	35	three-phase	1300
SR 500	1100	800	1000	500	1400	1400	1600	46	three-phase	1500
SR 600	1100	800	1200	600	1400	1400	1800	54	three-phase	1600
SR 800	1100	1000	1000	800	1600	1600	1600	70	three-phase	1700
SR 1000	1100	1000	1300	1000	1600	1600	1900	90	three-phase	1900

*Please see page 70 for more information about mains voltage



Retort furnace SRA 200



SR 600 basic version



Overhead view into the retort

Cold-Wall Retort Furnaces up to 2400 °C



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



VHT 40/22-GR with graphite insulation and heating

The compact furnaces of the VHT product line are available as electrically heated chamber furnaces with graphite, molybdenum or MoSi_2 heating. A wide variety of heating designs as well as a complete range of accessories provide for optimal furnace configurations even for sophisticated applications.

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

The H_2 version provides for operation under hydrogen or other flammable gases. Key of the specification up is a certified safety package providing for a safe operation at all times and triggers an appropriate emergency program in case of failure.

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



Heat treatment of copper bars under hydrogen in VHT 08/16 MO

Alternative Heating Specifications

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

VHT ../GR with Graphite Insulation and Heating

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

VHT ../MO with Molybdenum Insulation and Heating

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

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

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

	VHT ...-18/GR	VHT ...-22/GR	VHT ...-16/MO	VHT ...-18/KE
Inert gas	✓	✓	✓	✓
Air	to 400 °C	to 400 °C	-	✓
Hydrogen	✓	-	✓	-
Rough vacuum and fine vacuum ($>10^{-3}$ mbar)	✓	✓	✓	✓
High vacuum ($<10^{-5}$ mbar)	-	-	✓	-
Oxygen	-	-	-	✓

Standard Equipment for all Models

Basic version

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

Additional equipment

- Tmax 3000 °C
- Housing, optionally divisible, for passing through narrow door frames (VHT 08)
- Manual gas supply for second process gas (N_2 or Ar) with adjustable flow and bypass
- Molybdenum or carbon-fiber-carbon retort with direct gas supply for clean atmosphere and improved temperature uniformity in the furnace chamber

Model	Inner dimensions of retort in mm			Volume in l
	w	d	h	
VHT 8/..	120	210	150	4
VHT 40/..	280	430	250	30
VHT 100/..	430	530	400	91

- Charge thermocouple with display
- Two-stage rotary vane pump with ball valve for pre-evacuating and heat-treating in a vacuum to 10^{-2} mbar



Graphite heating chamber



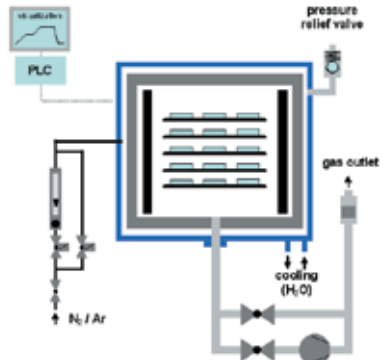
Molybdenum heating chamber



Ceramic fiber heating chamber



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



VHT gas supply diagram, automatic operation



Nitrogen emergency purging and exhaust gas torch for hydrogen version



Turbo-molecular pump



VHT 40/16MOH₂

Continuation of additional equipment

- Temperature measurement at 2200 °C with pyrometer and thermocouple, type S with automatic pull-out device for precise control results in the low temperature range (VHT 40 and larger)
- Turbo molecular pump with slide valve for pre-evacuation and for heat treatment in a vacuum to 10⁻⁵ mbar including electric pressure transducer and booster pump (only VHT.../MO)
- Heat exchanger with closed-loop cooling water circuit
- Automation package with graphic touch panel H 3700
 - 12" graphic touch panel H 3700
 - Input of all process data like temperatures, heating rates, gas injection, vacuum at the touch panel
 - Display of all process-relevant data on a process control diagram
 - Automatic gas supply for one process gas (N₂, argon or 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)
 - Transducer for absolute and relative pressure
- MFC flow controller for alternating volume flow and generation of gas mixtures with second process gas (only with automation package)
- Partial pressure operation: protective gas flushing at controlled underpressure (only with automation package)
- PC control via NCC with corresponding optional documentation and connection to customer PC networks



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



Two-stage rotary vane pump for heat treatment in a vacuum to 10⁻² mbar



Turbo-molecular pump with booster pump for heat treatment in a vacuum to 10⁻⁵ mbar

H₂ Version VHT.../MO-H₂ or VHT.../GR-H₂ for Operation with Hydrogen or other Reaction Gases

In the H₂ version the furnaces of the VHT.../MO or VHT.../GR product line can be operated under hydrogen or other reaction gases. For these applications, the systems are additionally equipped with the required safety technology. Only certified and industry proven safety sensors are used. The furnaces are controlled by a fail-safe PLC control system (S7-300F/ safety controller).

- Certified safety concept
- Automation package (see additional equipment above)
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe purging of furnace chamber with inert gas
- Pressure-monitored emergency flooding with automated solenoid valve opening
- Electric or gas-heated exhaust gas torch for H₂ post-combustion
- Atmospheric operation: H₂-purging of process reactor starting from room temperature at controlled over pressure (50 mbar relative)

Additional equipment

- Partial pressure operation: H₂ flushing at underpressure in the process reactor starting from 750 °C furnace chamber temperature
- Retort in the process chamber for debinding under hydrogen

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

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

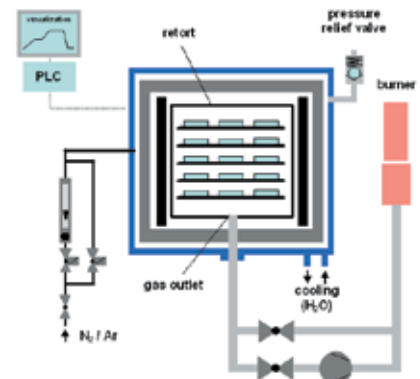
- Adapted safety concept for debinding
- Automation package (see additional equipment above)
- Exhaust gas torch for burning the exhaust gases
- Debinding retort in the furnace chamber with direct discharge of the exhaust gases into the exhaust gas torch
- Bypass for safe flushing of furnace chamber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

Additional equipment

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



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



VHT gas supply diagram, debinding and sintering

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Supply power/kW	Electrical connection*	Weight in kg	Material heater/ insulation
		w	d	h		W	D	H				
VHT 8/18-GR	1800	170	240	200	8	1250 (800) ¹	1100	2000	27.0	three-phase ²	1200	Graphite/graphite felt
VHT 40/18-GR	1800	300	450	300	40	1600	2100	2300	83.0	three-phase	2000	Graphite/graphite felt
VHT 100/18-GR	1800	450	550	450	100	1900	2600	2500	On request	three-phase	2800	Graphite/graphite felt
VHT 8/22-GR	2200	170	240	200	8	1250 (800) ¹	1100	2000	27.0	three-phase ²	1200	Graphite/graphite felt
VHT 40/22-GR	2200	300	450	300	40	1600	2100	2300	83.0	three-phase	2000	Graphite/graphite felt
VHT 100/22-GR	2200	450	550	450	100	1900	2600	2500	129.0	three-phase	2800	Graphite/graphite felt
VHT 8/16-MO	1600	170	240	200	8	1250 (800) ¹	1100	2700	34.0	three-phase ²	1200	Molybdenum
VHT 40/16-MO	1600	300	450	300	40	1600	2100	2300	128.0	three-phase	3000	Molybdenum
VHT 100/16-MO	1600	450	550	450	100	1900	2600	2500	On request	three-phase	4000	Molybdenum
VHT 8/18-KE	1800	170	240	200	8	1250 (800) ¹	1100	2000	12.5	three-phase ²	1200	MoSi ₂ /ceramic fiber
VHT 40/18-KE	1800	300	450	300	40	1600	2100	2300	28.0	three-phase	2000	MoSi ₂ /ceramic fiber
VHT 100/18-KE	1800	450	550	450	100	1900	2600	2500	On request	three-phase	2800	MoSi ₂ /ceramic fiber

¹With the switching system unit removed

²Only heating between two phases

*Please see page 66 for more information about mains voltage.

Chamber Dryer Electrically Heated or Gas-Fired



Standard models



Motor-driven rotary rack with baskets for moving the charge during heat treatment

The chamber dryers of the KTR range can be used for complex drying processes and heat treatment of charges of normal weight and packing density to an application temperature of 260 °C. The high-performance air circulation enables optimum temperature uniformity throughout the usable space. A wide range of accessories allow the furnace to be modified to meet specific process requirements. The design for the heat treatment of combustible materials in conformance with EN 1539 is available for all sizes.

- Tmax 260 °C
- Electrically heated (via a heating register with integrated chrome steel heating elements) or gas-fired (direct gas heating including injection of the hot air into the intake duct)
- Optimum temperature uniformity up to ± 3 K according to DIN 17052-1



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



KTR 8000

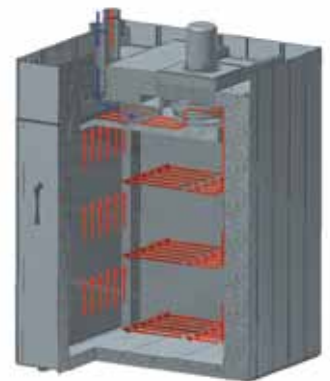


KTR 2000 S with observation window and rotary rack for the charge

- High-quality mineral wool insulation provides for outer temperatures of < 20 °C above room temperature
- High air exchange for fast drying processes
- Double-wing door for furnaces KTR 3100 and larger
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the dryer and load
- Incl. floor insulation
- For control systems see page 64 ff.

Additional equipment

- Entry ramp for pallet trucks or track cutouts for charging trolley
- Optimal air circulation for individual charges by means of adjustable air outlets
- Fan system for faster cooling with manual or automatic control
- Manually adjustable intake and exhaust air vents
- Programmed opening and closing of exhaust vents
- Observation window and furnace chamber lighting
- Safety technology according to EN 1539 for charges containing solvents, see page 26
- Catalytic or thermal exhaust gas cleaning systems
- Custom-built sizes
- Tightly welded inner housing
- Process control and documentation with Controltherm MV software package, see page 64 ff.



Air-circulation in the chamber dryer

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*
		w	d	h		W	D	H		
KTR 1500	260	1000	1000	1500	1500	1930	1430	2315	21	three-phase
KTR 3100	260	1250	1250	2000	3100	2160	1680	2880	30	three-phase
KTR 4500	260	1500	1500	2000	4500	2410	1930	2880	50	three-phase
KTR 6125	260	1750	1750	2000	6125	2660	2180	3000	50	three-phase
KTR 8000	260	2000	2000	2000	8000	2910	2430	3000	59	three-phase

*Please see page 66 for more information about supply voltage



Adjustable outflow openings as additional equipment

Air Circulation Chamber Furnaces > 500 Liters Electrically Heated or Gas-Fired



N 3920/26HAS



N 4000/26HA with lift-door



Enclosed heater coils on electrically heated models



Gas burner positioned along the furnace side

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

Standard version for models up to 600 °C (850 °C models, see page 22)

- Tmax. 260 °C, 450 °C or 600 °C
- Electrically heated or gas-fired
- Electric heating by means of heater coils
- Direct gas heating or upon request with indirect gas heating with radiation tube, e.g. for heat treatment of aluminum
- Optimal air circulation for your charge by means of adjustable air outlets
- Horizontal air flow (type ../HA)
- High air exchange for perfect heat transfer
- Ground level charging without floor insulation for 260 °C models
- Optimum temperature uniformity up to ± 4 K according to DIN 17052-1
- Furnace chamber lined with alloy 1.4301 (DIN)
- High quality mineral wool insulation provides for low outer temperatures
- High-grade, multi-layered insulation with light weight refractory bricks on the hot face for 850 °C models
- Air inlet and air outlet openings closable with plug
- Inside unlocking device for furnaces with walk-in chambers
- Furnace sizes suitable for common charging systems, such as pallets, baskets, etc.
- Double-wing door for furnaces N 1500 and larger



N 2520/60HA with roller conveyor inside and in front of the furnace



N 1500/85HA with lift door and work piece holders in the furnace

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- For control systems see page 64 ff.

Additional Accessories for models up to 600 °C

- Optional floor insulation provides for improved temperature uniformity for 260 °C models
- Entry ramps or track cutouts for floor-level charging of models with bottom insulation
- Furnace positioned on base frame provides for ergonomic charging height
- Electro-hydraulic lift door
- Fan system for faster cooling with manual or automatic control
- Automatic control of exhaust air vents for better ventilation of the furnace chamber
- Observation window and/or furnace chamber lighting
- Optimum temperature uniformity up to ± 3 K according to DIN 17052-1
- Safety technology according to EN 1539 for charges containing solvents, see page 26
- Charging systems or roller conveyors, also electrically driven provide for easy charging, see page 46
- Catalytic or thermal exhaust gas cleaning systems
- Custom sizes up to 30,000 liters and charge weights up to 30 tons
- Process control and documentation with Controltherm MV software package, see page 64 ff.



