Nabertherm

MORE THAN HEAT 30-3000 °C

Heat Treatment II
Annealing, Hardening, Brazing, Forging, Nitriding






Furnaces
Protective Gas Boxes
Hardening Systems
Quenching Baths
Charging Plates
Tongs
Gloves
Charging Baskets
Other Accessories

www.nabertherm.com

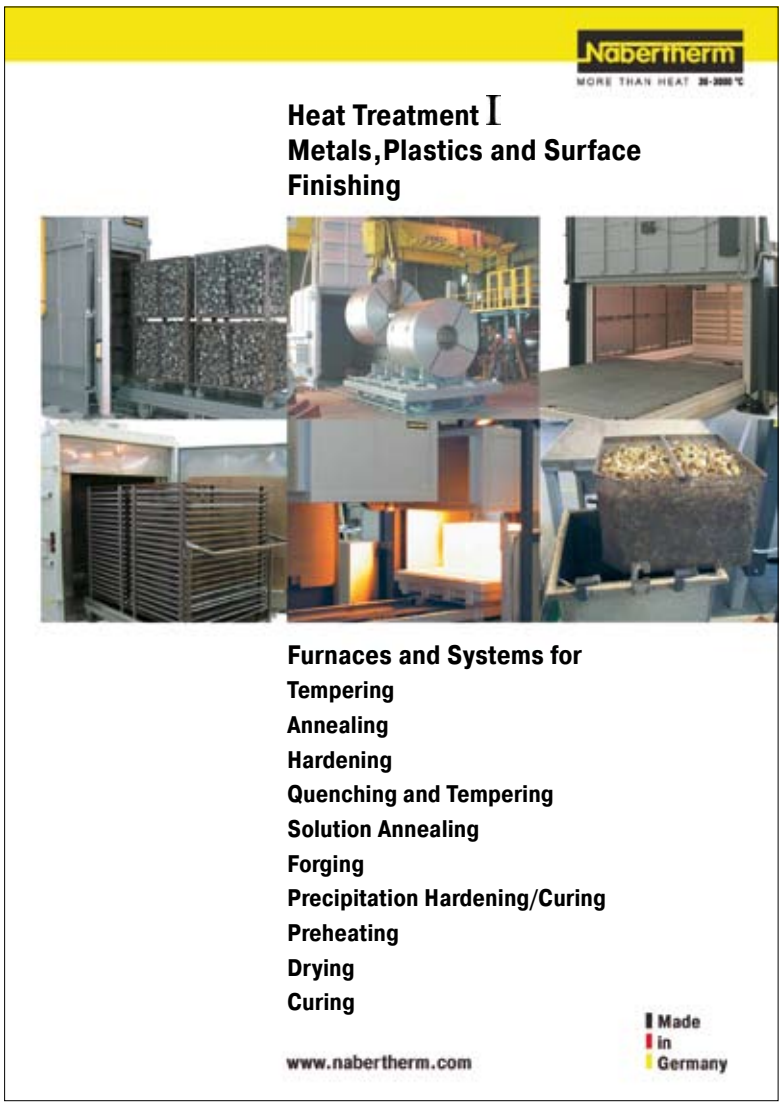
Made in Germany

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

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

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

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



Customer Service and Spare Parts
Our professional service engineers are available for you worldwide. Due to our complete inhouse production, we can despatch spare parts from stock or produce with short delivery time.

More Than Heat – Experience in Many Fields of Thermal Processing
In addition to furnaces for heat treatment, Nabertherm offers a wide range of standard furnaces and systems for many other thermal processing applications. The modular design of our products allows us to customize a solution to your individual needs without expensive modifications. Our professional R&D department will be pleased to test your product samples in order to specify the right heat treatment equipment for you.

Please ask for our extensive catalog featuring furnaces and furnace systems used for heat treatment!

Contents

Overview of Heat Treatment Processes

Quenching and Tempering
Case Hardening
Hardening
Tempering
Solution Annealing
Aging

Annealing
Recovery Annealing
Recrystallization Annealing
Stress Relief Annealing
Soft Annealing
Normalizing

Thermal Chemical Diffusion
Without Subsequent Hardening:
Oxidizing
Powder Nitriding
Powder Boriding

with Subsequent Hardening:
Carburizing

As a manufacturer of electrically and gas heated furnaces for heat treatment, Nabertherm offers a wide range of accessory equipment and consumable materials required for heat treatment.

The MHS 17 hardening system shown on page 17, featuring an oil and water bath as well as an air quenching system, is suitable for occasional applications. This system can be extened to a full-scale hardening shop using a minimum of space. The basis for annealing are the furnace models N 7/H - N 17/HR and for tempering, the circulation air furnace N 15/65 HA.

Multitherm N 31/H - N 81 chamber furnaces as well as Multitherm N 30/45 - N 120/85 HA circulation air furnaces are suitable for hardening and tempering of medium-sized workpieces. In addition to oil and water baths, charging aids can also be supplied for these models. The semi-automated SHS 41 protective gas hardening system is suitable for annealing under protective gas and quenching in oil.

For large-format workpieces we recommend furnaces N 161 - N 1491 and N 250/45 - N 500/85 HA. There are also charging aids available for these models. Quenching baths are custom manufactured and designed to fit the process.

Protective gas boxes and bags can be used to prevent oxidation and decarburizng of the steel during heat treatment. These are flushed with protective gases such as argon, nitrogen or forming gas 95/5 and thus force the oxygen out of the containers. The systems required and their corresponding furnaces and boxes, are described in detail. If there is no protective gas available, workpieces can also be wrapped in annealing and hardening foils or packed in annealing envelopes. The foil used binds the enclosed oxygen. If used properly, clean, oxidation-free surfaces are achieved under protective gas as well as enclosed in foil.

Annealing boxes and the required consumables are available for powder nitriding to obtain greater protection against corrosion, for carburizing of low alloy steels, for neutral atmosphere annealing in an oxygen-free atmosphere and for boriding.

For the even quenching of workpieces and for bainitic hardening, Nabertherm supplies bath furnaces with neutral salt for temperatures up to 500 °C. Salt bath furnaces up to 750 °C and 1000 °C are available for heat treatment in active salt baths, for Tenifer nitriding, for carburizing and bright annealing.

There are tongs, face protection, gloves and other equipment available for working at the hot furnace. We can supply a Rockwell hardness tester for testing hardness after treatment.

The furnaces described in this catalog and the accessory equipment available allow many different heat treatment processes which otherwise are only possible using expensive furnace systems. This brochure offers customers the opportunity to assemble their own hardening shop to their own specifications and makes it easy to select required accessory equipment.

Contact Nabertherm at any time for a detailed consultation.

Chamber Furnaces with Radiation Heating


N 7/H


N 41/H

N 7/H - N 1491

These universal chamber furnaces with radiation heating are designed for highly adverse conditions during heat treatment. They are ideally suited for tooling construction processes and in the hardening shop, such as annealing, hardening or preheating for forging. The use of various accessories allow these furnaces to be modified for your application.

Standard Features, Table-Top Models N 7/H - N 17/HR

- Compact, low-cost construction
- Heating from floor and both side walls
- Heating elements on support tubes ensure free heat radiation and a long service life
- Low energy consumption due to multi-layer insulation
- Casing made of sheets of textured stainless steel (non-corrosive design)
- Exhaust air vent mounted on the side
- Optimal temperature uniformity up to ΔT 20 K in accordance with DIN 17052-1
- Floor heating protected by heat conducting SiC tiles
- Parallel swinging door which opens downward (protection against heat radiation)

Standard Features N 31/H - N 61/H, like models N 7/H - N 17/HR, plus

- Upper door area amored with stainless steel to avoid burn damage
- Exhaust air vent in rear wall of furnace
- Door movement cushioned by gas springs
- Base included in delivery


N 641 with annealing box and lift trolley

Standard Version N 81/H - N 1491/H, like models N 31/H - N 61/H, except

- Door movement with counterweight and gas spring; opening upward
- Models N 761 + N 1491 equipped with electro-hydraulic lift door

For additional features see separate heat treatment catalog

Article no.		Model	Tmax	Inner dimensions in mm			Volume	Exterior dimensions in mm			Supply	Electrical	Weight
Controller B 150	Controller C 290		°C	w	d	h	in l	W	D	H	power/kW	connection*	in kg
001311110	001311190	N 7/H[1]	1280	250	250	120	7	720	640	510	3,0	1-phase	60
001311210	001311290	N 11/H[1]	1280	250	350	140	11	720	760	510	3,6	1-phase	70
001311310	001311380	N 11/HR[1]	1280	250	350	140	11	720	760	510	5,5	3-phase[2]	70
001311510	001311580	N 17/HR[1]	1280	250	500	140	17	720	890	510	6,4	3-phase[2]	90
001321110	001321173	N 31/H	1280	350	350	250	30	840	1010	1320	13,0	3-phase	210
001321210	001321290	N 41/H	1280	350	500	250	40	840	1160	1320	15,0	3-phase	260
001321310	001321395	N 61/H	1280	350	750	250	60	840	1410	1320	20,0	3-phase	400
101320400	101320490	N 81	1200	500	750	250	80	1140	1900	1790	20,0	3-phase	820
101320500	101320590	N 161	1200	550	750	400	160	1180	1930	1980	30,0	3-phase	910
101320600	101320690	N 321	1200	750	1100	400	320	1400	2270	2040	47,0	3-phase	1300
101320700	101320790	N 641	1200	1000	1300	500	640	1690	2670	2240	70,0	3-phase	2100
101320800	101320890	N 761	1200	800	1900	500	760	1550	2540	2650	70,0	3-phase	2400
101320900	101320990	N 1491	1200	1660	1200	750	1490	2430	1840	3150	110,0	3-phase	5400
101330400	101330490	N 81/13	1300	500	750	250	80	1220	1960	1840	22,0	3-phase	900
101330500	101330590	N 161/13	1300	550	750	400	160	1260	1990	2030	35,0	3-phase	1000
101330600	101330690	N 321/13	1300	750	1100	400	320	1480	2330	2090	60,0	3-phase	1500
101330700	101330790	N 641/13	1300	1000	1300	500	640	1770	2730	2290	80,0	3-phase	2500

[1]Table-top model
[2]Heating only between two phases

*Please see page 32 for more information about mains voltage

Charging Plates for Models N 7 - N 641/13

We recommend this useful accessory equipment for applications up to 1100 °C to protect the furnace floor.