Pull-out drawers for heavy loads



Track cutouts for pallet truck or charging trolley

Air Circulation Chamber Furnaces > 500 Liters Electrically Heated or Gas-Fired



Standard version for models 850 °C

- Tmax. 850 °C
- Electrically heated or gas-fired
- Electric heating with heating elements on supports tubes
- Direct gas heating into the outlet of the air circulation fan
- Optimal air circulation for your charge by means of adjustable air outlets
- Horizontal air-flow (type ../HA)
- Manually adjustable air inlet and exhaust air vents
- High air exchange provides for perfect heat transfer
- Base frame with 900 mm charging height
- Optimum temperature uniformity up to ± 5 K according to DIN 17052-1
- Air baffles made of 1.4828 (DIN)
- Multi-layered insulation with fiber plates (not classified according to EU directive 67/548) and light-weight refractory bricks in the floor incl. microporous backing insulation provides for low outer temperatures
- Furnaces sizes perfectly suited to accommodate common charging systems, e.g. like pallets or pallet boxes
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Additional accessories for models 850 °C

- Electro-hydraulic lift door
- Fan system for faster cooling with manual or automatic control
- Automatic control of exhaust air vents for better ventilation of the furnace chamber
- Optimum temperature uniformity up to ± 3 K according to DIN 17052-1
- Base frame for customized charging height
- Charging systems or roller conveyors, also electrically driven provide for easy charging, see page 46
- Custom sizes up to 30,000 liters and charge weights up to 30 tons
- Process control and documentation with Controltherm MV software package, see page 64 ff.

N 670/65 HAS with water quench tanks



N 12000/25AS



N 24500/20HAS

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Circulation rate m³/h	Connected load/kW	Electrical connection*
		w	d	h		W	D	H			
N 560/26HA	260	750	1000	750	560	1450	1865	2220	900	13.0	three-phase
N 1000/26HA	260	1000	1000	1000	1000	1930	1900	1600	3600	18.0	three-phase
N 1500/26HA	260	1500	1000	1000	1500	2380	1900	1600	3600	22.0	three-phase
N 1500/26HA1	260	1000	1500	1000	1500	1880	2400	1600	3600	22.0	three-phase
N 2000/26HA	260	1500	1100	1200	2000	2380	2000	1800	6400	22.0	three-phase
N 2000/26HA1	260	1100	1500	1200	2000	1980	2400	1800	6400	22.0	three-phase
N 2010/26HA	260	1000	1000	2000	2000	1880	1900	2720	7200	30.0	three-phase
N 2880/26HA	260	1200	1200	2000	2880	2080	2100	2720	9000	54.0	three-phase
N 4000/26HA	260	1500	2200	1200	4000	2380	3110	1800	9000	47.0	three-phase
N 4000/26HA1	260	2200	1500	1200	4000	3080	2410	1800	9000	47.0	three-phase
N 4010/26HA	260	1000	2000	2000	4000	1880	2900	2720	9000	54.0	three-phase
N 4500/26HA	260	1500	1500	2000	4500	2380	2400	2720	12800	54.0	three-phase
N 5600/26HA	260	1500	2500	1500	5600	2110	3180	2340	9000	69.0	three-phase
N 6750/26HA	260	1500	3000	1500	6750	2110	3680	2340	19200	98.0	three-phase
N 7200/26HA	260	2000	1500	2400	7200	2610	2410	3000	18000	93.0	three-phase
N 10000/26HA	260	2000	2500	2000	10000	2610	3180	2840	25600	106.0	three-phase
N 560/45HA(E¹)	450	750	1000	750	560	1450	1865	2220	900	13.0¹/ 19.0	three-phase
N 1000/45HA(E¹)	450	1000	1000	1000	1000	1930	1900	1600	3600	18.0¹/ 40.0	three-phase
N 1500/45HA(E¹)	450	1500	1000	1000	1500	2380	1900	1600	3600	22.0¹/ 40.0	three-phase
N 1500/45HA1(E¹)	450	1000	1500	1000	1500	1880	2400	1600	3600	22.0¹/ 40.0	three-phase
N 2000/45HA(E¹)	450	1500	1100	1200	2000	2380	2000	1800	6400	22.0¹/ 46.0	three-phase
N 2000/45HA1(E¹)	450	1100	1500	1200	2000	1980	2400	1800	6400	22.0¹/ 46.0	three-phase
N 2010/45HA(E¹)	450	1000	1000	2000	2000	1880	1900	2720	7200	30.0¹/ 54.0	three-phase
N 2880/45HA(E¹)	450	1200	1200	2000	2880	2080	2100	2720	9000	54.0¹/ 66.0	three-phase
N 4000/45HA(E¹)	450	1500	2200	1200	4000	2380	3110	1800	9000	47.0¹/ 65.0	three-phase
N 4000/45HA1(E¹)	450	2200	1500	1200	4000	3080	2410	1800	9000	47.0¹/ 65.0	three-phase
N 4010/45HA(E¹)	450	1000	2000	2000	4000	1880	2900	2720	9000	54.0¹/ 66.0	three-phase
N 4500/45HA(E¹)	450	1500	1500	2000	4500	2380	2400	2720	12800	54.0¹/ 66.0	three-phase
N 5600/45HA(E¹)	450	1500	2500	1500	5600	2110	3180	2340	9000	69.0¹/ 93.0	three-phase
N 6750/45HA(E¹)	450	1500	3000	1500	6750	2110	3680	2340	19200	98.0¹/ 116.0	three-phase
N 7200/45HA(E¹)	450	2000	1500	2400	7200	2610	2410	3000	18000	93.0¹/ 117.0	three-phase
N 10000/45HA(E¹)	450	2000	2500	2000	10000	2610	3180	2840	25600	106.0¹/ 130.0	three-phase
N 1000/60HA	600	1000	1000	1000	1000	1930	1900	1600	3600	40.0	three-phase
N 1500/60HA	600	1500	1000	1000	1500	2380	1900	1600	3600	40.0	three-phase
N 1500/60HA1	600	1000	1500	1000	1500	1880	2400	1600	3600	40.0	three-phase
N 2000/60HA	600	1500	1100	1200	2000	2380	2000	1800	6400	46.0	three-phase
N 2000/60HA1	600	1100	1500	1200	2000	1980	2400	1800	6400	46.0	three-phase
N 4000/60HA	600	1500	2200	1200	4000	2380	3110	1800	9000	65.0	three-phase
N 4000/60HA1	600	2200	1500	1200	4000	3080	2410	1800	9000	65.0	three-phase
N 1000/85HA	850	1000	1000	1000	1000	1930	1900	1600	3600	46.0	three-phase
N 1500/85HA	850	1500	1000	1000	1500	2380	1900	1600	3600	46.0	three-phase
N 1500/85HA1	850	1000	1500	1000	1500	1880	2400	1600	3600	46.0	three-phase
N 2000/85HA	850	1500	1100	1200	2000	2380	2000	1800	6400	64.0	three-phase
N 2000/85HA1	850	1100	1500	1200	2000	1980	2400	1800	6400	64.0	three-phase
N 4000/85HA	850	1500	2200	1200	4000	2380	3110	1800	9000	97.0	three-phase

¹Reduced connected power for plastics applications

*Please see page 66 for more information about supply voltage



N 4010/45HA with track cutouts, chamber lighting and observation window

Air Circulation Chamber Furnaces < 500 Liters Electrically Heated



N 30/65 HA with annealing box



N 250/65HA with annealing box



N 15/65HA as table-top model

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

- Tmax. 450 °C, 650 °C, or 850 °C
- Heating from bottom, sides and top
- Stainless steel air-baffle box in the furnace for optimum air circulation
- Swing door hinged on the right side
- Base frame included in the delivery, N 15/65 HA designed as table-top model (table available as an option)
- Horizontal air circulation
- Optimum temperature uniformity up to ± 4 K according to DIN 17052-1
- Optimum air distribution enabled by high flow speeds
- One removable tray and rails for two additional trays included in the scope of delivery (N 15/65 HA without removable tray)
- For control systems see page 64 ff.

Additional equipment (not for model N 15/65HA)

- Optimization of the temperature uniformity up to ± 3 K according to DIN 17052-1
- Fan cooling to accelerate the cooling process
- Motorized exhaust vents
- Manual lift door



N 500/45HAS with lift door and roller conveyor in the furnace



N 120/85HAS with charging basket

- Pneumatic lift door
- Adjustable air circulation for sensitive components
- Additional removable trays
- Roller conveyor in furnace chamber for heavy charges
- Annealing boxes, see page 48
- Feed and charging aids, see page 46
- Process control and documentation with Controltherm MV software package, see page 64 ff.



Customized air circulation furnace
N 500/HAS with four compartments, each
with roller conveyor and individual door

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
N 30/45 HA	450	290	420	260	30	607 + 255	1175	1315	3.6	1-phase	195
N 60/45 HA	450	350	500	350	60	667 + 255	1250	1400	6.6	3-phase	240
N 120/45 HA	450	450	600	450	120	767 + 255	1350	1500	9.6	3-phase	310
N 250/45 HA	450	600	750	600	250	1002 + 255	1636	1860	19.0	3-phase	610
N 500/45 HA	450	750	1000	750	500	1152 + 255	1886	2010	28.0	3-phase	1030
N 15/65 HA ¹	650	295	340	170	15	470	845	460	2.7	1-phase	55
N 30/65 HA	650	290	420	260	30	607 + 255	1175	1315	6.0	3-phase ²	195
N 60/65 HA	650	350	500	350	60	667 + 255	1250	1400	9.6	3-phase	240
N 120/65 HA	650	450	600	450	120	767 + 255	1350	1500	13.6	3-phase	310
N 250/65 HA	650	600	750	600	250	1002 + 255	1636	1860	21.0	3-phase	610
N 500/65 HA	650	750	1000	750	500	1152 + 255	1886	2010	31.0	3-phase	1030
N 30/85 HA	850	290	420	260	30	607 + 255	1175	1315	6.0	3-phase ²	195
N 60/85 HA	850	350	500	350	60	667 + 255	1250	1400	9.6	3-phase	240
N 120/85 HA	850	450	600	450	120	767 + 255	1350	1500	13.6	3-phase	310
N 250/85 HA	850	600	750	600	250	1002 + 255	1636	1860	21.0	3-phase	610
N 500/85 HA	850	750	1000	750	500	1152 + 255	1886	2010	31.0	3-phase	1030

¹Table-top model, see page 24

²Heating only between two phases

*Please see page 66 for more information about supply voltage

Air Circulation Chamber Furnaces/Ovens with Safety Technology for Solvent-Containing Charges according to EN 1539 or NFPA 86



Ship-lock type furnace N 560/ 6HACLS with safety technology, front charging and rear unloading



Drying oven KTR 1500 for drying of foundry cores with an alcohol-based binder



Exhaust port and powerful exhaust fan mounted on the furnace



Special door sealing with circular sealing lip

Safety Technology for Air Circulation Chamber Furnaces

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

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

To avoid an ignition in the furnace, flammable vapors must be diluted with air. Special care must be taken so high concentrations of flammable materials do not accumulate in "dead" areas within the furnace. For this purpose, the furnaces are equipped with an exhaust gas fan providing for a defined suction flow. A measurement system monitors this flow, while fresh air is simultaneously resupplied. In parallel, the furnace atmosphere is diluted by the inflow of fresh air. The air circulation is also monitored by the measurement system. Furnaces with a capacity greater than 1000 liters are additionally equipped with an explosion pressure relief.

- Furnace sizes between 120 and 10,000 liters
- Powerful exhaust fan capable of maintaining negative furnace pressure
- Defined and monitored air circulation flow and exhaust air
- Visual and audible emergency signals
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Air-Circulation Chamber Furnaces with Cleanroom Technology Electrically Heated



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



N 500/65 HAC with cleanroom technology

N 120/65 HAC - N 500/65 HAC

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

- Design of models N ../HA plus:
- Special sealing of the housing
- Insulation covered with stainless steel sheets
- Optimum temperature uniformity at 250 °C - 650 °C of up to ± 3 K in accordance to DIN 17052-1
- Operation under protective gases as an option



Removable shelves on various levels

Model	Tmax °C	Inner dimensions in mm			Outer dimensions in mm			Connected load/kW	Electrical connection*
		w	d	h	W	D	H		
N 120/65 HAC	650	450	600	450	900 + 255	1600	1600	9.6	3-phase
N 250/65 HAC	650	600	750	600	1050 + 255	1750	1750	18.6	3-phase
N 500/65 HAC	650	750	900	750	1120 + 255	1900	1900	27.6	3-phase

*Please see page 66 for more information about supply voltage



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

Ovens



TR 240



Electrical rotating device as additional equipment



Extricable metal trays to load the oven in different layers

TR 60 - TR 1050

With their maximum working temperature of up to 300 °C and forced air circulation, the ovens achieve a perfect temperature uniformity which is much better than in ovens of most competitors. They can be used for various applications such as e.g. drying, sterilizing or warm storing. The stainless steel interior chamber is easy to clean and rust-resistant. Ample warehousing of standard models provides for short delivery times.