Charging plate

- Tmax 1100 °C
- Three raised edges
- Hole for draw hook (see page 22 for draw hook)
- Made of heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Material thickness 4 mm
- Larger plates and custom dimensions available upon request

Article no.	Furnace	Exterior dimensions in mm		
		W	D	H
628000137	N 7	215	290	25
628000138	N 7/H	240	290	25
628000132	N 11	215	390	25
628000139	N 11/H, N 11/HR, N 21	240	390	25
628000140	N 17, N 17/R	215	540	30
628000141	N 17/H, N 17/HR	240	540	30
628000400	N 31/H	340	390	30
628000133	N 41, N 41/H	340	540	30
628000142	N 61, N 61/H	340	790	30
628000143	N 81	480	790	30
628000144	N 161	530	790	30
628000145	N 321	720	1140	30
628000146	N 641	950	1330	30

Hardening Boxes for Models N 7 - N 161/13

Working with Hardening Boxes

Hardening boxes are made of heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841) and also feature a lid for top charging. A ceramic fiber gasket is inserted in the circular seal profile on the upper edge of the box to seal it. To prevent oxidation during the process, neutral annealing coal is placed in the box. These bind the oxygen in the box at all temperatures. After the heat treatment, the box is removed from the oven, the lid is opened using tongs (page 22) and the workpiece removed. Our hardening boxes are also well suited for brazing.

The boxes can also be used with the appropriate granulate (page 7) for carburizing (also referred to as case hardening or cementing) and for powder nitriding or powder boriding. The workpieces are placed in the box with carburizing granulate or nitriding powder or boriding powder and a suitable activator (page 7).

Hardening boxes with lid and granulate

- Tmax 1100 °C
- Hardening box with lid and seal profile
- Lid sealed with ceramic fiber, ceramic insulating materials can alternatively be used
- Models up to N 17/HR with manipulating device available
- Starting with model N 31/H, with a charging trolley (page 30)
- Also usable for carburizing and powder nitriding
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Larger boxes and custom dimensions available upon request

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm			Charging
		w	d	h	W	D	H	method
631000123	all	104	84	65	140	120	90	charging fork
631000124	all	99	99	75	135	135	100	charging fork
631000125	all	144	114	95	180	150	120	charging fork
631000126	all	144	169	125	180	205	150	charging fork
631000127	N 7, N 7/H	114	164	77	150	200	102	charging fork
631000128	N 7/H	174	194	93	210	230	115	charging fork
631000129	N 11, N 11/R	174	244	107	210	280	132	charging fork
631000130	N 11/H, N 11/HR	184	294	107	230	330	132	charging fork
631000131	N 17, N 17/R	174	394	107	210	430	132	charging fork
631000132	N 17/H, N 17/HR	194	444	107	230	480	132	charging fork
631000396	N 31/H	244	294	147	280	330	172	draw hook
631000133	N 21, N 41, N 41/H	194	294	147	230	330	172	draw hook
631000135	N 41, N 41/H	244	344	177	280	380	200	draw hook
631000136	N 41, N 41/H	294	394	197	330	430	222	draw hook
631000137	N 61, N 61/H	274	494	197	310	530	222	draw hook
631000138	N 81	394	494	197	430	530	222	forklift
631000312	N 161	456	556	250	496	596	355	forklift

Article no. 601603960, 1 set of fiber insulation cord, 5 strips of 610 mm each

Hardening boxes on stacker

Neutral Annealing Coal

- For protection of tool steel against oxidation and decarburizing, binds oxygen at all process temperatures
- Workpieces are placed in a hardening box with annealing coal
- Reusable multiple times with addition of approx. 20 % new granulate

Article no.	Description	Container
491075110	Kratos K	10 kg bucket
491075125	Kratos K	25 kg sack

Neutral annealing coal

Carburizing Powder and Granulate

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

Carburizing granulate

Article no.	Description
491070250	KG 6 - granulate for alloyed steels and multiple re-use
491070275	KG 30 - granulate for non-alloyed steels and multiple re-use
491070300	Kratos L - powder for alloyed steels and single use
491070430	Kratos U - powder for non-alloyed steels and single use

Nitriding Powder and Activator, Boriding Powder

- Workpieces are placed into an annealing box together with the nitriding powder and activator and the lid is closed and sealed
- Powder nitriding or powder boriding causes a thin cover layer to form against friction wear and fatigue resistance is substantially increased
- At approx. 550 °C an extremely thick cover layer forms (up to 1000 HV) which covers the hardened steel or the carburized edge layer. The activator improves process conditions.
- The process duration at 550 °C is at least 10 hrs
- For all steels and cast iron, such as hot work steel matrices, injection molding dies, wear parts and machine components
- Anti-nitriding paste to protect areas which should not be processed

Boriding powder upon request.

Nitriding powder

Article no.	Description	Container
491010250	Nitriding powder	80 kg
491010150	Activator	25 kg
491010100	Activator	5 kg
491003000	Anti-nitriding paste	1 kg

Stainless Steel Heat Treating Foil to avoid Surface Reactions

Workpieces in foil heat treating

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

Foil off the roll can be cut to size using gold plates scissors and the workpiece can be wrapped to requirements. See page 9 for more details about accessory supplies required, such as tongs and special gloves. The protected workpiece can now be loaded into the heated furnace. Due to the foil's thinness, it takes on the furnace temperature immediately and binds oxygen trapped in the foil packaging. There is then no oxygen present to oxidize the workpiece itself. The workpiece stays clean.

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

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

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

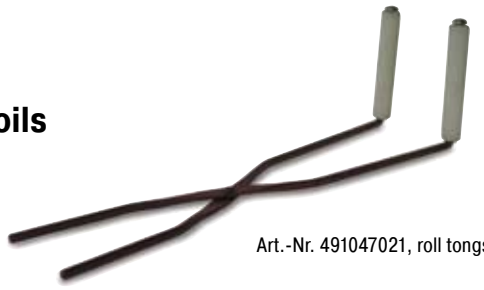
Annealing and Heat Treating Foils

Stainless steel heat treating foil

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

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

Accessory Equipment for processing Bags, Envelopes and Foils



Art.-Nr. 491047021, roll tongs

Art.-Nr. 491047010, fold lock

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

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

Annealing Envelopes

Annealing envelopes

- Annealing envelopes useful up to Tmax 1200 °C
- For hardening small parts
- Airtight lock by means of folds of a fold lock or suitable tools (page 8)
- Rapid heating of the foil binds the oxygen in the annealing envelope preventing virtually all oxidation and decarburizing
- Rapid quenching in air, oil or water, ensuring high dimensional accuracy
- Workpieces are placed as tightly as possible in the annealing envelope
- Envelopes made of ultra-thin stainless steel heat treating foil, welded on three sides, for single use

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

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

Other dimensions available upon request

Annealing Bags

Annealing bags

- Annealing bag suitable for powder nitriding, boriding and high speed steel hardening up to approx. 1050 °C - 1150 °C for cold work purposes
- Made of stainless steel heat treating foil for single use
- For hardening of blocks, stamps, cutting plates, etc.
- Rapid heating binds the oxygen in the annealing bag so that high-alloy and medium-alloy steel grades can be hardened
- Rapid quenching in air, oil or water, ensuring high dimensional accuracy
- Workpieces are placed as tightly as possible into the annealing bag
- Airtight lock by means of folds of a fold lock or suitable tools (page 8)

Quadratic cross-section

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

Rectangular cross-section

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

Other dimensions available upon request

Protective Gas Annealing Bag and Holder for Models N 7 - N 61/H

Protective gas annealing bag in operation

Working with the Protective Gas Annealing Bag and Holder

When workpieces made of air-hardened steel must be heat treated under protective gas and quenched, the protective gas annealing bag with holder is an optimal solution. This system consists of a holder with charge carrier and protective gas tube as well as a bag made of stainless steel heat treating foil. We would be pleased to carry out trials at our technical center.

Holder with protective gas annealing bag

The charge is placed on the charge carrier and covered with the protective gas annealing bag. The bag is preflushd with protective gases such as argon, nitrogen or forming gas 95/5 (page 15) and placed together with the holder in the furnace. After the charge has been heated, the protective gas annealing bag and holder are removed from the furnace and cooled with the help of the forced cooling system (page 17) or in still air. At the same time the workpiece remains in the bag in the protective gas atmosphere. This prevents oxidation from occuring. Due to thin-walled foil very rapid cooling times can be achieved.

The protective gas annealing bag is also suitable for quenching workpieces in oil or water. The protective gas annealing bag with holder is taken out of the hot furnace after the heating time. The bag is pulled off the holder above the quenching bath using a heat protection glove (page 22). After this the workpiece can slide directly into the quenching bath. In most steels, the brief exposure to ambient air while being pulled out normally has no effect on surface oxidation of workpieces.

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

Thermocouple integrated in holder

- Tmax 1200 °C
- Holder with protective gas annealing bag, protective protective gas through notch in upper furnace collar
- Supplied with three protective gas annealing bags
- Gas connection with quick-release coupling and 3/8 inch hose connection
- Holder with hand handle
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K
- Digital temperature display (page 16) and protective gas systems (page 15) optional
- Charging trolley optional (page 30)

Article no.	Furnace	Inner dimensions in mm			Max. workpiece	Replacement hood	Preflush/cooling rate	Process flush rate
		w	d	h	length in mm	(article no.)	l/min	l/min
631000539	N 7.. - N 61..	80	250	40	180	491040825	15 - 20	5 - 8
631000540	N 7.. - N 61..	120	250	60	180	491042225	15 - 20	5 - 8
631000541	N 11.. - N 61..	120	350	60	280	491042235	15 - 20	5 - 8
631000542	N 11.. - N 61..	160	350	80	280	491043635	15 - 20	5 - 8
631000543	N 17.. - N 61..	160	420	80	350	491043640	15 - 20	5 - 8
631000544	N 41.. - N 61..	200	420	100	350	491045242	20 - 25	10 - 15

Protective Gas Boxes for Models N 7 - N 641

Box with protective gas connection

Working with Protective Gas Boxes for a Protective Gas Atmosphere

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

The box is pressurized with protective gases such as argon, nitrogen or forming gas 95/5 via the protective gas tube. A mixture of 95 % nitrogen and 5 % hydrogen produces optimal results. There are manual and automatic systems available for protective gas. See pages 15-16. for more information about protective gases which can be used as well as manual and automatic protective gas systems.