- Tmax 300 °C
- Operating range, room temperature + 5 °C to 300 °C
- Models TR 60 - TR 240 designed as tabletop models
- Models TR 420 - TR 1050 designed as free standing models
- Horizontal, forced air circulation results in temperature uniformity better than ± 4 K
- Stainless steel chamber, alloy 304 (AISI)/(DIN material no. 1.4301), rust-resistant and easy to clean
- Large handle for opening and closing the door
- Charging in multiple layers possible using removeable trays (number of removeable trays included, see table to the right)
- Large, wide-opening swing door, hinged on the right with quick release for models TR 60 - TR 420
- Door hinge for models TR 60 - TR 420 can be simply changed from the right to the left side
- Double swing door with quick release for TR 1050
- Oven on castors (for TR 450 and larger)
- Infinitely adjustable exhaust at the rear wall with operation from the front
- PID microprocessor control with self-diagnosis system
- Solid state relays provide for lownoise operation
- For control systems see page 64 ff.



TR 420



TR 1050 with double door

Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Infinitely adjustable fan speed of the air circulation fan
- Observation window for charge observing
- Further removable trays with rails
- Various modifications available for individual needs
- Upgrading available to meet the quality requirements of AMS 2750 D (see page 61 ff.) or FDA
- Process control and documentation with Controltherm MV software package, see page 64 ff.



TR 60 with observation window

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg	Trays incl.	Trays max.	Max. total load¹
		w	d	h		W	D	H						
TR 60	300	450	380	350	60	700	650	690	2.1	single-phase	90	1	4	120
TR 120	300	650	380	500	120	900	650	840	2.1	single-phase	150	2	7	150
TR 240	300	750	550	600	240	1000	820	940	3.1	single-phase	190	2	8	150
TR 450	300	750	550	1000	420	1000	820	1445	6.3	three-phase	120	3	17	150
TR 1050	300	1200	630	1400	1050	1470	955	1920	9.3	three-phase	380	4	22	170

¹Max. load per layer 30 kg

*Please see page 66 for more information about supply voltage

Air Circulation Bogie Hearth Furnaces Electrically heated or Gas-Fired



W 3300/85S with chain drive



W 4000/60AS with charging basket made of 1.4828

The air circulation bogie hearth furnaces W 1000/60 A- W 1000/85A are used when heavy charges weighing up to more than 25 t have to be heat-treated. They are ideal for processes such as solution annealing, artificial ageing, annealing or soft annealing, for which a high degree of temperature uniformity is crucial. The high-performance air circulation assures that the temperature uniformity achieved throughout the usable

space is outstanding. A broad selection of additional equipment enables these furnaces to be optimally adapted to suit specific processes.



Cooling fan for accelerated cooling

- Tmax 600 °C or 850 °C
- Double-walled housing with rear ventilation provides for low shell temperatures for the 850 °C models
- Swing door hinged on the right side
- Heating from chrome steel heating elements in the intake area of the air circulation system for the 600 °C models
- Heating from three sides (both side walls and the trolley) for the 850 °C models
- High-performance air circulation fan with vertical circulation
- Optimum temperature uniformity up to ± 5 K according to DIN 17052-1
- Bottom heating protected by SiC tiles on the bogie providing level stacking surface for the 850 °C models
- Furnace chamber fitted with inner sheets made of stainless steel 1.4301 for 600 °C models and of 1.4828 for 850 °C models
- Insulation structured with high-quality mineral wool for 600 °C models
- Insulation made of high-quality, non-classified fiber material for 850 °C models
- Bogies with flanged wheels running on rails for easy and precise movement of heavy loads



Charge support in a circulating air bogie hearth furnace for 850 °C



- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads from model W 4800
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Circulating air bogie hearth furnace for heat-treating coils



W 10430/85AS in custom sizes

Additional equipment

- Direct gas heating or upon request with indirect gas heating with radiation tube
- Custom-built sizes
- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads up to Model W 4000
- Optimization of the temperature uniformity up to ± 3 K according to DIN 17052-1
- Bogie running on steel wheels with gear rack drive, no rails in front of the furnace necessary
- Different possibilities for an extension to a bogie hearth furnace system:
 - Additional bogies
 - Bogie transfer system with parking rails to exchange bogies running on rails or to connect multiples furnaces
 - Motor-driven bogies and cross-traversal system
 - Fully automatic control of the bogie exchange
- Electro-hydraulic lift door
- Motor-driven exhaust air vents, adjustable via the program
- Controlled cooling system with frequency-controlled cooling fan and motorized exhaust air vent
- Multi-zone control adapted to the particular furnace model provides for optimum temperature uniformity in the 850 °C models
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization
- Process documentation and control with Controltherm MV software package and the Nabertherm NCC control center for monitoring, documentation and control, see page 64 ff.



W 13920/60AS4 with floor grid for heavy loads

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*
		w	d	h		W	D	H		
W 1000/.. A	600 or 850	800	1600	800	1000	1800	2390	2305	50.0	three-phase
W 1600/.. A		1000	1600	1000	1600	2000	2390	2535	50.0	three-phase
W 2200/.. A		1000	2250	1000	2200	2000	3040	2535	95.0	three-phase
W 3300/.. A		1200	2250	1200	3300	2200	3040	2745	95.0	three-phase
W 4000/.. A		1500	2250	1200	4000	2500	3040	2780	120.0	three-phase
W 4800/.. A		1200	3300	1200	4800	2200	4090	2780	120.0	three-phase
W 6000/.. A		1500	3300	1200	6000	2500	4090	2900	156.0	three-phase
W 6600/.. A		1200	4600	1200	6600	2200	5390	2770	152.0	three-phase
W 7500/.. A		1400	3850	1400	7500	2400	4640	2980	154.0	three-phase
W 8300/.. A		1500	4600	1200	8300	2500	5390	2780	203.0	three-phase

*Please see page 66 for more information about supply voltage

Air Circulation Ovens with Bogie Hearth Electrically Heated or Gas-Fired



WTR 5180/26AS

Ovens with bogie hearth from the WTR range are used to dry, temper, or vulcanize large quantities of material. The design of the oven corresponds basically to the bogie air circulation furnaces W 1000/60 A ff. They can be individually adapted to suit the required process. These ovens can also be designed for heat treatment of combustible materials according to EN 1539.



WTR 2880/26AS

- Tmax 260 °C
- Swing door hinged on the right side
- Heating from chrome steel heating elements in the intake area of the air circulation system
- High-performance air circulation fan with vertical circulation
- Optimum temperature uniformity up to ± 4 K according to DIN 17052-1
- Oven chamber with inner shelves made of galvanized steel sheet
- Insulation structured with high-quality mineral wool
- Bogies with flanged wheels running on rails for easy and precise movement
- Over-temperature limit controller with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 – as temperature limiter controller to protect the oven and load
- Manually adjustable air inlet and exhaust air vents
- High air exchange for fast drying processes
- Oven sizes suitable for common charging systems, such as pallets, baskets, etc.



Additional equipment, see air circulation bogie hearth furnaces on page 31

W 28800/S in customized dimensions

Air Circulation Pit-Type Furnaces Electrically Heated



S 250/65A



S 120/65A with protective gas retort box and cooling station next to the furnace

S 30/45A - S 500/85A

Pit-type furnaces with air circulation offer the advantage of easy charging, for heat treatment of heavy parts or loads in charge baskets. With maximum application temperatures available from 450 °C to 850 °C, these compact furnaces are particularly useful for processes such as tempering, solution annealing, artificial ageing, and soft annealing.

- Tmax 450 °C, 650 °C, 850 °C
- Air circulation fans in the furnace bottom, high circulation rate
- Vertical air circulation with square air heating chamber
- Optimum temperature uniformity up to ± 4 K according to DIN 17052-1
- Interior walls from stainless steel
- Switchgear with solid-state relays
- See page 64 ff. for a description of the control system



Basket system for charging in different layers

Additional equipment

- Charging hoist with swivel arm and charge basket
- Optimization of the temperature uniformity up to ± 2 K according to DIN 17052-1
- Integrated fan for rapid cool down or separate cooling station for retort box cooling outside of the furnace
- Retort box with protective gas inlet and outlet for production in a defined atmosphere (see page 48)
- Manual or automatic gas supply systems (see page 48)

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
S 30/45A	450	300	250	400	30	750	850	1250	3.6	1-phase	130
S 60/45A	450	350	350	500	60	800	950	1350	6.6	3-phase	225
S 120/45A	450	450	450	600	120	900	1050	1450	9.6	3-phase	280
S 250/45A	450	600	600	750	250	1050	1200	1600	19.0	3-phase	750
S 500/45A	450	750	750	900	500	1200	1350	1750	28.0	3-phase	980
S 30/65A	650	300	250	400	30	750	850	1250	6.0	3-phase ¹	130
S 60/65A	650	350	350	500	60	800	950	1350	9.6	3-phase	225
S 120/65A	650	450	450	600	120	900	1050	1450	13.6	3-phase	280
S 250/65A	650	600	600	750	250	1050	1200	1600	21.0	3-phase	750
S 500/65A	650	750	750	900	500	1200	1350	1750	31.0	3-phase	980
S 30/85A	850	300	250	400	30	600	740	1000	6.0	3-phase ¹	130
S 60/85A	850	350	350	500	60	800	950	1350	9.6	3-phase	225
S 120/85A	850	450	450	600	120	900	1050	1450	13.6	3-phase	280
S 250/85A	850	600	600	750	250	1050	1200	1600	21.0	3-phase	750
S 500/85A	850	750	750	900	500	1200	1350	1750	31.0	3-phase	980



S 30/65HA with exchangeable retort and two retort air cooling devices

¹Heating only between two phases

*Please see page 66 for more information about supply voltage

Air Circulation Pit-Type Furnaces Electrically Heated or Gas-Fired



S 1780/65AS



S 1000/A

S 100/A - S 1000/A

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

- Tmax 750 °C
- Useful for heavy charge weights
- Air circulation fans in the furnace lid, high circulation rate
- Heating chamber with air baffle cylinder
- Heating elements on all wall surfaces
- Distribution of air flow through grid at the furnace floor
- Pneumatic or hydraulic lid lifting
- Optimum temperature uniformity up to ± 3 K according to DIN 17052-1
- For control systems see page 64 ff.

Additional equipment

- Integral fan for fast cooling
- Optimization of the temperature uniformity up to ± 2 K according to DIN 17052-1
- Variable rpm converter control of the air circulation velocity for sensitive parts
- Multiple zone control or special air circulation system for optimum temperature uniformity tailored to the charge
- Custom dimensions up to 10,000 liters
- Charge weights up to 7 tons
- Process control and documentation with Controltherm MV software package, see page 64 ff.

Model	Tmax °C	Inner dimensions cond. cylinder		Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		ø in mm	h in mm		W	D	H			
S 100/A	750	450	600	100	1100	1200	1600	17.5	3-phase	1000
S 200/A	750	600	800	200	1200	1300	2050	28.5	3-phase	1300
S 300/A	750	600	1000	300	1200	1300	2250	39.5	3-phase	1500
S 500/A	750	800	1000	500	1400	1600	2400	52.5	3-phase	1600
S 600/A	750	800	1200	600	1400	1600	2600	62.5	3-phase	1800
S 800/A	750	1000	1000	800	1600	1800	2400	70.0	3-phase	1900
S 1000/A	750	1000	1300	1000	1600	1800	2700	90.0	3-phase	2200

*Please see page 66 for more information about supply voltage

Pit-Type and Top-Loading Furnaces Electrically Heated or Gas-Fired

Our top-loading furnaces are perfectly suited for heat treatment of long, heavy products. Charging is mostly carried out with the help of an overhead crane. Heating from all sides and from the bottom provides for an optimum temperature uniformity. Tailor-made dimensions are designed and manufactured in accordance with the size and weight of components.

- Tmax 900 °C, 1280 °C, 1340 °C or 1400 °C
- Electrically heated or gas-fired
- Five-side heating of the electric furnace from the sides and the bottom
- Heating elements on supporting tubes provide for long service life
- SiC-bottom plates provide for level stack charging surface
- Bottom heating protected by SiC plates
- Multiple layer insulation with lightweight refractory bricks and special backing isolation
- Lid insulation consists of fiber material with a special fastening
- Electrohydraulic opening system of the lid with two-hand operation
- Closable air supply vents in the lower area of the furnace chamber
- Closable exhaust air vents in the lid
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Additional equipment

- Automatic exhaust air flaps for faster cooling
- Controlled fan cooling with electrically driven exhaust air flaps
- Multi-zone control of the heating provides for optimum temperature uniformity
- Furnace chamber can be divided in length for short workparts, partitions can be controlled separately
- Customized dimensions
- Customized charging racks
- Process control and documentation with Controltherm MV software package, see page 64 ff.



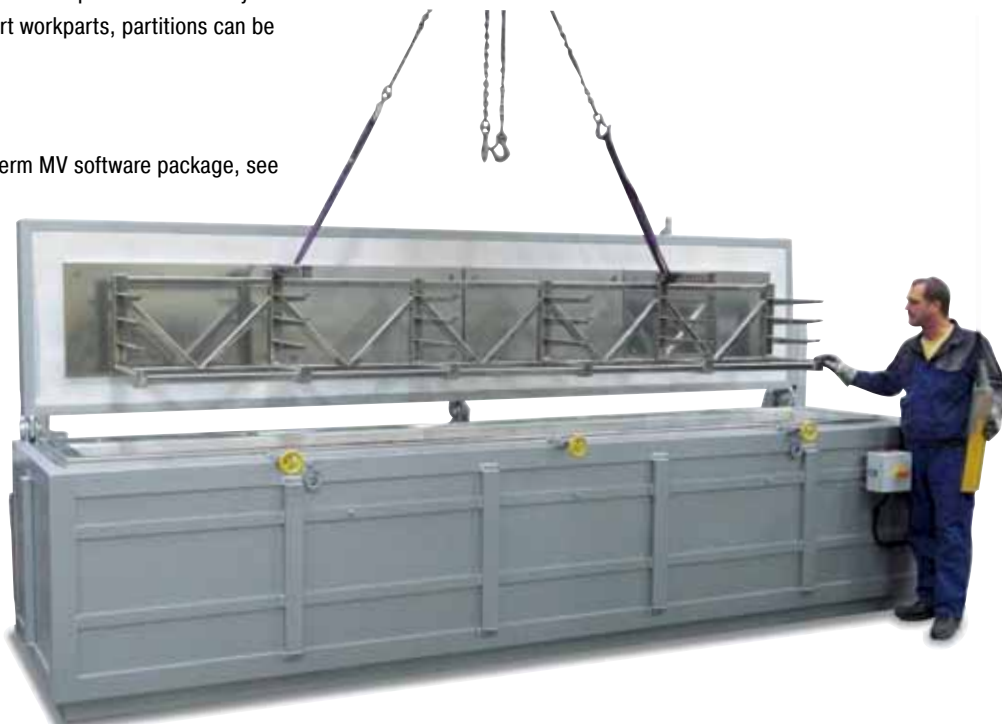
S 5120/GS1 with individual customized dimensions, furnace chamber divided in two sections, split cover



Furnace chamber S 5120/GS with receptacle for an insulating plate in order to divide the furnace chamber



S 4100/S with customized dimensions for sintering of high parts



S 1512/85HAS with customized charging rack

Bogie Hearth Furnaces Electrically Heated



W 8250/S in customized dimensions



W 2200/S with exchangeable table system

W 1000 - W 10000/H

For annealing and hardening of larger parts, for example heavy cast parts or tool steel dies to temperatures between 800 °C and 1200 °C, we recommend our bogie hearth furnaces with radiation heating. The bogie can be loaded outside the furnace. When the design includes an electro-hydraulic lift door and a motorized bogie, the furnace can be opened while hot and the load can be removed for cooling or quenching. When several bogies are used together with a second door or bogie-transfer system, one bogie can be loaded outside the furnace while the other bogie is in the furnace. This shortens process times and the residual energy of the furnace can be used when the new charge is heated.

- Tmax 1280 °C or 1340 °C
- Double-walled housing with rear ventilation, provides low shell temperatures
- Swing door hinged on the right side
- Heating from five sides (four sides and bogie) provides for a optimum temperature uniformity
- Bogie heating receives power via blade contacts when driven in
- Heating elements mounted on support tubes provide for free radiation and long service life



W 6430/S1

- Bottom heating protected by SiC tiles on the bogie providing level stacking surface
- Multi-layer insulation consisting of lightweight refractory bricks backed by microporous silica insulation
- Self-supporting and long-life ceiling construction with bricks laid in arched construction
- Bgies with flanged wheels running on rails for easy and precise movement of heavy loads
- Adjustable air inlet damper
- Manual vapor vent on the furnace roof
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Additional equipment

- Customized dimensions
- Fiber insulation for short heating time requirements
- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads
- Bogie running on steel wheels with gear rack drive, no rails in front of the furnace necessary
- Different possibilities for an extension to a bogie hearth furnace system:
 - Additional bogies
 - Bogie transfer system with parking rails to exchange bogies running on rails or to connect multiples furnaces
 - Motor-driven bogies and cross-traversal system
 - Fully automatic control of the bogie exchange
- Electro-hydraulic lift door
- Motor-driven exhaust air flap, switchable via the program
- Controlled cooling system with frequency-controlled cooling fan and motorized exhaust air flap
- Multi-zone control adapted to the particular furnace provides model for optimal the temperature uniformity
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization
- Process documentation and control with Controltherm MV software package for Nabertherm Control Center (NCC) for monitoring, documentation and control, see page 64 ff.



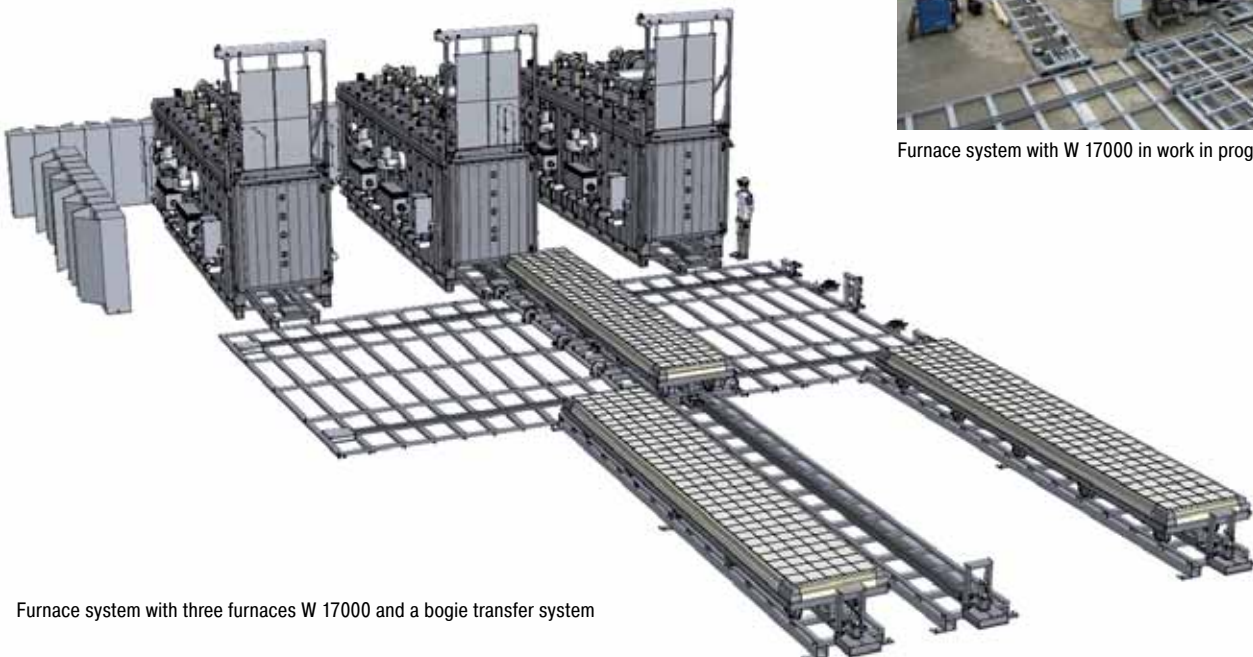
Bogie running on steel wheels with gear rack drive, no rails necessary



Bogie hearth furnace with gas box

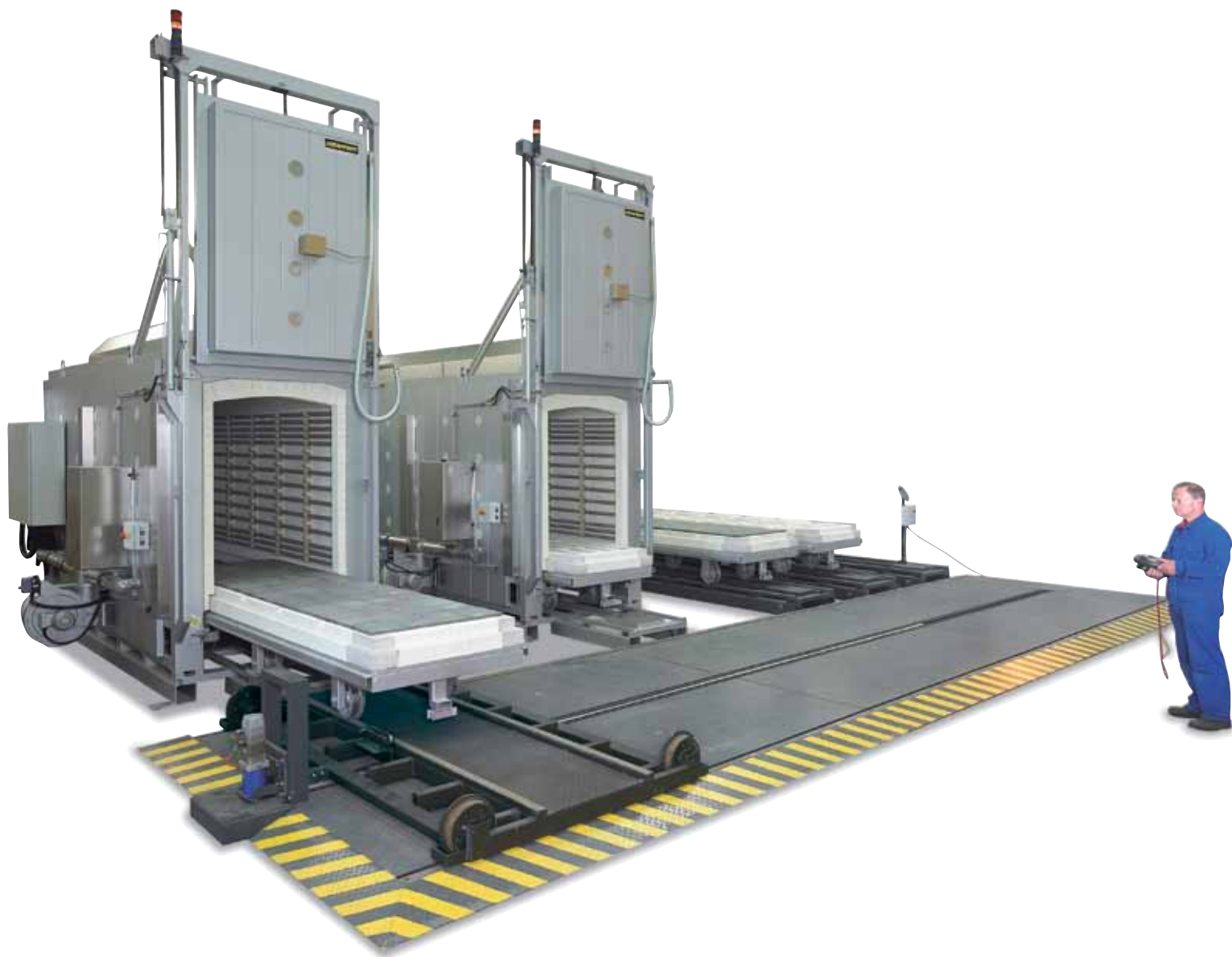


Furnace system with W 17000 in work in progress



Furnace system with three furnaces W 17000 and a bogie transfer system

Bogie Hearth Furnaces Electrically Heated



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



Bogie hearth furnace W 6340S in customized dimensions

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
W 1000	1280	800	1600	800	1000	1470	2400	1820	57	three-phase	3000
W 1500	1280	900	1900	900	1500	1570	2700	2010	75	three-phase	3500
W 2200	1280	1000	2200	1000	2200	1670	3000	2120	110	three-phase	4500
W 3300	1280	1000	2800	1200	3300	1670	3600	2320	140	three-phase	5300
W 5000	1280	1000	3600	1400	5000	1670	4400	2520	185	three-phase	7300
W 7500	1280	1000	5400	1400	7500	1670	6200	2520	235	three-phase	10300
W 10000	1280	1000	7100	1400	10000	1670	7900	2520	300	three-phase	12500
W 1000/H	1340	800	1600	800	1000	1470	2400	1820	75	three-phase	3500
W 1500/H	1340	900	1900	900	1500	1570	2700	2010	110	three-phase	4000
W 2200/H	1340	1000	2200	1000	2200	1670	3000	2120	140	three-phase	5000
W 3300/H	1340	1000	2800	1200	3300	1670	3600	2320	185	three-phase	6000
W 5000/H	1340	1000	3600	1400	5000	1670	4400	2520	235	three-phase	8000
W 7500/H	1340	1000	5400	1400	7500	1670	6200	2520	370	three-phase	11300
W 10000/H	1340	1000	7100	1400	10000	1670	7900	2520	440	three-phase	13800

*Please see page 66 for more information about supply voltage

Bogie Hearth Furnaces Gas-Fired



Bogie hearth furnace WB 14880S

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

- Tmax 1300 °C
- Powerful, sturdy high-speed burner with pulse control and special flame control in the furnace chamber provide for optimum temperature uniformity
- Operation with city gas, natural gas or liquified gas
- Fully automatic PLC control of the temperature as well as monitoring of the burner function
- Reduction-resistant fiber insulation with low heat storage provides for short heating and cooling times
- Double-walled housing provides for low outside temperatures
- Exhaust hood with fittings for further discharge of the exhaust gases
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Additional equipment

- Customized furnace dimensions
- Automatic lambda control to set the furnace atmosphere
- Exhaust air and exhaust gas piping
- Recuperator burners utilizing part of the waste heat in the exhaust tract to preheat the combustion air and considerably contribute to energy saving
- Thermal or catalytic exhaust cleaning systems
- Process documentation and control with Controltherm MV software package for Nabertherm Control Center (NCC) for monitoring, documentation and control, see page 64
- Other additional equipment for bogie hearth furnaces, see pages 37 ff.