After charging the box it is closed and preflushed outside the furnace. Afterwards the box is placed in the preheated furnace. The quantity of gas can be reduced to the process flush quantity. After the heat treatment the box is pulled out of the furnace, the charge taken from the box and placed in the quenching medium. In most steels, the brief exposure to ambient air while being pulled out normally has no effect on surface oxidation of workpieces. We recommend using binding wire (page 22) on the parts so that they can easily be grasped by tongs (page 22).

Winch stacker with hardening box and furnace

There is a flexible type K thermocouple in the box for measuring the temperature; we recommend connecting it to a digital display device or to a temperature recorder (page 16).

The box can also be cooled down on a cooling platform (page 20) while closed. Be sure that the protective gas flowrate is increased for this application.

- Tmax 1100 °C
- Protective gas box with lid, protective gas inlet and outlet through the furnace collar and seal profile. Gas connection including quick-release coupling with 3/8 inch hose connection
- Lid sealed with ceramic fiber, ceramic insulating materials can alternatively be used
- Starting with model N 81 the gas ductway runs through the lower furnace collar
- Up to N 17/HR includes manipulating fork
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K

N 11 with protective gas box

Additional Equipment

- Starting from N 31/H a charging trolley is recommended (page 30)
- Digital temperature display (page 16)
- Protective gas systems (page 15)

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm			Preflush/cooling rate	Process flush rate
		w	d	h	W	D	H	l/min	l/min
631000382	N 7, N 7/H	114	164	77	150	200	102	15 - 20	5 - 8
631000383	N 7/H	174	194	97	210	230	110	15 - 20	5 - 8
631000384	N 11, N 11/R	174	244	107	210	280	132	15 - 20	5 - 8
631000385	N 11/H, N 11/HR	194	294	107	230	330	132	15 - 20	5 - 8
631000386	N 17, N 17/R	174	394	107	210	430	132	15 - 20	5 - 8
631000387	N 17/H, N 17/HR	194	444	107	230	480	132	15 - 20	5 - 8
631000398	N 31, N 31/H	294	294	147	330	330	172	20 - 25	10 - 15
631000388	N 21, N 41, N 41/H	194	294	147	230	330	172	20 - 25	10 - 15
631000389	N 41, N 41/H	244	344	177	280	380	200	20 - 25	10 - 15
631000390	N 41, N 41/H	294	394	197	330	430	222	20 - 25	10 - 15
631000391	N 61, N 61/H	274	494	197	310	530	222	20 - 25	10 - 15
631000392	N 81	394	494	197	430	530	222	20 - 25	10 - 15
631000393	N 161	456	556	250	496	596	355	20 - 25	10 - 15
631000607	N 321	472	850	212	581	960	330	20 - 25	10 - 15
631000608	N 641	722	1050	312	860	1160	456	20 - 25	10 - 15

Larger boxes and custom dimensions available upon request
Article no. 601603960, 1 set of fiber insulation cord, 5 strips of 610 mm each

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

Protective Gas Boxes with additional Vacuum Lid for Models N 7 - N 161

Working with Protective Gas Boxes with additional Vacuum Lid to ensure Protective Gas Atmosphere
When heat treating bulk goods and hollow parts under defined protective gas atmosphere we recommend the usage of protective gas boxes with an additional vacuum lid. Thus the traces of oxygen in the box can be reduced by a considerable amount which improves the quality of the components accordingly.

These boxes are equipped with a lid for top charging, protective gas inlet and outlet as well as a vacuum lid with rubber sealing gasket. Gas ductwork and handling while hot is the same as the protective gas boxes described on page 11. In addition, these boxes also feature a connection for a vacuum pump with a shut-off valve.

After charging the box in a cold state it is brought into vacuum and afterwards flushed with protective gas. By repeating this process once or several times the results are considerably improved. After the box was flushed with protective gas the last time, the vacuum lid is removed and the box is placed into the preheated furnace. Protective gas is used for heat treatment.

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

The box can also be force-cooled on a cooling platform (page 20) while closed. Be sure that the protective gas flowrate is increased for this application.

- Tmax 1100 °C
- Protective gas box with process lid, vacuum lid, protective gas inlet and outlet through the furnace collar and seal profile for process lid with support for vacuum lid
- Lid sealed with ceramic fiber, ceramic insulating materials can alternatively be used
- Vacuum lid with rubber sealing gasket
- Gas connection with quick-release coupling and 3/8 inch hose connection
- Manipulating fork (up to N 17/HR)
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K

Additional Equipment

- Starting with model N 31/H, with a charging trolley (page 30)
- Digital temperature display (page 16)
- Vacuum pump (page 13)
- Protective gas system (page 15)

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm*			Preflush/cooling rate	Process flush rate
		w	d	h	W	D	H	l/min	l/min
631000515	N 7, N 7/H	104	144	42	150	200	102	15 - 20	5 - 8
631000516	N 7/H	164	174	62	210	230	110	15 - 20	5 - 8
631000517	N 11, N 11/R	164	224	72	210	280	132	15 - 20	5 - 8
631000518	N 11/H, N 11/HR	184	274	72	230	330	132	15 - 20	5 - 8
631000519	N 17, N 17/R	164	374	72	210	430	132	15 - 20	5 - 8
631000520	N 17/H, N 17/HR	184	424	72	230	480	132	15 - 20	5 - 8
631000521	N 31, N 31/H	284	274	112	330	330	172	20 - 25	10 - 15
631000522	N 21, N 41, N 41/H	184	274	112	230	330	172	20 - 25	10 - 15
631000523	N 41, N 41/H	234	324	142	280	380	200	20 - 25	10 - 15
631000524	N 41	284	374	162	330	430	222	20 - 25	10 - 15
631000525	N 61, N 61/H	264	474	162	310	530	222	20 - 25	10 - 15

Larger boxes and custom dimensions available upon request

*without vacuum lid

Vacuum Pump


Vacuum pump

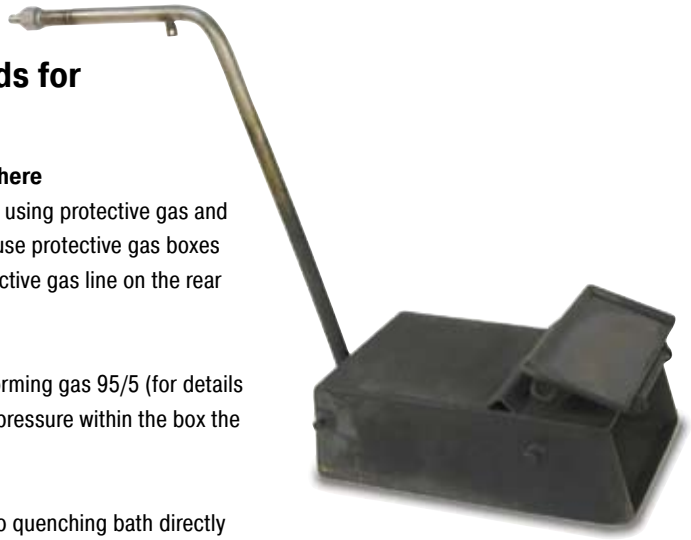
Oil sealed rotary vane vacuum pump for universal use within the low vacuum range. Highly compact and low noise construction. Vacuum pressure gauge included in delivery.

- Sliding vane rotary pump Sogevac SV 16BG with sucking capacity of max. 16 m³/h
- 0,5 mbar absolute
- Connection hose made of stainless steel 1000 mm
- Connector KF16
- Manometer (-1/0,6 bar)

Article no.	Exterior dimensions in mm			Connections on suction side		Supply power	Supply voltage*	Nominal suction power $m^3 h$	Suction capacity $m^3 h$-l
	W	D	H						
601403057	215	281	199	3/4"	1/2" inner thread	0.55 KW	230 V	16	15

*Article no. for other possible supply voltages on request

Protective Gas Boxes with Hinged Lids for Bulk Goods for Models N 7 - N 81


Protective gas box with hinged lid

Working with Protective Gas Boxes with Hinged Lid for Protective Gas Atmosphere
When simultaneously heat treating small amounts of bulk material or several small parts using protective gas and afterwards quenching the bulk material or small parts in oil or water, we recommend to use protective gas boxes with a hinged lid. Boxes with an angled hinged lid on the front are equipped with a protective gas line on the rear wall. The supply line is run through the upper furnace collar.

After preflushing the box accordingly with protective gases such as argon, nitrogen or forming gas 95/5 (for details see page 15) the box is placed with hinged lid first into the furnace. Due to a slight overpressure within the box the protective gas is vented off through the hinged lid.

After the heat treatment the box is taken out of the furnace and the charge is poured into quenching bath directly out of the box. By placing the box at an angle the hinged lid opens by itself. While removing the workpieces the surface oxidation is not influenced by the short contact with ambient air.

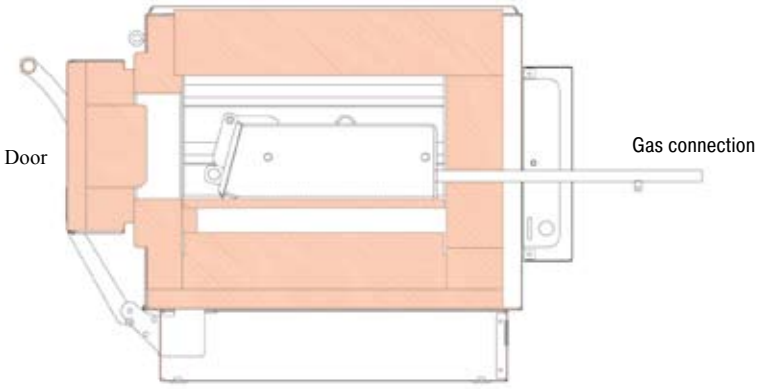
- Tmax 1100 °C
- Protective gas box with hinged lid and hinges and protective gas inlet through the upper furnace collar
- Lid remains closed through its own weight
- Gas connection with quick-release coupling and 3/8 inch hose connection
- With manipulating fork
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K

Additional Equipment
- Starting with model N 31/H, with a charging trolley (page 30)
- Digital temperature display (page 16)
- Protective gas systems (page 15)

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm			Preflush/cooling rate l/min	Process flush rate l/min
		w	d	h	W	D	H		
631000569	N 7	174	179	74	210	230	94	15 - 20	5 - 8
631000570	N 7/H	194	179	74	230	230	94	15 - 20	5 - 8
631000571	N 11, N 11/R	174	265	94	210	316	114	15 - 20	5 - 8
631000572	N 11/H, N 11/HR	194	265	94	230	316	114	15 - 20	5 - 8
631000573	N 17, N 17/R	174	405	94	210	456	114	15 - 20	5 - 8
631000574	N 17/H, N 17/HR	194	405	94	230	456	114	15 - 20	5 - 8
631000575	N 31/H	149	265	114	185	316	134	20 - 25	10 - 15

Larger boxes and custom dimensions available upon request

Gas Feed Boxes with Hinged Lid for Models N 7 - N 81 which remain in the Furnace



Protective gas box with hinged lid for permanent operation

Working with Protective Gas Boxes with Hinged Lid in continuous Operation

We recommend the usage of protective gas boxes with hinged lids which remain in the furnace while repeatedly heat treating workpieces using protective gas. Boxes with an angled hinged lid on the front are flushed with protective gas via a protective gas line on the rear wall. For the protective gas supply the pipe goes through a bore on the rear wall of the furnace. The gas protection atmosphere which is polluted due to repeatedly opening or charging the boxes does not interfere most heat treatment processes.