Piping at a bogie hearth furnace



Furnace chamber with eight high-speed burners

Chamber Furnaces Gas-Fired



NB 660



NB 4330/S



Chamber furnace with gas supply system

NB 300 - NB 600

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

- Tmax 1300 °C
- Powerful, atmospheric burners for operation with liquified gas or natural gas
- Special positioning of the gas burners with flame guide top-down provides for optimum temperature uniformity
- Fully automatic temperature control
- Gas fittings with flame control and safety valve in accordance with DVGW (German Technical and Scientific Association for Gas and Water)
- Multi-layer, reduction-proof insulation with light-weight refractory bricks and special back-up insulation result in low gas consumption
- Self-supporting and rugged ceiling, bricks laid in arched construction or as fiber insulation
- Double-walled housing, side panels made of stainless steel (NB 300), for low outside temperatures
- Solid, double-walled door
- Exhaust hood with 150 mm (NB 300) and 200 mm (NB 440, NB 600) diameter connection
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Additional equipment

- Customized furnace dimensions
- Fan burner with fully automatic control
- Exhaust air and exhaust gas piping
- Thermal or catalytic exhaust cleaning systems
- Recuperator technology for heat recovery, see page 60
- Process documentation and control with Controltherm MV software package for Nabertherm Control Center (NCC) for monitoring, documentation and control, see page 64 ff.



NB 2880/S

Chamber Furnaces Electrically Heated



N 41/H

N 412/S

N 7/H - N 641/13

These universal chamber furnaces with radiation heating have been specifically designed to withstand heavy-duty use in the heat treatment shop. 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 your application requirements.

- Compact, robust design
- Three-sides heating: from both side walls and floor
- High-quality, free-radiating heating elements mounted on support tubes for longest service life
- Floor heating protected by heat conducting SiC tiles
- Parallel guided downward swinging door (user protected from heat radiation)
- Stainless steel upper door jamb protects furnace structure when furnace is opened hot
- Exhaust air flaps in rear
- Optimum temperature uniformity up to ± 10 K according to DIN 17052-1
- Low energy consumption due to multi-layer insulation
- Gas spring dampers provide for easy door opening and closing
- Heat resistant zinc paint for protection of door and door frame (for N81 and larger)
- For control systems see page 66 ff.

Additional equipment see page 42/43

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connections*	Weight in kg
		w	d	h		W	D	H			
N 7/H ¹	1280	250	250	120	7	720	640	510	3.0	1-phase	60
N 11/H ¹	1280	250	350	140	11	720	740	510	3.6	1-phase	70
N 11/HR ¹	1280	250	350	140	11	720	740	510	5.5	3-phase ²	70
N 17/HR ¹	1280	250	500	140	17	720	890	510	6.4	3-phase ²	90
N 31/H	1280	350	350	250	30	840	1010	1320	15.0	3-phase	210
N 41/H	1280	350	500	250	40	840	1160	1320	15.0	3-phase	260
N 61/H	1280	350	750	250	60	840	1410	1320	20.0	3-phase	400
N 81	1200	500	750	250	80	1140	1900	1790	20.0	3-phase	820
N 161	1200	550	750	400	160	1180	1930	1980	30.0	3-phase	910
N 321	1200	750	1100	400	320	1400	2270	2040	47.0	3-phase	1300
N 641	1200	1000	1300	500	640	1690	2670	2240	70.0	3-phase	2100
N 81/13	1300	500	750	250	80	1220	1960	1840	22.0	3-phase	900
N 161/13	1300	550	750	400	160	1260	1990	2030	35.0	3-phase	1000
N 321/13	1300	750	1100	400	320	1480	2330	2090	60.0	3-phase	1500
N 641/13	1300	1000	1300	500	640	1770	2730	2290	80.0	3-phase	2500

¹Table-top model

²Heating only between two phases

*Please see page 66 for more information about supply voltage



N 27/HS for forging with pneumatic door movement and radiation curtain



N 7/H

Chamber Furnaces Electrically Heated



Annealing furnace with electro-hydraulic lift-door on transportable base for preheating of large steel sheets for the automotive industry.



N 691/S with two-piece door



Door heating element as additional equipment

These very rugged chamber furnaces with radiation heating are designed for continuous heat-treatment processes. They are ideally suited for forming processes such as forging or hot forming steel sheets. The use of a wide variety of accessories enables these furnaces to be tailored to the relevant application.

- Tmax. 1200 °C
- Very rugged design
- Heating from three sides (both sides and the floor)
- Heating elements installed on ceramic support tubes enable unimpaired heat radiation
- Floor heating protected by heat-conducting SiC plate
- Manual lift door for models to N 951
- Electro-hydraulic lift door for models from N 1296
- Heating operated with low-wear semi-conductor relay (for models to 60 kW), see page 41
- Optimum temperature uniformity up to ± 10 K according to DIN 17052-1
- Closable measuring port for customer's temperature measuring system
- Holding time measurement for the charge until it goes to forging or forming of steel sheets: After charging, the operator presses a key and the previously defined holding time for the load begins to run. The end of the holding time is indicated by both acoustic and optical signals, meaning that the charge can be removed.
- Heat resistant zinc paint for protection of door and door frame
- For control systems see page 64 ff.

Additional equipment

- Other temperatures on request
- SiC plates to protect the wall heating elements
- Electro-hydraulic lift door for models to N 951
- Protective gas ports in combination with silicone sealing of the chamber
- Annealing boxes for powder nitriding, annealing and hardening under protective gas
- Loading devices and charging aids
- Charging grates for heavy loads



N 6080/13S pre-heating furnace for forging; with door-in-door



N 761 with annealing box and charging bogie

- Cooling fan in combination with automated exhaust air vents in the top of the furnace
- Heating elements also in door and rear wall for optimized temperature uniformity up to ± 5 K according to DIN 17052-1
- Commissioning of the furnace with test firing and temperature uniformity measurement using 11 thermocouples including record of the measurement results
- Process control and documentation with Controltherm MV software package, see page 64 ff.



Furnace chamber with supporting rails for metal trays

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*
		w	d	h		W	D	H		
N 731	1200	750	1300	750	730	1800	2400	2890	72	three-phase
N 761	1200	800	1900	500	760	1740	2700	2650	72	three-phase
N 891	1200	800	1400	800	890	1740	2200	3450	72	three-phase
N 951	1200	1000	1900	550	950	2060	2700	2780	72	three-phase
N 1296	1200	1800	1200	600	1296	2860	2000	3020	75	three-phase
N 1491	1200	1660	1200	750	1490	2720	2000	3350	115	three-phase
N 1501	1200	1000	1500	1000	1500	2060	2300	3845	100	three-phase
N 1601	1200	1600	2000	500	1600	2660	2900	2900	115	three-phase
N 1760	1200	2200	1600	500	1760	3400	2500	2900	115	three-phase
N 1771	1200	1400	1400	900	1770	2460	2200	3745	115	three-phase
N 2161	1200	1700	1700	750	2160	2760	2600	3350	115	three-phase
N 2201	1200	1000	2200	1000	2200	2060	3000	3845	155	three-phase
N 2251	1200	2500	1500	600	2250	3560	2300	3020	115	three-phase
N 2401	1200	2500	1200	800	2400	3560	2000	3445	115	three-phase

*Please see page 66 for more information about supply voltage



N 1491/S in production

Lift-Top Furnaces Electrically Heated



H 1000/S with table changing system



Lift-top furnace with recesses for extending charges

H 125/LB or LT - H 3000/LB or LT

Lift-top furnaces have the advantage that they are highly accessible for charging. The heating from all four sides and the table provides for very uniform temperatures. The basic furnace is equipped with a fixed table under the hood. The system can be expanded by adding one or several exchangeable tables which can be driven manually or motorically. Another option is to remove the hood completely with a shop crane. In such cases, the furnace heating system has a plug-in power supply.

- Tmax 1200 °C
- Double-walled housing with rear ventilation for low shell temperatures
- Electrohydraulically driven hood with fixed table
- Five-sided heating from all four sides and from the table provides for a optimum temperature uniformity up to ± 10 K according to DIN 17052-1
- Heating elements mounted on support tubes provide for free radiation and long service life of the heating wire



Lift-top furnace system with three exchangeable tables and protective gas boxes for heat treatment in protective gas



- Bottom heating protected by SiC tiles which provide for a level stacking surface
- Multilayer insulation consisting of lightweight refractory bricks backed by special insulation
- Long-life ceiling design with fiber insulation
- Manual exhaust air flap on the furnace roof
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

HG 5208/S with exchangeable table for heat treatment of large parts and charging the oven with the help of a shop crane.

Additional equipment

- Customized dimensions
- Controlled cooling system with frequency-controlled cooling fan and motor-driven exhaust air flap
- Multi-zone control adapted to the particular furnace provides model for optimal the temperature uniformity
- Additional tables, table changing system, also automatically driven
- Hood, removable by customer's crane, hood heating connected with plug-in power supply
- Commissioning of the furnace with test firing and temperature uniformity measurement using 11 thermocouples including record of the measurement results
- Process documentation and control with Controltherm MV software package for Nabertherm Control Center (NCC) for monitoring, documentation and control, see page 64 ff.



HG 2000, standard version

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
H 125/LB, LT	1200	800	400	400	125	1330	1280	1900	12	three-phase	1250
H 250/LB, LT	1200	1000	500	500	250	1530	1380	2100	18	three-phase	1400
H 500/LB, LT	1200	1200	600	600	500	1730	1480	2300	36	three-phase	1800
H 1000/LB, LT	1200	1600	800	800	1000	2130	1680	2700	48	three-phase	2800
H 1350/LB, LT	1200	2800	620	780	1360	3690	1700	2750	75	three-phase	3500
H 3000/LB, LT	1200	3000	1000	1000	3000	4000	2100	3200	140	three-phase	6200

*Please see page 66 for more information about supply voltage

Charging Devices and Accessories for Chamber and Bogie Hearth Furnaces



Semi automatic heat treatment system with two furnaces N 250/65HA, each equipped with pneumatic lifting door and movable roller conveyor for easy furnace unloading.

By upgrading a furnace with useful accessories and devices for charging, you can considerably accelerate and simplify your heat processing which increases your productivity. The solutions shown on the following pages are only a part of our program, available in this product range. Ask us about accessories you may need. Our team of skilled engineers is prepared to develop a custom solution with you for any particular problem.



Chamber furnace system consisting of two air circulation furnaces N 250/65 HA with pneumatic swing door opening for cooling and convenient furnace charging



Air circulation furnace with charging grill shelves. The shelves can be moved individually on telescoping guides and can be taken out individually.



N 2380/55 HAS
Air circulation furnace system with charging trolley for sheet metal tempering

Quench Tanks



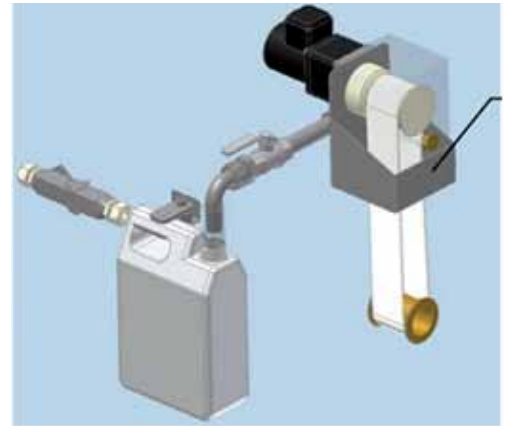
Subject to process, charge size and weight a customized quench tank will be designed and delivered. Standard sizes are also available. Water, oil or polymer are available as quenching medium. Various examples of different quench tank design as part of manual and fully automatic heat treatment systems are described 56 ff..

Available quenching mediums:

- Water
- Oil
- Polymer

Design Specifications

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



Oil separator for quench tanks with water



quench tank with water integrated in a heat treatment system for aluminium



Protective gas supply as fire protection



Powerful circulation of quenching medium



Circulation of quenching medium

Protective Gas and Carburization Systems for Annealing and Hardening



Sealed annealing box



Annealing tray with alloy bag and protective gas inlet



Annealing box with protective gas inlet and outlet



Annealing box with protective gas inlet and outlet, constructed for evacuation at ambient temperatures

Our protective gas and carburization modules allow you to upgrade our annealing and hardening furnaces into a compact annealing and hardening system as an economical alternative to expensive vacuum systems and protective gas furnaces. We can recommend different systems based on your application. Our professional test center will be pleased to test your product samples in order to specify the right heat treatment equipment for you.

■ Annealing Box

Our annealing boxes with lid sealing may be used for carburizing, annealing and hardening in neutral atmospheres, powder nitriding or boriding. Your charge is placed in the box and bedded in carburizing granulate, neutral annealing coal or nitriding or boriding powder. The box is sealed, and when heated, the resulting atmosphere in the closed annealing box provides for the respective surface reaction of the charge. For carburizing and similar processes, the annealing box may be removed while hot, opened and the charge quenched in fluid. For annealing processes, the box may remain in the furnace until it is cooled down.

■ Annealing Tray with Alloy Bag

This system, consisting of a lightweight tray with gas port and alloy bag, is particularly useful for air-quenched steels. The thin-walled alloy bag allows fast heat transfer. Its protective gas connections allow you to process your charge in a defined atmosphere. The small size of the gas lightweight tray you to pre-flush or cool the unit outside the furnace or place it on a cooling table for fast cooling by fan.

■ Annealing Box with Protective Gas Inlet and Outlet

The boxes are equipped with lid and protective gas inlet and outlet. The lid is sealed by means of a sealing channel with a high-temperature rope gasket before it is introduced into the furnace. The furnace is equipped with a special passage for the protective gas connections. The box is connected to a gas supply panel to introduce the required atmosphere in the box. When the heating process is finished, the box may be removed from the furnace, the lid removed and the parts quenched in liquid or air.

■ Annealing Box with Protective Gas Inlet and Outlet constructed for Evacuation Ambient Temperatures

This version of our annealing box is designed to be evacuated prior to the heating cycle. After evacuation, the box is refilled with a protective atmosphere for the heating cycle. This system is particularly useful for bright annealing of bulk materials, and nonferrous and noble metals, since oxygen can be more efficiently removed from the box by evacuation than through purging. Temperature-resistant seals allow this version of the annealing box to maintain a vacuum at ambient temperatures.

■ Additional Accessories

In addition to the above-mentioned protective gas and carburization systems, Nabertherm has a variety of heat treatment accessories ranging from the sealing cords for the annealing boxes to fully automatic gas supply panels. Ask for our Heat Treatment II Catalog.



Automatic gas supply panel for 2 gases with flow meter and solenoid valves



Sophisticated gas supply system



Powder nitriding in an annealing box



Powder carburizing of steel



Protective gas box used in a large bogie hearth furnace with air circulation



Custom-sized box for fork-lift loading



Annealing tray with alloy bag



Bulk material bright annealing in an annealing box with evacuation facility

Salt-Bath Furnaces for Heat Treatment of Steel or Light Metals Electrically or Gas-Fired



TS 20/15 - TSB 70/90

Salt-bath furnaces offer remarkably high temperature uniformity and excellent heat transfer to the work piece. Our salt-bath furnaces TS 20/15 - TSB 70/90 are especially useful for heat-treating of metals in neutral or active salt baths. Processes such as carbonitriding (e.g. Tenifer) up to 600 °C, carburizing up to 950 °C, or bright annealing up to 1000 °C can be realized. In their standard version these furnaces are equipped with safety technology for heat treatment of steel. As additional feature they can be equipped with extended safety technology for heat treatment of light metals.

TS 40/30 with exhaust gas collection at crucible rim

Standard model

- Tmax 750 °C or 1000 °C in the salt bath
- Safety technology according to EN 60519-2
- Useful for heat treatment of steel
- Bath temperature control
- Electric (TS) all-round heating or gas heating (TSB)
- Removable collar plate made of solid steel
- Insulated swing-a-way lid
- Optimum temperature uniformity up to ± 2 K according to DIN 17052-1 in the bath
- Over-temperature limit controller in the furnace chamber to prevent dangerous conditions for the furnace or personnel
- Bath control of salt bath and furnace chamber

Crucibles

- Type P: low carbon steel, CrNi plated and corundum coated for carburizing baths up to 950 °C, 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 and for dip brazing of Aluminium

Additional equipment

- Exhaust gas collection at rim for connection to an exhaust system
- Custom dimensions
- Enhanced safety systems for heat treatment of aluminium and magnesium in the salt bath with second over-temperature limit controller and PLC-bath control with thermocouples in the salt bath and in the furnace chamber

Model	Tmax °C ²	Inner dimensions crucible		Volume in l	Outer dimensions in mm			Connected load/kW ¹	Electrical connection*	Weight in kg ¹
		Ø in mm	h in mm		W	D	H			
TS 20/15	750	230	500	20	850	970	800	16	3-phase	650
TS 30/18	750	300	500	30	950	1070	800	20	3-phase	700
TS 40/30	750	400	500	60	1050	1170	800	33	3-phase	750
TS 50/48	750	500	600	110	1150	1270	970	58	3-phase	1000
TS 60/63	750	610	800	220	1250	1370	1170	70	3-phase	1200
TS 70/72	750	700	1000	370	1350	1470	1370	80	3-phase	1500
TS, TSB 20/20	1000	230	500	20	850	970	800	21	3-phase	650
TS, TSB 30/30	1000	300	500	30	950	1070	800	33	3-phase	700
TS, TSB 40/40	1000	400	500	60	1050	1170	800	44	3-phase	750
TS, TSB 50/60	1000	500	600	110	1150	1270	970	66	3-phase	1000
TS, TSB 60/72	1000	610	800	220	1250	1370	1170	80	3-phase	1200
TS, TSB 70/90	1000	700	1000	370	1350	1470	1370	100	3-phase	1500

¹Only for electric version

²Salt bath temperature

*Please see page 66 for more information about supply voltage



TSB 30/30 with exhaust gas collection at crucible rim



Salt bath plant for annealing of aluminum components in the aircraft industry

Martempering Furnaces using Neutral Salts Electrically Heated

WB 20 - WB 400

WB 20 - WB 400 martempering furnaces are filled with neutral salt and offer remarkably rapid and intensive heat transmission to the workpiece while ensuring optimum temperature uniformity. For working temperatures at between 180 °C and 500 °C these furnaces are ideal 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 valuable mechanical components during the subsequent hardening process.

Tempering in a martempering bath is the same as the tempering process in air circulation furnaces 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.

- Tmax 500 °C
- Optimal temperature uniformity
- Martemper bath temperature control
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Heating with immersion heating elements
- Charging basket

Additional equipment

- Charging aid mounted on side of furnace
- Process control and documentation with Controltherm MV software package, see page 64 ff.

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
WB 20	500	300	210	460	20	610	580	920	2.6	1-phase	110
WB 30	500	300	210	580	30	610	580	920	3.2	1-phase	140
WB 70	500	400	300	680	70	750	680	980	7.5	3-phase	240
WB 200	500	540	520	880	200	900	900	1200	18.0	3-phase	660
WB 400	500	730	720	980	400	1100	1100	1300	24.0	3-phase	1150

*Please see page 66 for more information about supply voltage



WB 30 with charging aid



Salt-bath hardening in practice



Information about salts by Petrofer and Durferit and their application

Salt	Application	Working temperature in °C	Comment
AS 135/140	Salt-bath hardening, tempering, austempering	180 - 500	Not for use with workpieces which are heated up to above 950 °C and salts which contain more than 13 % KCN
AS 220/225	Tempering, austempering	250 - 500	
AS 200/235	Tempering, austempering	280 - 500	Nitrite-free in the as-received condition
AS 200/235	Tempering	340 - 500	



Double martempering bath

Rotary Hearth Furnaces up to 1300 °C with and without Air Circulation Electrically Heated or Gas-Fired



Rotary hearth furnace DH 3020/1480/450/11, movable on rails, for preheating parts for two forges



Gear rim drive under the furnace



Rotary table with base plates made of highly heat-resistant steel to protect the insulation



Exhaust hood above charging opening

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

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

- Tmax 1100 °C, 1200 °C or 1300 °C without air circulation
- Tmax 260 °C, 600 °C or 850 °C with air circulation
- Wire heating elements in the furnaces ceiling for furnaces up to 1200 °C
- SiC heating rods in the furnace ceiling for furnaces up to 1300 °C
- Gas heating as an alternative to electrical heating
- Models for 650 °C and 850 °C with powerful air circulation for better heat transfer onto the charge and to optimize the temperature uniformity
- Very compact design compared with continuous furnaces
- Designed for continuous operation at one working temperature
- Table diameter up to 3000 mm
- Hearth movement in defined segments
- Low-vibration movement of the rotary hearth
- Parallel swivel door
- Automatic drive or rotational motion initiated by foot switch
- Furnace floor can be lowered using a forklift truck for maintenance purposes



Rotary hearth furnace DH 1200/-/300/11

Additional equipment

- Customized dimensions
- Exhaust hood above the door opening for discharge of the warm exhaust air when door is open
- Pneumatic drive of the parallel swivel door
- Charging aids for ease of loading and unloading
- Multi-zone control for adjustable thermal profile during the cycle
- Protective gas connections
- Process control and documentation with Controltherm MV software package, see page 64 ff.



Pre-heating of steel rings for forging

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	Electrical connection*	Weight in kg
		Ø Outer	Ø Inner	h		W	D	H			
DH 1200/-/300/11	1100	1200	0	300	340	2200	2200	2500	54.0	three-phase	1000
DH 1500/800/250/11	1100	1500	800	250	630	2400	2300	2450	21.0	three-phase	1500
DH 3020/1480/450/11	1100	3022	1480	450	2500	4000	4000	2500	98.0	three-phase	3500

*Please see page 66 for more information about supply voltage



Furnace floor can be lowered for maintenance purposes

Continuous Furnaces Electrically Heated or Gas-Fired



Continuous furnace D 650/S with chain conveyor for 950 °C

Continuous furnaces are a good choice for processes with fixed cycle times such as drying or preheating, curing or degassing of plastic parts. The standard models are available for temperatures between 100 °C and 1000 °C. The furnace design is subject to the required throughput, the process requirements for the heat treatment and the required cycle time. The conveyor technology (e.g. belt, rollers) is tailored to the required operational temperature and the charge geometry to be handled. The conveyor speed and the number of control zones also depend on process requirements.

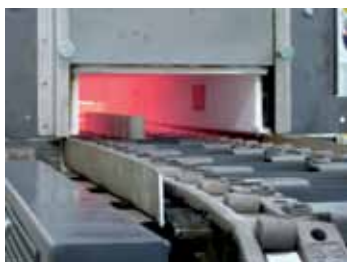


Service flap door at furnace side

- Temperatures between 100 °C and 1000 °C
- Conveyor speed infinitely variable
- Customized conveyor belt width

Additional equipment

- Charge and discharge section tailored to process requirements
- Heating-up and cooling section with defined gradients to follow specific temperature profiles
- Exhaust gas treatment facilities
- Different conveyor specifications corresponding to the parts to be conveyed
- Roller conveyors
- Charging aids for loading and unloading
- Different heating concepts depending on process requirements, e.g. radiation heating, air circulation, infrared or gas-fired
- Retorts for operation under protective gas



Discharge of D 650/S



Cooling facility at discharge of a continuous belt furnace



Continuous roller furnace N 650/45 AS for heat treatment of heavy workparts

Wire and Strand Annealing Furnaces



Strand annealing furnace D 390/S in customized dimensions

D 20/S - D 320/S

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.

- 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
- For control systems see page 66 ff.