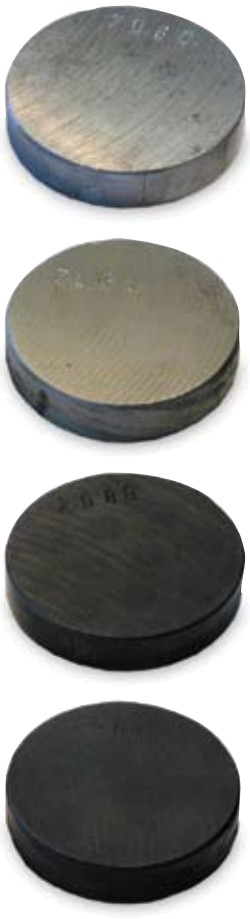
For charging, the box is opened in the furnace using a draw hook (page 22) and the workpieces are placed into the box. The box is continuously flushed with protective gas such as argon, nitrogen or forming gas 95/5. The box is closed by the hinged lid's own weight. Due to a slight overpressure within the box the protective gas is vented off through the hinged lid.

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

- Tmax 1100 °C
- Gas feed box with hinged lid and hinges and protective gas inlet through the rear wall of box and furnace
- Lid remains closed through its own weight
- Gas connection with quick-release coupling and 3/8“ hose connection
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Larger boxes and custom dimensions available upon request
- Charge thermocouple type K

Additional Equipment

- Digital temperature display (page 16)
- Gas feed systems (page 15)



Probes heat treated in different processes

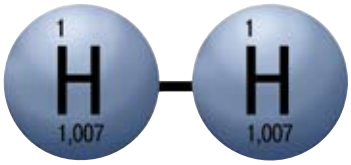
Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm			Preflush/cooling rate l/min	Process flush rate l/min
		w	d	h	W	D	H		
631000581	N 7/H	174	179	74	210	230	94	15 - 20	5 - 8
631000582	N 7/H	194	179	74	230	230	94	15 - 20	5 - 8
631000583	N 11, N 11/R	174	265	94	210	316	114	15 - 20	5 - 8
631000584	N 11/H, N 11/HR	194	265	94	230	316	114	15 - 20	5 - 8
631000585	N 17, N 17/R	174	405	94	210	456	114	15 - 20	5 - 8
631000586	N 17/H, N 17/HR	194	405	94	230	456	114	15 - 20	5 - 8
631000587	N 31/H	149	265	114	185	316	134	20 - 25	10 - 15
631000588	N 31/H	209	265	134	245	316	154	20 - 25	10 - 15
631000589	N 41, N 41/H	209	265	184	245	316	204	20 - 25	10 - 15
631000590	N 41, N 41/H	264	405	184	300	456	204	20 - 25	10 - 15
631000591	N 61, N 61/H	264	655	184	300	706	204	20 - 25	10 - 15
631000592	N 81	389	655	184	425	706	204	20 - 25	10 - 15

Larger boxes and custom dimensions available upon request

Gas Feed Systems

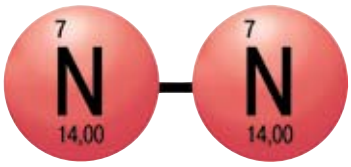
Protective Gases

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



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

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



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

Nitrogen and argon are gases which are heavier than air. This makes it relatively easy to fill the protective gas containers. Forming gas with added hydrogen is lighter, but it has the advantage of burning at higher temperatures and therefore binds with the oxygen. Even in a cold state, the leaking hydrogen transports the oxygen very easily out of the container.

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

Manual Gas Feed Fitting for Bottles

- Pressure reducing valve with assembled flow meter and attached pressure gauge indicating the bottle pressure
  The assembled variable area flow meter ensures good readability of the amount used
- Connection: screw connection for bottle
- Exit: 3/8 inch hose connection
- 200 bar intake pressure, 4 bar outlet pressure
- Incl. 4 m 3/8 inch connecting hose

Pressure reducing valve with assembled flow meter

For N 7 - N 17/HR

Article no.	Type of gas	Flow rate l/min
631000306	Ar	0 - 16
631000307	N_2	0 - 16
631000308	Forming gas 95/5	0 - 16

*Article no. for Spain, France and Portugal on request

For N 21 - N 641/13, N 30/45HA + N 500/85HA

Article no.	Type of gas	Flow rate l/min
631000309	Ar	0 - 32
631000310	N_2	0 - 32
631000311	Forming gas 95/5	0 - 32

Gas Feed Systems

Gas Feed Fitting with Solenoid Valve

- Designed like the manual gas feed fitting described above, however with an additional solenoid valve mounted on the furnace, controlled using the controller "Extra" function.
- Connection: screw connection for bottle
- Exit: 3/8 inch hose connection
- 200 bar intake pressure, 4 bar outlet pressure
- Incl. 4 m 3/8 inch connecting hose
- Available only in combination with furnace or switchgear

For N 7 - N 17/HR

Article no.	Type of gas	Flow rate l/min
631000376	Ar	0 - 16
631000377	N_2	0 - 16
631000378	Forming gas 95/5	0 - 16

*Article no. for Spain, France and Portugal on request

For N 21 - N 641/13, N 30/45HA + N 500/85HA

Article no.	Type of gas	Flow rate l/min
631000379	Ar	0 - 32
631000380	N_2	0 - 32
631000381	Forming gas 95/5	0 - 32

Automatic gas feed system for two flushing quantities

Automatic Gas Feed System for two different Flushing Quantities, e.g. high Volume Preflushing and low Volume for ongoing Operation

Consisting of:

- Switching system with 3-step switch for gas inlet Off/Manual/Automatic via "Extra" function of respective controller, timer for switching from large gas quantity to small gas quantity. Gas feed stops at when program quits
- Automatic gas feed panel with pressure reducer, two adjustable flow meters and two solenoid valves, preinstalled conduit and wiring attached to furnace from the side on an assembly plate.
  - Connection: 3/8 inch hose connection
  - Exit: 3/8 inch hose connection
  - Max. 10 bar intake pressure, max. 300 mbar rear pressure
  - Incl. 5 m connection hose 3/8 inch
  - Available only in combination with furnace or switchgear

Article no.	Type of gas	Flow rate l/min
631000316	Ar	4 - 80
631000200	N_2	4 - 80
631000315	Forming gas 95/5	4 - 80

Temperature Measurement in Protective Gas Systems

Thermostat (manual device)

The use of a thermometer with thermocouple is recommended for determining the exact heat treatment temperature in gas feed boxes or gas feed annealing bags with holder. The thermocouple is permanently mounted on the respective gas feed box or gas feed annealing bag holder. A simple manual temperature probe with LCD display or a temperature indicator with LED display and interface to documentation via the Nabertherm software can be supplied, mounted in a separate metal casing. Both are equipped with a two-pole plug unit for connecting to the thermocouple. The temperature can be determined in this way and, if necessary, readjusted on the controller.

Upon request, the furnace can be operated by charge control with a thermocouple attached to the workpiece.

Article no.	Description
402000057	Temperature indicator with digital display, 230 V 1/N connection, in metal casing
542100028	Temperature indicator with digital display, battery-operated, manual device
V000800	Connecting cable between heat treatment with charge thermocouple and Article no. 402000057, 3 m
V000801	Connecting cable between heat treatment with charge thermocouple and Article no. 542100028, 3 m

Tool Shop Hardening Systems

MHS 17 with forced cooling system

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

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

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

Side platform

Article no.		Model	Tmax	Inner dimensions in mm			Volume	Exterior dimensions in mm			Supply	Electrical	Weight
			°C	w	d	h	in l	W	D	H	power/kW	connection*	in kg
Controller B 150	Controller C 290	for MHS 17											
001311110	001311190	N 7/H	1280	250	250	120	7	720	640	510	3,0	1-phase	
001311210	001311290	N 11/H	1280	250	350	140	11	720	740	510	3,6	1-phase	70
001311310	001311380	N 11/HR	1280	250	350	140	11	720	740	510	5,5	3-phase[1]	70
001311510	001311580	N 17/HR	1280	250	500	140	17	720	890	510	6,4	3-phase[1]	90
Controller B 180	Controller P 330												
001334160	001334150	N 15/65HA	650	295	340	170	15	470	845	460	2,7	1-phase	55

[1]Heating only beetween two phases

*Please see page 32 for more information about mains voltage

Article no.	Article	Exterior dimensions in mm			Volume	Charging floor grid dimensions		Supply	Supply
		W	D	H	in l	Width in mm	length in mm	power/kW	voltage
631000428	Work platform	1000	610	760	-	-	-	-	-
631000430	Oil bath	270	500	500	50	400	200	-	-
631000431	Water bath	270	500	500	50	400	200	-	-
491005900	Heating element	-	-	-	-	-	-	3,0	230 V
631000429	Forced cooling system (cooling platform)	556	610	760	-	400	200	0,2	230 V
631000442	Side platform	556	610	760	-	-	-	-	-

Tool Shop Hardening Systems

KHS 17

MHS 61

The work platform of the system is designed for supporting an N 7/H - N 61/H series hardening furnace and N 15/65 HA - N 60/65HA tempering furnaces. Suitable gas feed boxes can be integrated.

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

Article no.		Model	Tmax	Inner dimensions in mm			Volume	Exterior dimensions in mm			Supply	Electrical	Weight
			°C	w	d	h	in l	W	D	H	power/kW	connection*	in kg
Controller B 150	Controller C 290	for KHS 17											
001311110	001311190	N 7/H	1280	250	250	120	7	720	640	510	3,0	1-phase	60
001311210	001311290	N 11/H	1280	250	350	140	11	720	740	510	3,6	1-phase	70
001311310	001311380	N 11/HR	1280	250	350	140	11	720	740	510	5,5	3-phase[1]	70
001311510	001311580	N 17/HR	1280	250	500	140	17	720	890	510	6,4	3-phase[1]	90
Controller B 180	Controller P 330												
001334160	001334150	N 15/65HA	650	295	340	170	15	470	845	460	2,7	1-phase	55
Controller B 150	Controller C 290	for MHS 61											
001321110	001321173	N 31/H	1280	350	350	250	30	840	1010	1320	13,0	3-phase	210
001321210	001321290	N 41/H	1280	350	500	250	40	840	1160	1320	15,0	3-phase	260
001321310	001321395	N 61/H	1280	350	750	250	60	840	1410	1320	20,0	3-phase	400
001334200	001334250	N 30/65HA	650	290	420	260	30	607 + 255	1175	1315	6,0	3-phase[1]	195
001334300	001334350	N 60/65HA	650	350	500	350	60	667 + 255	1250	1400	9,6	3-phase	240

Heating only beetween two phases

*Please see page 32 for more information about mains voltage

Article no.	Article	Exterior dimensions in mm			Volume	Charging floor grid dimensions		Supply	Supply
		W	D	H	in l	Width in mm	length in mm	power/kW	voltage
KHS 17									
401000104	Work table with quenching and cleaning bath	735	850	1155	-	-	-	-	-
401000102	Charging basket	-	-	-	-	-	-	-	-
MHS 61									
631000696	Work platform	1050	730	1250		-	-	-	-
631000430	Oil bath	270	500	500	50	400	200	-	-
631000431	Water bath	270	500	500	50	400	200	-	-
491005900	Heating element	-	-	-	-	-	-	3,0	230 V

SHS 41 Protective Gas Hardening System

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

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

This low cost system can be used for hardening processes which otherwise could only be handled in complex furnace systems. Our professional R&D department will be pleased to carry out suitable testing of your product samples to determine the heat treatment equipment you require.

- Multitherm N 41/H chamber furnace
- Pneumatic pedal switch operated door opening
- Charging plate
- Oil quench bath on rollers
- Pneumatic lowering unit
- Heating of oil quench bath
- Oil temperature display
- Charging floor grid and gas bell
- Holding unit for gas bell
- Manual protective gas unit (page 15)
- Draw hook (page 22)
- Safety equipment consisting of rim exhaust with flame trap

Additional Equipment

- Suction hood
- Water bath

Protective gas hardening system with furnace N 41/H

Article no.	Furnace Model	Tmax °C	Inner dimensions in mm w	d	h	Volume in l	Exterior dimensions in mm W	D	H	Supply power/kW	Electrical connection*	Weight in kg
001321282	N 41/H[1]	1280	350	500	250	40	840	1160	1320	15,0	3-phase	260

[1]Furnace description, see page 5

*Please see page 32 for more information about mains voltage

Article no.	Protective gas hardening system	bell size in mm W	D	H	Oil quench bath size in liters	max. load Weight	max. quench yield/h	Preflush rate	Process flush rate	Supply power/kW	Electrical connection*
631006096	SHS 41	260	380	180	300	25 kg	20 kg	20 - 25	10 - 15	15.0	3-phase

*Please see page 32 for more information about mains voltage

Cooling Platforms

Storage platforms for cooling and charging trolleys facilitate rapid forced cooling of mechanical components, hardening or annealing boxes. The platform can also be used for charging the box in front of the furnace.

Fan with 25m³/min cooling air

Article no.	Furnace	Exterior dimensions in mm			Connected load	Supply	Comments
		W	D	H	kW	voltage*	
631000429	Up to N 17/HR	550	610	760	0.2	230 V	The same as forced cooling system MHS 17, see page 17
631000529	Up to N 61/H	335	1100	880 - 920	0.2	230 V	The same as CWK1 charging trolley , see page 30
631000294	Up to N 161	700	800	900	0.9	230 V	

*Article no. for other possible supply voltages on request

Quenching and Cleaning Baths

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

Article no.	Bath	Exterior dimensions in mm			Volume	Quenchant performance	max. load
		W	D	H	in l	in kg/h	weight in kg
101300030	Q 50	350	350	700	50	5 - 10	
101300040	Q 200	550	550	900	200	25 - 30	30

Article no.	Heating element (optional)	Supply power/kW	Supply voltage*
491007005	Q 50	3	230 V
491007058	Q 200	6	400 V

*Article no. for other possible supply voltages on request

Q 200 D

The oil and water quench baths are combined within a single casing and separated by a tall sheet metal wall in the Q 200 D, Q 400 D and Q 600 D combination baths so that the oil quench bath is slightly preheated by the water bath. A splash pan is installed in front of the combination bath. Charging aids are available as additional equipment. The Q 200 D combination bath comes with a charge carrier, for models Q 400 D and Q 600 D must be ordered extra. For greater quenchant performance, the baths can be equipped with oil coolers.

Article no.	Bath	Exterior dimensions in mm			Volume in l	max. load
		W	D	H	Oil/water	weight in kg
101300100	Q 200 D	1120	700	1000	200/125	20
101300200	Q 400 D	1500	750	900	400/300	40
101300300	Q 600 D	1800	900	900	600/450	60

Heating element	Supply power/kW	Supply voltage*
Q 200 D	6	400 V
Q 400 D	9	400 V
Q 600 D	15	400 V

*Other supply voltages possible on request

Charging aid manual + electric	Total height in mm	Max. load weight in kg	Compressed air in bar	Supply power/kW	Electrical connection[1]
Q 200 D	1800	50	6 - 9	-	-
Q 400 D	2480	80	-	0.3	1-phase
Q 600 D	2480	100	-	0.3	1-phase

Oil cooler	max. quenchant performance in kg/h	Supply power/kW	Electrical connection[1]
Q 200 D	approx. 100	0,55	3-phase
Q 400 D	approx. 200	2,20	3-phase
Q 600 D	approx. 300	2,20	3-phase

[1]Please see page 32 for more information about mains voltage

Hardening Oil

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

Article no.	Description	Container
491000140	Durixol W 25	50 l barrel
491000161	Durixol W 25	200 l barrel
491000240	Durixol W 25 w	50 l barrel

Hardening oil

Quench Water Additive

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

Article no.	Description	Container
491050200	Hydrodur GF	50 kg sack

Detergent

- For long retention in wash water for cost savings
- Prevents oil traces on workpieces and fumes during tempering

Article no.	Description	Container
493000016	Feroclean N-SF	10 kg canister
493000014	Feroclean N-SF	30 kg canister
493000017	Feroclean N-SF	50 kg barrel
493000018	Feroclean N-SF	200 kg barrel

Detergent in canister

Insulating Materials

- Formable ceramic-based mass for sealing hardening boxes
- Also suitable for covering workpiece parts not requiring hardening

Article no.	Description	Container
491000120	Lenit heat-resistant putty	19 kg
491000136	Lenit heat-resistant putty	37 kg

Draw Hook

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

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

Binding Wire

- For binding workpieces to allow easy removal from boxes
- Annealed twice and safe from breakage during charging

Article no.	Wire Ø in mm	Container
491036090	1.00	25 kg ring
491036125	1.25	25 kg ring
491036150	1.50	50 kg ring
491036200	2.00	50 kg ring
491036300	3.00	50 kg ring

Hardening Tongs

Article no.
491003001

491003002

491003005

491003006

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

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

Gloves

Article no.: 491041101 491041104 491041103 493000004

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

Article no.	Description	Short-time contact temperature in °C
491041101	Fiberglass glove, 400 mm long	approx. 900
491041102	Kevlar mitt, 280 mm long	approx. 400
491041103	Kevlar finger glove, 300 mm long	approx. 400
491041104	Kevlar mitt, 350 mm long	approx. 450
493000004	NOMEX finger glove, knit	approx. 600

Heat-Resistant Face Mask

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

Article no.	Description
491037105	Heat-resistant face mask

Chamber Furnaces with Air Circulation

N 120/65 HA

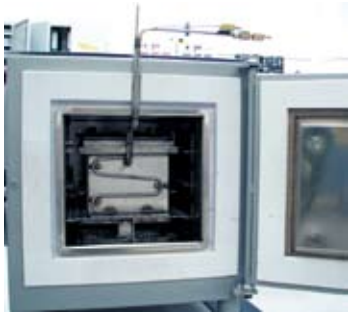
N 500/65 HA

N 30/45 - N 500/85HA

Due to its high temperature uniformity, these chamber furnaces with air circulation are suitable for processes such as tempering, quenching and tempering, precipitation hardening/curing, solution annealing, artificial aging, preheating or soft annealing and brazing. The furnaces can be equipped with suitable protective gas boxes for soft annealing of copper or tempering titanium as well as tempering of steel in a protective gas atmosphere. The modular design of the furnaces allows accessory equipment to be added based on process requirements.