Additional equipment

- Gas supply systems for protective gas including hydrogen in the muffle tubes, with burn off torch and safety technology
- Process and charge documentation
- Double chamber furnace system with parallel chambers for simultaneous operation at different temperatures



Vertical strand furnace D 44/S

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Connected load/kW	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

*Please see page 66 for more information about supply voltage



Wire-drawing furnaces based on a tube furnace with a length of 6 meters

Tempering Plants for Steel and NE-Metals



Fully automatic tempering system for aluminum with 2 pit furnaces, water bath, and 6 parking places

Fully Automatic Tempering System with Air-Circulating Pit-Furnace S 1780/65 AS for Solution Annealing, Water Bath, Lift Conveyor and Pit Furnace S 3180/26AS for Artificial Aging

This tempering system is available for the tempering of aluminum parts with a quenching time of 30 seconds. All functional processes are fully automated. Both, the solution annealing and the artificial aging furnaces are designed as pit furnaces.



Removal of the charge basket from solution annealing and transfer to water bath

To save time, the conveyor unit picks-up the lid of the solution annealing furnace after solution annealing, along with the attached load basket and transports it to the water bath. The lid is then unlinked and conveyed back to the solution annealing furnace. After quenching, the basket is parked in a free spot.

The subsequent artificial aging process also takes place in a pit furnace. Due to the longer period needed for artificial aging, the artificial aging furnace is equipped for the introduction of two baskets, while the solution annealing furnace can only handle one.

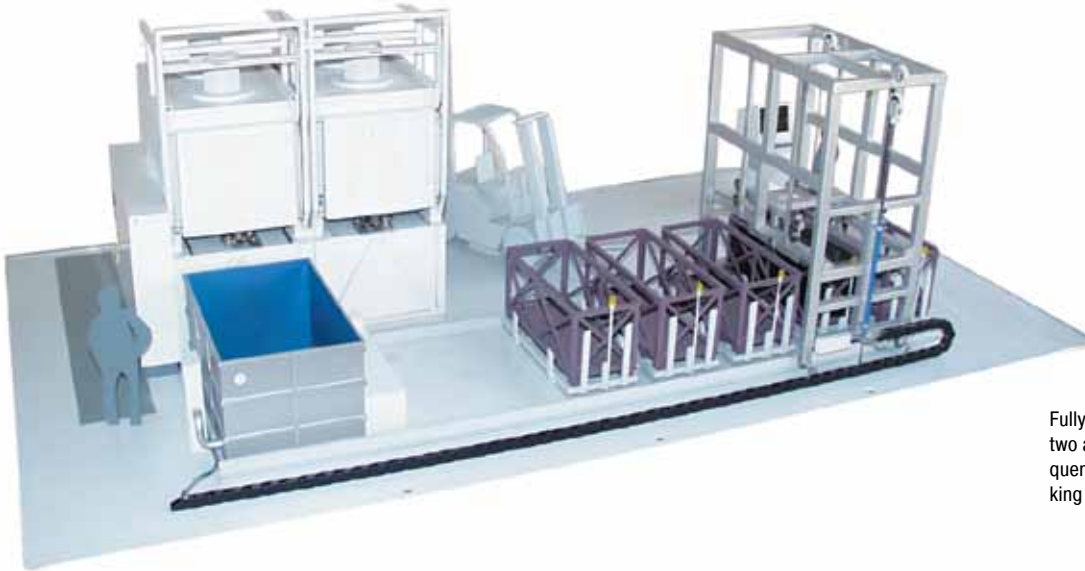
The entire heat treatment, including all movements, is fully automated. The PLC controls handle all movement and locking processes. The system automatically detects occupied parking spaces and furnaces and starts the programmed processes according to priority. Charge documentation takes place on an ongoing basis, that is, the loaded basket is documented from the time it is loaded into a parking place until removal after the end of the process.



PC interface for central operation

Systems design

- Pit furnace S 1780/65 AS for solution annealing of one basket, Tmax 650 °C, volume 1780 liters
- Pit furnace S 3180/26 AS for artificial aging of two baskets, Tmax 260 °C, volume 3180 liters
- Water bath with powerful circulation and heating, along with control of the water temperature
- Linear lift conveyor for all movement processes
- PLC controls with Nabertherm Control Center (NCC) for temperature regulation, control of all movements, and parallel batch documentation
- 6 parking spots with automatic occupancy detection, loading with forklift
- Safety fence around the entire system



Fully automated tempering system with two air-circulating bogie hearth furnaces, quench bath, conveyor system, and parking spots for five charge baskets

Fully Automated Heat Treatment System with Air-Circulating Bogie Hearth Furnace W 2780/60 AS for Solution Annealing, W 2780/26 AS for Artificial Aging, Lift Conveyor, and Heated Water Bath

This tempering system is available for the tempering of T6 aluminum alloys with a quenching time of 10 seconds. All functional processes are fully automated. Both the solution annealing furnace and the artificial aging furnace are mounted on a platform and are designed as bogie hearth furnaces. After solution annealing, the conveyor unit positions itself in front of the furnace, the door opens, the bogie moves out, and the basket is automatically picked-up by the lift conveyor. The bogie moves back into the furnace and the load is quenched in the water bath underneath.

After the quenching process, the basket is lifted back out of the water bath, drips off, and is conveyed to the artificial aging furnace. After artificial aging, the lift conveyor transports the basket to a free parking spot.

The entire heat treatment, including all movements, is fully automated. The PLC controls handle all movement and locking processes. The system automatically detects occupied parking spaces and furnaces and starts the programmed processes according to priority. Charge documentation takes place on an ongoing basis, that is, the loaded basket is documented from its process start in the parking space until removal after the end of the process.

System Design

- Bogie hearth furnace W 2780/60 AS for solution annealing, Tmax 600 °C, volume 2780 liters
- Bogie hearth furnace W 2780/26 AS for artificial aging, Tmax 260 °C, volume 2780 liters
- Water bath with powerful circulation and heating, along with control of the water temperature
- Linear lift conveyor for all movement processes
- PLC controls with Nabertherm Control Center (NCC) for temperature regulation, control of all movements, and parallel batch documentation
- 5 parking spots with automatic occupancy detection, loading with forklift
- Safety fence around the entire system



Heat Treatment Systems for Steel and NE-Metals



Bogie hearth furnace W 7440/26 AS for solution annealing and water bath WB 24000/S for quenching



2 x S 3570/65 AS for solution annealing

Manual Heat Treatment System with Two Air-Circulating Pit Furnaces S 3570/65 AS for Solution Annealing, Water Bath, Bogie Hearth Furnace W 7440/26 AS for Artificial Aging

This tempering system was built for the tempering of aluminum parts for automotive industry. The movement processes are performed manually using the customer's crane. These solution annealing furnaces are designed as pit furnaces, while the artificial aging furnace is a bogie hearth furnace.

Solution annealing of the components takes place in two pit furnaces with 3570 liter furnace chambers. After the solution annealing process is concluded, the lid of the furnace is opened pneumatically, the basket is removed using the crane, and it is placed into the water bath. For better quench results, the water bath is equipped with a powerful circulation pump.

After quenching, the operator uses the crane to move the load onto the bogie of furnace W 7440/26 AS for artificial aging. The bogie hearth furnace is equipped with a chain-driven bogie which is moved out of the furnace electrically. The furnace is dimensioned to accept the loads from both solution annealing furnaces.

The furnace has PLC controls for temperature measurement and charge documentation. Every load can be assigned a name or a charge number, which is then stored along with the date.

System Design

- 2 pit furnaces S 3570/65 AS for solution annealing of one basket each, Tmax 650 °C, volume 3570 liters
- Bogie hearth furnace W 7440/26 AS for artificial aging of two baskets, Tmax 260 °C, volume 7440 liters
- Water bath with powerful circulation and heating, along with control of the water temperature
- PLC controls with Nabertherm Control Center (NCC) for charge documentation



Water bath with powerful circulation pump



Annealing system with top-hat furnace H 4263/12S and water bath

Manual Heat Treatment System for Steel with Top-Hat Furnace H 4263/12S and Water Bath

This tempering system is available for the tempering of 8 meter steel profiles with a quenching time of 30 seconds. The furnace is a top-hat furnace which is loaded with a crane. After heat treatment, the operator positions the crane with attached C-hook in front of the furnace. The furnace is electrohydraulically opened by the operator at 1150 °C and the bogie is moved out of the furnace.

The charge holder on the bogie and the C-hook are designed in such a way that the charge is positioned into the C-hook directly when the bogie drives out. The crane only needs to lift it up. The operator then moves the material over the water bath and lowers it for quenching. After the quenching process, the basket is lifted back out of the water bath, drips dry, and is manually placed onto a free parking spot with the crane.

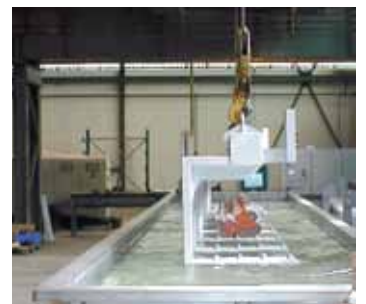
The system has PLC controls for temperature measurement and charge documentation. Every load can be assigned a name or a charge number, which is then stored along with the date.

System Design

- Top-hat furnace H 4263/12S, Tmax. 1200 °C, volume 4260 liters, electrohydraulic hood drive, chain drive for bogie
- Water bath with powerful circulation
- PLC controls with Nabertherm Control Center (NCC) for temperature regulation and charge documentation
- Safety fence around the entire system



Moving furnace table and material under the C hook of the crane



Quenching of steel bars in water

Energy Efficiency Technology



Counterflow heat exchanger for the air circulation chamber furnace N 2560/26 ACLS

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

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

The following examples outline engineering alternatives for heat recovery:

Heat Exchangers

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



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

Recuperator Burners

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

Heat Transfer Chambers

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

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

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

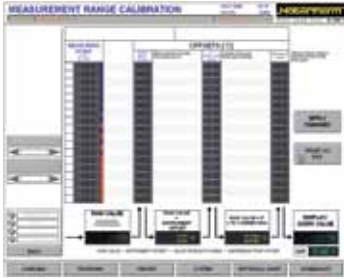


Heat transfer between a hot and a cold charge

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



AMS 2750 D, NADCAP, FDA



Implementation of AMS 2750 D

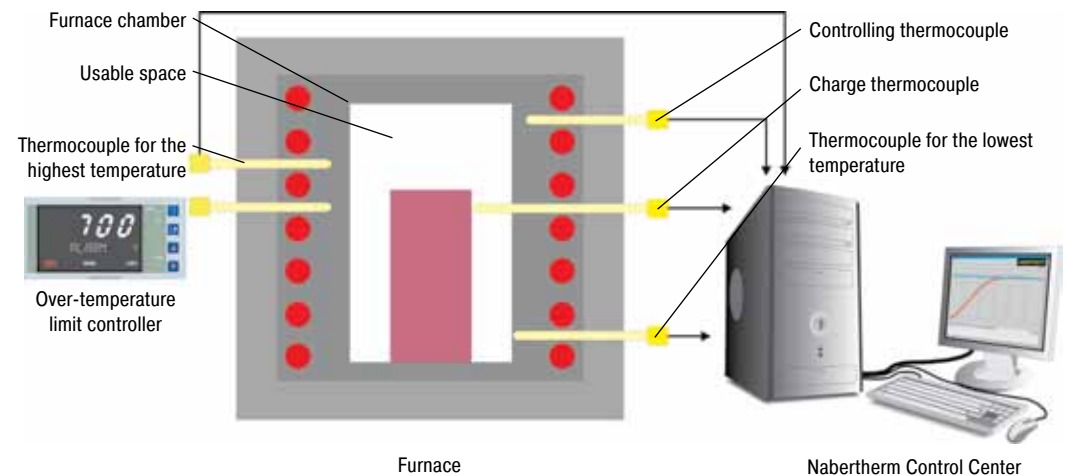
Basically, two different systems are available for control and documentation, a proven Nabertherm system solution or instrumentation using Eurotherm controllers/temperature recorders. The Nabertherm AMS package is a convenient solution that includes the Nabertherm Control Center for control, visualization,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

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

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

In daily use, the following product characteristics stand out:

- Very easy to navigate and straight-forward presentation of all the data in plain text on the PC
- Automatic saving of the charge documentation at the end of the program
- Administration of the calibration cycles in the NCC
- Results of the measurement distance calibration are entered in the NCC
- Schedule management of the required testing cycles including a reminder function. The testing cycles for TUS (Temperature Uniformity Survey) and SAT (System Accuracy Test) are entered in days and monitored by the system and the operator or tester is informed in time about up-coming tests. The values of the tests are entered directly into NCC and saved as PDF files on the PC. There are no additional tasks involved in documenting the tests.
- Option of transferring the measurement data to a customer's server



Example of a design with Type A Nabertherm Control Center



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.