N 15/65 HA

- Tmax. 450 °C, 650 °C or 850 °C
- Floor, wall and ceiling heating
- Stainless steel air baffle box in furnace for optimal air circulation
- Right-mounted swinging door
- Base included in delivery, for table-top model N 15/65 HA optional base available
- Horizontal air circulation
- Optimal temperature uniformity in accordance with DIN 17052-1 up to ΔT 6 K in usable space
- Optimal distribution of air due to high circulation rates
- One shelf and rails for two additional shelves included



Air circulation furnace with protective gas box

Article no.		Model	Tmax	Inner dimensions in mm			Volume	Exterior dimensions in mm			Supply	Electrical	Weight
Controller B 150	Controller C 290		°C	w	d	h	in l	W	D	H	power/kW	connection*	in kg
001333200	001333250	N 30/45HA	450	290	420	260	30	607 + 255	1175	1315	3.6	1-phase	195
001333300	001333350	N 60/45HA	450	350	500	350	60	667 + 255	1250	1400	6.6	3-phase	240
001333400	001333450	N 120/45HA	450	450	600	450	120	767 + 255	1350	1500	9.6	3-phase	310
001333500	001333550	N 250/45HA	450	600	750	600	250	1002 + 255	1636	1860	19.0	3-phase	6110
001333600	001333650	N 500/45HA	450	750	1000	750	500	1152 + 255	1886	2010	28.0	3-phase	1030
001334160 (B 180)	001334150 (P 330)	N 15/65HA[1]	650	295	340	170	15	470	845	460	2.7	1-phase	55
001334200	001334250	N 30/65HA	650	290	420	260	30	607 + 255	1175	1315	6.0	3-phase[2]	195
001334300	001334350	N 60/65HA	650	350	500	350	60	667 + 255	1250	1400	9.6	3-phase	240
001334400	001334450	N 120/65HA	650	450	600	450	120	767 + 255	1350	1500	13.6	3-phase	310
001334500	001334550	N 250/65HA	650	600	750	600	250	1002 + 255	1636	1860	21.0	3-phase	610
001334600	001334650	N 500/65HA	650	750	1000	750	500	1152 + 255	1886	2010	31.0	3-phase	1030
001336100	001336150	N 30/85HA	850	290	420	260	30	607 + 255	1175	1315	6.0	3-phase[2]	195
001336200	001336250	N 60/85HA	850	350	500	350	60	667+255	1250	1400	9.6	3-phase	240
001336300	001336350	N 120/85HA	850	450	600	450	120	767+255	1350	1500	13.6	3-phase	310
001336400	001336450	N 250/85HA	850	600	750	600	250	1002+255	1636	1860	21.0	3-phase	610
001336500	001336550	N 500/85HA	850	750	1000	750	500	1152+255	1886	2010	31.0	3-phase	1030

[1]Table-top model
[2]Heating only beetween two phases

*Please see page 32 for more information about mains voltage

Protective Gas Boxes for Models N 30/45HA - N 500/85HA

Protective gas box (open)

Protective gas box with lid

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

- For the non-combustible protective gases argon, nitrogen and forming gas 95/5 with less than 5 % H_2 (observe national regulations)
- Protective gas supply with quick lock and hose connector (outer diameter 8 mm)
- Protective gas box with lid, protective gas supply and return line through the furnace collar
- Protective gas outlet on the top right side
- Sealing of lid with ceramic fiber
- Gas connection including quick-release coupling with 3/8 inch hose sleeve
- Made of heat-resistant alloys: 450 °C - 304 (AISI)/(DIN material no. 1.4301), 650 °C - 321 (AISI)/(DIN material no. 1.4541) or 850 °C - 309 (AISI)/(DIN material no. 1.4828)
- Lid sealed with ceramic fiber, ceramic insulating materials can alternatively be used
- The annealing boxes are equipped with 70 mm high stacker shoes for WS charging trolley (page 30)
- Protective gas boxes in a special dimension are required for air circulation furnaces with lift door
- Pull lug of model N 30/45 HA - N 120/85 HA
- Charge thermocouple type K

Additional Equipment

- Digital temperature display (page 16), Protective gas systems (page 15), Charging trolley (page 30)

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm		
		w	d	h	W	D	H
631000400	N 30/45HA	220	320	160	282	376	242
631000401	N 60/45HA	270	420	260	332	476	342
631000402	N 120/45HA	370	520	350	436	560	430
631000403	N 250/45HA	480	630	460	546	680	600
631000404	N 500/45HA	630	780	610	696	836	760
631000405	N 30/65HA	220	320	160	282	376	242
631000406	N 60/65HA	270	420	260	332	476	342
631000407	N 120/65HA	370	520	350	436	560	430
631000408	N 250/65HA	480	630	460	546	680	600
631000409	N 500/65HA	630	780	610	696	836	760
631000410	N 30/85HA	220	320	160	282	376	242
631000411	N 60/85HA	270	420	260	332	476	342
631000412	N 120/85HA	370	520	350	436	560	430
631000413	N 250/85HA	480	630	460	546	680	600
631000414	N 500/85HA	630	780	610	696	836	760

Article no. 601603960, 1 set of fiber insulation cord, 5 strips of 610 mm each

Protective Gas Boxes with Vacuum Lid for Models N 30/45HA - N 500/85HA

Protective gas box with vacuum lid

The same as the boxes described above, however with vacuum lid and vacuum connection. Before the box is placed in the furnace, in a cold state a vacuum and protective gas atmosphere are alternately generated to force out the oxygen and achieve a pure atmosphere.

- Protective gas box with process lid, vacuum lid, protective gas inlet and outlet through the furnace collar and seal profile for process lid with support for vacuum lid
- Protective gas supply with quick lock and hose connector (outer diameter 8 mm)
- Lid sealed with ceramic fiber, ceramic insulating materials can alternatively be used
- Vacuum lid with rubber sealing gasket
- Gas connection with quick-release coupling with 3/8 inch hose sleeve
- Charge thermocouple type K
- Pull lug of model N 30/45 HA - N 120/85 HA
- Made of heat-resistant alloys: 450 °C - 304 (AISI)/(DIN material no. 1.4301), 650 °C - 321 (AISI)/(DIN material no. 1.4541) or 850 °C - 309 (AISI)/(DIN material no. 1.4828)

Additional Equipment

- Digital temperature display (page 16), Protective gas systems (page 15), Vacuum pump (page 13), Charging trolley (page 30)

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm		
		w	d	h	W	D	H
631000549	N 30/45HA	170	300	130	258	388	222
631000550	N 60/45HA	230	380	220	318	468	312
631000551	N 120/45HA	330	480	320	418	568	412
631000552	N 250/45HA	410	560	380	698	648	542
631000553	N 500/45HA	560	810	530	648	898	692
631000554	N 30/65HA	170	300	130	258	388	222
631000555	N 60/65HA	230	380	220	318	468	312
631000556	N 120/65HA	330	480	320	418	568	412
631000557	N 250/65HA	410	560	380	498	648	542
631000558	N 500/65HA	560	810	530	648	898	692
631000559	N 30/85HA	170	300	130	258	388	222
631000560	N 60/85HA	230	380	220	318	468	312
631000561	N 120/85HA	330	480	320	418	568	412
631000562	N 250/85HA	410	560	380	498	648	542
631000563	N 500/85HA	560	810	530	648	898	692

Article no. 601603960, 1 set of fiber insulation cord, 5 strips of 610 mm each
Larger boxes and custom dimensions available upon request

Pit-Type Furnaces with Air Circulation and Accessory Equipment for Tempering and Quenching

S 250/65 with swivel arm as charging aid

S 120/65 with charging aid and cooling platform as additional equipment

S 30/45 A - S 500/85A

Pit-type furnaces with air circulation offer the benefit of easy charging of heavy parts or baskets and are used in the same applications as the chamber furnaces described above: steel tempering after hardening, but also for precipitation hardening/curing, quenching and tempering, solution annealing, artificial aging, preheating and soft annealing, etc. Protective gas boxes with or without a vacuum lid as well as charging baskets and charging aids are available for a wide range of applications.

- Tmax. 450 °C, 650 °C or 850 °C
- Stainless steel interior
- Hot air blower integrated in floor, high air speed
- Vertical air guidance
- Optimal temperature uniformity in accordance with DIN 17052-1 up to ΔT 6 K in usable space

Pit-type furnace S 250/65 with protective gas box for bright annealing

Additional Equipment

- Charging aid mounted on side of furnace (page 26)
- Cooling platform

Article no.		Model	Tmax	Inner dimensions in mm			Volume	Exterior dimensions in mm			Supply	Electrical	Weight
Controller B 150	Controller C 290		°C	w	d	h	in l	W	D	H	power/kW	connection*	in kg
001353100	001353150	S 30/45A	450	300	250	400	30	520	460	920	3,6	1-phase	130
001353200	001353250	S 60/45A	450	350	350	500	60	570	560	1020	6,6	3-phase	225
001353300	001353350	S 120/45A	450	450	450	600	120	670	660	1120	9,6	3-phase	280
001353400	001353450	S 250/45A	450	600	600	750	250	820	810	1350	19,0	3-phase	750
001353500	001353550	S 500/45A	450	750	750	900	500	970	960	1500	28,0	3-phase	980
001354100	001354150	S 30/65A	650	300	250	400	30	530	520	1020	6,0	3-phase[1]	130
001354200	001354250	S 60/65A	650	350	350	500	60	580	620	1120	9,6	3-phase	225
001354300	001354350	S 120/65A	650	450	450	600	120	680	720	1220	13,6	3-phase	280
001354400	001354450	S 250/65A	650	600	600	750	250	830	870	1450	21,0	3-phase	750
001354500	001354550	S 500/65A	650	750	750	900	500	980	1020	1600	31,0	3-phase	980
001355100	001355150	S 30/85A	850	300	250	400	30	600	740	1000	6,0	3-phase[1]	130
001355200	001355250	S 60/85A	850	350	350	500	60	710	840	1100	9,6	3-phase	225
001355300	001355350	S 120/85A	850	450	450	600	120	810	940	1200	13,6	3-phase	280
001355400	001355450	S 250/85A	850	600	600	750	250	960	1090	1350	21,0	3-phase	750
001355500	001355550	S 500/85A	850	750	750	900	500	1100	1240	1500	31,0	3-phase	980

[1]Heating only beetween two phases

*Please see page 32 for more information about mains voltage

Charging Aid for Models S 30/45 A - S 250/85 A

Swivel arm mounted on furnace

A charging aid, fastened to the furnace consisting of a swivel arm and winch is recommended for charging series S 30/45A - S 250/85A pit-type furnaces with protective gas boxes or baskets. This allows easy and safe furnace charging.

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

Article no.	Furnace	Total height in mm
631000314	S 30/.. - S 120/..	2400
631000271	S 250/..	2600

Protective Gas Boxes for Models S 30/45A - S 500/85A

Protective gas box with sealing lock

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

- For the non-combustible protective gases argon, nitrogen and forming gas 95/5 with less than 5 % H_2 (observe national regulations)
- Protective gas box with lid, protective gas supply and return line through the furnace collar
- Lid sealed with ceramic fiber, ceramic insulating materials can alternatively be used
- Gas connection with quick-release coupling with 3/8 inch hose sleeve
- Made of heat-resistant alloys: 450 °C - 304 (AISI)/(DIN material no. 1.4301), 650 °C - 321 (AISI)/(DIN material no. 1.4541) or 850 °C - 309 (AISI)/(DIN material no. 1.4828)
- Charging aid lifting eyes

Additional Equipment

- Digital temperature display (page 16)
- Protective gas systems (page 15)
- Charge thermocouple type K

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm			Article no. with charge thermocouple
		w	d	h	W	D	H	
631006050	S 30/45A	215	165	277	281	231	354	631000500
631006051	S 60/45A	265	265	377	331	331	454	631000501
631006052	S 120/45A	365	365	477	431	431	554	631000502
631006053	S 250/45A	515	515	627	581	581	654	631000503
631006054	S 500/45A	665	665	777	731	731	804	631000504
631000360	S 30/65A	215	165	277	281	231	354	631000505
631000361	S 60/65A	265	265	377	331	331	454	631000506
631000362	S 120/65A	365	365	477	431	431	554	631000507
631000363	S 250/65A	515	515	577	581	581	654	631000508
631000364	S 500/65A	665	665	727	731	731	804	631000509
631000259	S 30/85A	215	165	277	281	231	354	631000510
631000260	S 60/85A	265	265	377	331	331	454	631000511
631000261	S 120/85A	365	365	477	431	431	554	631000512
631000262	S 250/85A	515	515	577	581	581	654	631000513
631000263	S 500/85A	665	665	727	731	731	804	631000514

Article no. 601603960, 1 sales unit of fiber insulation cord, 5 strips of 610 mm each

Charging Baskets

The workpieces are placed in basket for tempering. We recommend the use of a charging aid (page 26) for charging.

- Heat-resistant charging basket for small parts and bulk materials
- Filling from above
- Incl. handle or crane lifting eyes
- Hole size 10 mm
- Made of heat-resistant alloys: 450 °C - 304 (AISI)/(DIN material no. 1.4301), 650 °C - 321 (AISI)/(DIN material no. 1.4541) or 850 °C - 309 (AISI)/(DIN material no. 1.4828)

Charging basket for top charging

Article no.	Furnace	Inner dimensions in mm		
		w	d	h
631000477	S 30/45A	210	180	350
631000478	S 60/45A	260	280	450
631000479	S 120/45A	360	380	550
631000480	S 250/45A	510	530	650
631000481	S 500/45A	570	570	750
631000266	S 30/65A	210	180	350
631000267	S 60/65A	260	280	450
631000268	S 120/65A	360	380	550
631000269	S 250/65A	510	530	650
631000270	S 500/65A	570	570	750
631000482	S 30/85A	210	180	350
631000483	S 60/85A	260	280	450
631000484	S 120/85A	360	380	550
631000485	S 250/85A	510	530	650
631000486	S 500/85A	570	570	750

The workpieces are placed on different levels for tempering. We recommend the use of a charging aid (page 26) for charging.

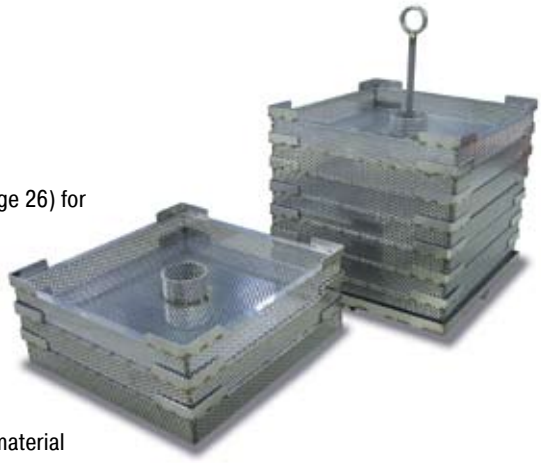
- Heat-resistant charging basket
- Charged from side via 2 drawers (3 levels)
- Incl. handle / crane lifting eyes
- Hole size 10 mm
- Made of heat-resistant alloys: 450 °C - 304 (AISI)/(DIN material no. 1.4301), 650 °C - 321 (AISI)/(DIN material no. 1.4541) or 850 °C - 309 (AISI)/(DIN material no. 1.4828)

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

Article no.	Furnace	Inner dimensions in mm		
		w	d	h
631006035	S 30/45A	230	180	400
631006036	S 60/45A	280	280	450
631006037	S 120/45A	344	344	500
631006038	S 250/45A	490	490	720
631006039	S 500/45A	660	660	770
631006040	S 30/65A	230	180	400
631006041	S 60/65A	280	280	450
631006042	S 120/65A	344	344	500
631006043	S 250/65A	490	490	720
631006044	S 500/65A	660	660	770
631006045	S 30/85A	230	180	400
631006046	S 60/85A	280	280	450
631006047	S 120/85A	344	344	500
631006048	S 250/85A	490	490	720
631006049	S 500/85A	660	660	770

The workpieces are placed on different levels for tempering. We recommend the use of a charging aid (page 26) for charging.

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



Basket for charging in different floors

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

Martempering Furnaces using Neutral Salts

WB 30 with charging aid

WB 10 - WB 400

WB 10 - 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.

Salt-bath hardening in practice

- Tmax 500 °C
- Optimal temperature uniformity
- Martemper bath temperature control
- Over-temperature limiter controller with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter for furnace and product
- Heating with immersion heating elements
- Charging basket

Additional Equipment

- Charging aid mounted on side of furnace

Article no.	Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions in mm			Supply	Electrical	Weight
		°C	w	d	h	in l	W	D	H	power/kW	connection*	in kg
001305100	WB 10	500	220	200	300	10	550	450	570	1.0	1-phase	60
001305200	WB 20	500	300	210	460	20	610	580	920	2.6	1-phase	110
001305300	WB 30	500	300	210	580	30	610	580	920	3.2	1-phase	140
001305700	WB 70	500	400	300	680	70	750	680	980	7.5	3-phase	240
001305800	WB 200	500	540	520	880	200	900	900	1200	18.0	3-phase	660
001305900	WB 400	500	730	720	980	400	1100	1100	1300	24.0	3-phase	1150

*Please see page 32 for more information about mains voltage

Double martempering bath

Information about salts by Petrofer and Durferrit 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	

Salt-Bath Furnaces, electrically (TS) or gas heated (TSB) for Heat Treatment of Steel or Light Metals

TS 40/30
with exhaust gas collection at crucible rim

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 - TS or 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 addional feature they can be equipped with extended safety technology for heat treatment of light metals.

Standard Model

- Maximum temperatures of 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 according to DIN 17052-1 up to ΔT 4 K in the bath
- Over-temperature limiter controller in the furnace chamber to prevent dangerous conditions for the furnace or personnel
- Cascade control of salt bath and furnace chamber

TSB 30/30
with exhaust gas collection at crucible rim

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

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 limiter controller and PLC-bath control with thermocouples in the salt bath and in the furnace chamber

Model	Tmax	Inner dimensions crucible		Volume	Outer dimensions in mm			Supply	Electrical	Weight
	°C[2]	Ø in mm	h in mm	in l	W	D	H	power/kW[1]	connections*	in kg[1]
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

[1]Only for electric version
[2]Salt bath temperature

*Please see page 32 for more information about supply voltage

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

Charging Devices with and without Cooling Fan for Models N 31/H - N 641/13, N 30/45 HA - N 500/85 HA

CWK1 charging trolley

CW 1 and CWK 1 Charging Trolley

For charging larger workpieces and hardening boxes.

- 4 casters, freely movable
- Equipped with a rack at working height for temporary storage
- CWK version with cooling fan (0.2 kW, 230 V)

Article no.	Furnace	Designation	Exterior dimensions in mm		
			W	D	H
631000528	N 31/H, N 41.., N 61.. N 30/..HA, N 60/..HA	CW 1	330	1100	880 - 920
631000529	N 31/H, N 41.., N 61.. N 30/..HA, N 60/..HA	CWK 1	330	1100	880 - 920

Charging trolley CW 2

Charging Trolleys CW 2 - CW 4 and CWK 2 - CWK 4

- 2 casters, 2 fixed rollers for heavy loads
- Equipped with a grid at working height for temporary storage
- Furnace locking via pedal lever
- CWK version with cooling fan

Article no.	Furnace	Designation	Useful dimensions in mm		Connected load	Electrical
			W	D	kW	connection*
631000530	N 81, N 161, N 120/..HA	CW 2	550	750	-	-
631000531	N 321	CW 3	750	1100	-	-
631000468	N 641	CW 4	1000	1300	-	-
631000469	N 81, N 161, N 120/..HA	CWK 2			0.9	1-phase
631000470	N 321	CWK 3	750	1100	0.9	1-phase
631000471	N 641	CWK 4	1000	1300	0.9	1-phase

*Please see page 32 for more information about mains voltage

WS charging stacker

WS Charging Stacker

- Charging by means of a hand winch stacker
- Compact construction with push bar and manual lifting device for easy and safe lifting
- WS 81 with parallel guided lift
- 2 casters, 2 fixed rollers for heavy loads
- Adjustable loading forks
- Guide on furnace for precise positioning
- Max. charging weight 500 kg

Article no.	Furnace	Max. charge weight	Designation
631000473	N 81	100	WS 81
631000425	N 161	500	WS 161
631000370	N 321	500	WS 321
631000426	N 641	700	WS 641
631000299	N 250/..HA	500	WS 25
631000532	N 500/..HA	500	WS 50

Hardness Testers

Model RAS(N) as Standard Model

- For Rockwell hardness test A - B - C of hardened and tempered steel, strip steel, soft and carbonized steel, non-ferrous metals, construction steel and cast iron
- Measuring height 230 mm, plug-in depth 133 mm
- Dimensions: 180 x 450 x 645 mm (WxDxH)
- Incl. platform (dimensions: 400 x 600 x 900 mm (WxDxH))
- Total weight approx. 100 kg
- Easy handling with automatic zero adjustment and automatic load change
- Water level for aligning
- Delivery includes base plates Ø 50 mm and Ø 40 mm as well as prism for round parts, diamond penetrator 120° and steel ball 1/16 inch and HRB and HRC control plates for calibrating at regular intervals

Hardness tester RAS(N)

Article no.	Description
491000600	RAS(N) tester incl. platform and accessories
491000650	Spare diamond
491000660	Spare 1/16“steel ball
491000670	Spare control plate for Rockwell B or C

Model PR1 (portable)

- For Rockwell hardness test A - B - C
- For evaluating and controlling welding seams, local stock material or axles, machine parts, shafts without prior disassembly
- For mobile use on offshore platforms, ships, etc.
- Measuring height 120 mm
- Weight 1700 g
- Delivered in wooden case

Hardness tester PR1 in wooden case

Article no.	Description
491000250	PR 1 tester incl. accessories and wooden case
491000160	Spare diamond

Experience in using different Materials

Our customers have heat treated highly different materials in our technical heat treatment center. The following section summarizes the experience we have gained.