Instrumentation for TUS Measurements as a Separate Model

The TUS standard requires that the temperature uniformity of the furnace be tested with a TUS measurement at regular intervals. This measurement must be performed by an independent measurement system and not by the instrumentation used for process control. The testing intervals are filed in the NCC in days. The system reminds in time that a test must be performed.

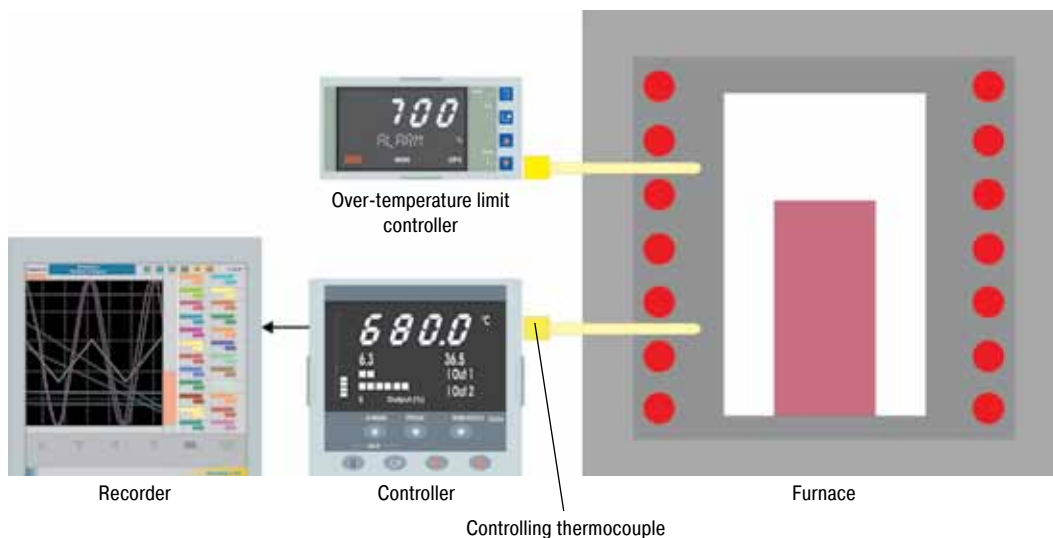
This test can be performed either using an independent temperature recorder (see page 64) with the customer's calibrated testing thermocouples or using the Nabertherm TUS module that is connected to the Nabertherm Control Center as a separate module.

The TUS module has its own PLC which converts the measurement results of the testing thermocouples. The evaluation, including an easy-to-navigate and simply log function, is then performed via the furnace's Nabertherm Control Center.



TUS module with ports for 16 thermocouples and PROFIBUS connection to the Nabertherm Control Center

Alternative Instrumentation with Temperature Controllers and Recorders from Eurotherm



Example of a design containing Type D Eurotherm instrumentation

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 also page 64).



N 12012/26 HAS1 according to AMS 2750 D

Professional Control and Documentation Alternatives



PC for HiProSystems control in a separate cabinet

HiProSystems Control and Documentation

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

Alternative User Interfaces

Touch panel H 700

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

Touch panel H 1700

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

Touch panel H 3700

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

For Control, Visualisation and Documentation

Nabertherm Control Center NCC

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

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

Temperature Recorder

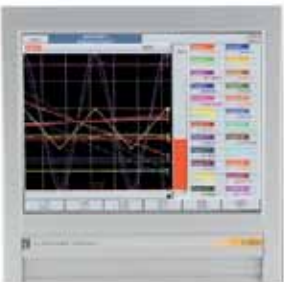
Besides the documentation via the software which is connected to the controls, Nabertherm offers different temperature recorders which can be used with respect to the application.



H 1700 with colored, tabular depiction of the data



H 3700 with colored graphic presentation of data



Temperature recorder

	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 AMS 2750 D			x

Controltherm MV Software for Control, Visualisation and Documentation

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

In the basic version one furnace can be connected to the MV-software. The system can be extended to four, eight or even 16 multi-zone controlled furnaces. Up to 400 different heat treatment programs can be stored. The process will be documented and filed. Process data can be read-out graphically or in table format. A data transfer to MS-Excel is also possible.

Furnaces which are not controlled via a Nabertherm controller can be also documented with the MV-software. We deliver an extension package as optional equipment. With respect to the individual version, three, six or even nine independent thermocouples can be connected. Independent of the control system, the values of each thermocouple will be read-out and evaluated by the MV-software.

Features

- Simple installation without specific knowledge
- All Nabertherm controllers with interface connectable
- Manipulation protected storage of temperature curves of up to one, four, eight or 16 furnaces (also multizone-controlled), depending on the version of MV-software
- Redundant storage on a network server possible
- Programming, archiving and printing of programs and graphics
- Free input of descriptive charge data text with comfortable search function
- Data exportable into Excel format for further evaluation
- Start/stop of the controller from the local PC (only with Nabertherm controllers mit interface)
- Selectable languages: German, English, French, Italian or Spanish
- 400 additional programs storable (only with Nabertherm controllers with interface)

Extension Package II for Connection of one Additional Temperature Measuring Point, Independent of the Controller

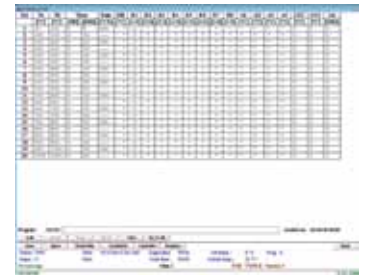
- Connection of an independent thermocouple, type K or S with display of the measured temperature on the included controller C 6 D, e.g. for documentation of charge temperature
- Conversion and transmission of measured data to the MV-software
- For data evaluation, please see MV-software features

Extension Package II for Connection Three, Six or Nine Temperature Measuring Points, Independent of the Controller

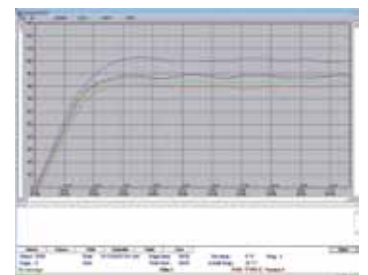
- Connection of three thermocouples, type K, S, N or B to the supplied connection box
- Extendable to two or three connection boxes for up to nine temperature measuring points
- Conversion and transmission of measured data to the MV-software
- For data evaluation, please see MV-software features



Controltherm MV Software for Control, Visualisation and Documentation



Data input in table format if used together with Nabertherm controllers



Graphical display of set and actual temperature curve



Extendable for connection of up to 16 furnaces

Process Control and Documentation

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

Standard Controller

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

Assignment of Standard Controllers to Furnace Families

	NRA 12/06 - NRA 430/11	NR, NRA .. H ₂ -Ausführung	NR, NRA .. IDB-Ausführung	SRA 500 - SR 1000	VHT	KTR	N .. HA	N 30/45 HA - N 500/85 HA	N .. /65 HAC	TR	W .. A	WTR	S .. 45/65/85A	S .. /A	W .. - W .. /H	W ..	WB	NB ..	N 7/H..	N 31..	N ..	H ..	TS ..	WB ..	DH ..	D ..
Catalog page	10	12	12	13	14	18	20	24	26	28	30	32	33	30	32	36	39	40	41	41	42	44	50	51	52	55
Controller	●			●		○	○	○	○		●	○	○	○	○	●		○	○	○		●		○		
P 300																										
P 310										○																
P 330																										
R 6										●																
B 130																										
B 150						●	●	●	●			●	●	●	●			●	●	●				●		
B 180										○																
C 280																		○								
C 42																										
3208																										●
H 100/PLC	○			○			○	○	○	○	○	○	○	○	○					○	○	○	●			
H 700/PLC					●																		○			
H 1700/PLC	○		●	○	○	○	○	○	○		○	○	○	○	○	○	●	●		○	○	○			●	○
H 3700/PLC	○	●		○	○	○	○	○	○		○	○	○	○	○	○	○	○		○	○	○	○		○	○

Functionality of the Standard Controllers

	B 130	C 280	P 300	P 310	R 6	B 150	3208	C 42	B 180	P 330	H 100	H 700	H 1700	H 3700
Number of programs	2	9	9	9		1		9	1	9	50	10	10	10
Segments	4	4	40	40		2		18	2	40	99	20	20	20
Extra functions (e.g. fan or autom. flaps)		2	2 ¹	2 ¹				2		2	2	2	5	8
Maximum number of control zones	1	1	1	2	1	1	1	1	1	1	2	4	8	8
Graphic color display												5,7"	5,7"	12"
Status messages in clear text	●	●	●	●		●	●	●	●	●	●	●	●	●
Start time configurable (e.g. to use night power rates)	●	●	●	●		●	●	●	●	●	●	●	●	●
Operating hour counter	●	●	●	●		●	●	●	●	●	●	●	●	●
Auto tune	●	●	●	●		●	●	●	●	●	●	●	●	●
Program entry in steps of 1 °C or 1 min.	●	●	●	●		●	●	●	●	●	●	●	●	●
Keypad lock	●	●				●								
Skip-button for segment jump			●	●		●				●		●	●	●
Drive of manual zone regulation				●										
Interface for MV software	○	○	○	○		○		●	○	●				
Programmable power outlet										●				
kWh meter	●	●	●	●		●		●	●	●	●	●	●	●
Real-time clock								●		●	●	●	●	●
Bath control/charge control											○	●	○	○
Data entry via touchpanel												●	●	●
Data input via number pad			●	●				●	●	●				●

● Standard

○ Option

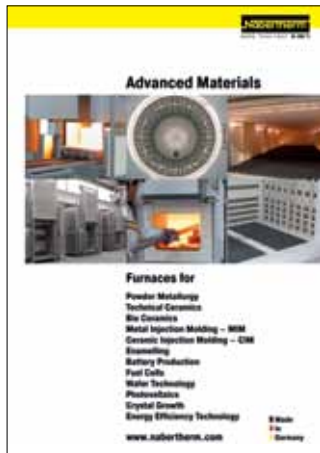
¹ As an extra feature in ovens with air circulation

Mains Voltages for Nabertherm Furnaces

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

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

The Nabertherm Product Range – www.nabertherm.com



Advanced Materials

With our broad range of furnaces for advanced materials we offer interesting solutions for many applications in powder metallurgy and technical ceramics, for the manufacture of fuel cells and other innovative areas of application. Our electric or gas heating furnaces can be operated in air, protective gas atmospheres or in a vacuum. From our laboratory furnaces to fully automated multi-purpose furnace systems with exhaust gas cleaning systems, we are sure to find a solution to meet your needs.

Laboratory

Apart from the furnaces shown for production Nabertherm offers a wide range of standard furnaces for laboratories. We keep standard units in stock for short delivery times. Please ask for our special laboratory brochure which provides more detailed information on the furnaces which could be of interest to you.

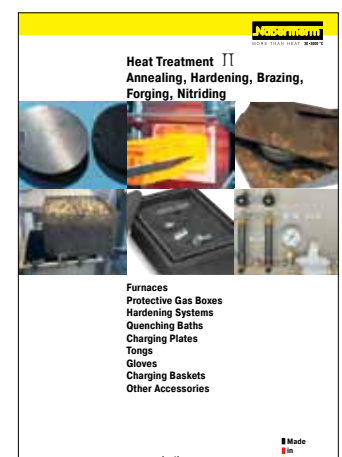


Glass

For glass applications Nabertherm offers a wide range of furnaces for slumping/bending, decorating, laminating or annealing of different glass types. Also heat-soak ovens or fully automatic cooling lines are available in different standard sizes. Based on our wide standard range we are able to develop also customized solutions for your application.

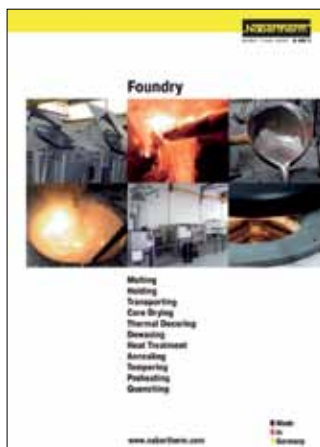
Heat Treatment II

Annealing, ageing, hardening, nitriding, brazing in protective gas, tempering, drying, curing – these are only some of the applications which can be realized with our broad range of furnaces and heat treatment accessories. From the simple charging plate, via annealing boxes to compact multi-purpose tool shop hardening systems with quenching bath, we are sure to find a reasonably-priced solution for your heat treatment needs.



Foundry

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



The whole World of Nabertherm: www.nabertherm.com

Please visit our website

www.nabertherm.com and find out all you want to know about us - and especially about our products.

Besides news and our current calendar of trade fairs, there is also the opportunity to get in touch directly with your local sales office or nearest dealer worldwide.

Professional Solutions for:

- Arts & Crafts
- Glass
- Advanced Materials
- Laboratory/Dental
- Thermal Process Technology for Metals, Plastics and Surface Finishing
- Foundry



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