Aluminum
In most cases aluminum is not heat treated using protective gas. A protective atmosphere is often required for brazing aluminum construction parts. Experiments in circulation air furnaces protective gas boxes lead to good results.

Cold- and hot-working Steels
These steels can be used directly in the furnace but also in a protective gas box or a protective gas annealing bag with holder in order to avoid decarbonizing and scaling. Best results are achieved using forming gas. The annealing bag is useful if the tools are not too big. The advantage of using the bag is the minimal mass. By using a fan the charge can be cooled down very quickly. This requires to increase the gas flow in order to draw the heat away from the tool. When used properly the tools remain bright.

Large parts can be treated in a protective gas boxes. The protective gas box is taken out of the furnace after an appropriate through-heating time. Afterwards, the box must be opened and the part quenched accordingly. Numerous steels can be quenched in still air.

Protective gas annealing bags or protective gas box can, of course, also be used if the tools are cooled down in an oil quench bath or in a martempering bath. The containers then are opened and the charge is immersed in the appropriate quenching medium using tongs or a crane.

Copper
Copper characteristically becomes compressed and therefore hardens after mechanical processing. To soften it for rework the copper must annealed again. This can be done in a normal furnace. Because copper reacts to atmospheric oxygen and oxides form on its surface, after annealing copper parts are quenched in a water bath, causing the oxides to chip off.
If the oxide formation is avoided then no quenching is required. The oxides can be prevented from forming by using protective gas. Use of a protective gas box is advisable in this case. In certain cases, the customer must determine if the use of forming gas is allowed, because hydrogen generally may impair the material properties of copper.

Titanium
This material is highly sensitive and very prone to the formation of oxides. Titanium is often used in safety-related parts. Requirements are especially demanding in aviation, space and medical technology. No forming gas may normally be used with this material because the hydrogen causes damage to the material. Here argon is used together with a protective gas box and vacuum lid. Otherwise, normal operation with various systems is possible, as described.

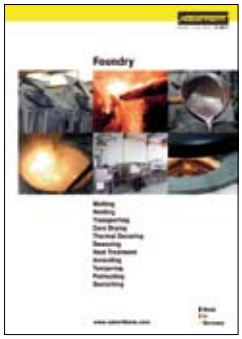
Supply Voltages for Nabertherm Furnaces

1-phase: all furnaces are available for supply voltages of 110 V - 240 V, 50 or 60 Hz.
3-phase: all furnaces are available for supply voltages of 200 V - 240 V or 380 V - 480 V, 50 or 60 Hz.

The Nabertherm Product Range – www.nabertherm.com

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.

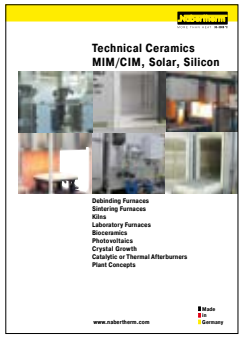


Laboratory/Dental

Laboratory furnaces are available for a variety of applications ranging between 30 - 3000 °C. Our standard product range includes muffle, tube, convection, melting, assay, and high temperature furnaces.

Technical Ceramics MIM/CIM, Solar, Silicon/BioCeramics

Wire-heated kilns for use up to 1400 C and MoSi² kilns for use up to 1800 C offer the best value and quality for sintering Technical Ceramics. All are available in sizes from bench-top to walk-in. To remove binders, we offer solutions from our Combi-Furnaces that debind and sinter in the same furnace to specialized systems for binder removal in a specialized atmosphere (e.g. BASF Catamold).

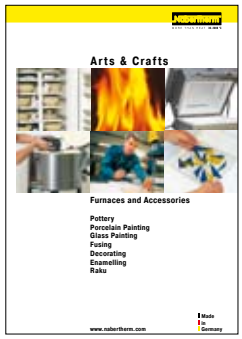


Glass

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

Arts & Crafts

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



Steel Selection

These specifications are recommendations and approximate values only. Nabertherm provides no guarantee and accepts no liability for this. Specific information must be determined by the customer.
Steel manufacturers provide specific heat treatment regulations for each steel type.

Case hardening steels

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Cr	Mo	Ni	Other	Warm forming temperature [°C]
1.0401	C 15	1015	0,12 - 0,18	≤ 0,40	0,30 - 0,60	≤ 0,045	≤ 0,045	-	-	-	-	1150 - 850
1.5919	15 CrNi 6	3115	0,14 - 0,19	≤ 0,40	0,40 - 0,60	≤ 0,035	≤ 0,035	1,40 - 1,70	-	1,70 - 1,70	-	1150 - 850
1.6587	17 CrNiMo 6	-	0,15 - 0,21	≤ 0,40	0,50 - 0,90	≤ 0,025	≤ 0,015	1,50 - 1,80	0,25 - 0,35	1,40 - 1,70	Al ≤ 0,05; Cu ≤ 0,3	1150 - 850
1.7131	16 MnCr 5	5115	0,14 - 0,19	≤ 0,40	1,00 - 1,30	≤ 0,035	≤ 0,035	0,80 - 1,10	-	-	-	1150 - 850

Quenching steels

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Cr	Mo	Ni	Other	Warm forming temperature [°C]
1.0503	C 45	1045	0,42 - 0,50	≤ 0,40	0,50 - 0,80	≤ 0,045	≤ 0,045	≤ 0,40	≤ 0,10	≤ 0,40	Cr+Mo+Ni ≤ 0,63	1100 - 850
1.6511	36 CrNiMo 4	-	0,32 - 0,40	≤ 0,40	0,50 - 0,80	≤ 0,035	≤ 0,035	0,90 - 1,20	0,15 - 0,30	0,90 - 1,20	-	1050 - 850
1.6580	30 CrNiMo 8	-	0,26 - 0,34	≤ 0,40	0,30 - 0,60	≤ 0,035	≤ 0,035	1,80 - 2,20	0,30 - 0,50	1,80 - 2,20	-	1050 - 850
1.7033	34 Cr 4	5132	0,30 - 0,37	≤ 0,40	0,60 - 0,90	≤ 0,035	≤ 0,035	0,90 - 1,20	-	-	-	1050 - 850
1.7220	34 CrMo 4	4137	0,30 - 0,37	≤ 0,40	0,60 - 0,90	≤ 0,035	≤ 0,035	0,90 - 1,20	0,15 - 0,30	-	-	1050 - 850
1.7228	50 CrMo 4	4150	0,46 - 0,54	≤ 0,40	0,50 - 0,80	≤ 0,035	≤ 0,035	0,90 - 1,20	0,15 - 0,30	-	-	1050 - 850
1.8159	50 Crv 4	6150	0,47 - 0,55	≤ 0,40	0,70 - 1,10	≤ 0,035	≤ 0,035	0,90 - 1,20	-	-	V 0,10 - 0,25	1050 - 850

Nitriding steels

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Cr	Mo	Al	Other	Warm forming temperature [°C]
1.8507	34 CrAlMo 5	-	0,30 - 0,37	≤ 0,40	0,50 - 0,80	≤ 0,025	≤ 0,030	1,00 - 1,30	0,15 - 0,25	0,80 - 1,20	-	1050 - 850
1.8519	31 CrMoV 9	-	0,26 - 0,34	≤ 0,40	0,40 - 0,70	≤ 0,025	≤ 0,030	2,30 - 2,70	0,15 - 0,25	-	V 0,10 - 0,20	1050 - 850
1.8550	34 CrAlNi 7	-	0,30 - 0,37	≤ 0,40	0,40 - 0,70	≤ 0,025	≤ 0,030	1,50 - 1,80	0,15 - 0,25	0,80 - 1,20	Ni 0,85 - 1,15	1050 - 850

Tool steels

Cold-working steels, non alloy

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Cr	Mo	Ni	Other	Warm forming temperature [°C]
1.1545	C 105 W1	W1	1,00 - 1,10	0,10 - 0,25	0,10 - 0,25	≤ 0,020	≤ 0,020	-	-	-	-	1000 - 800
1.1740	C 60 W	-	0,55 - 0,65	0,15 - 0,40	0,60 - 0,80	≤ 0,035	≤ 0,035	-	-	-	-	1100 - 800

Tool steels

Cold-working steels, alloyed

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Cr	Mo	V	Other	Warm forming temperature [°C]
1.2162	21 Mn Cr 5	-	0,18 - 0,24	0,15 - 0,24	1,10 - 1,40	≤ 0,030	≤ 0,030	1,00 - 1,30	-	-	-	1050 - 850
1.2210	115 CrV 3	5120	1,10 - 1,25	0,15 - 0,30	0,20 - 0,40	≤ 0,030	≤ 0,030	0,50 - 0,80	-	0,07 - 0,12	-	1050 - 850
1.2316	X 36CrMo 17	-	0,33 - 0,43	≤ 1,00	≤ 1,00	≤ 0,030	≤ 0,030	15,0 - 17,0	1,00 - 1,30	-	Ni ≤ 1,00	1100 - 750
1.2436	X 210 CrW 12	D6	2,00 - 2,25	0,10 - 0,40	0,15 - 0,45	≤ 0,030	≤ 0,030	11,0 - 12,0	-	-	W 0,60 - 0,80	1000 - 850
1.2550	60 WCrV 7	S1	0,55 - 0,65	0,50 - 0,70	0,15 - 0,45	≤ 0,030	≤ 0,030	0,90 - 1,20	-	0,10 - 0,20	W 1,80 - 2,10	1050 - 850
1.2767	X 45 NiCrMo 4	-	0,40 - 0,50	0,10 - 0,40	0,15 - 0,45	≤ 0,030	≤ 0,030	1,20 - 1,50	0,15 - 0,35	-	Ni 3,80 - 4,30-	1050 - 850

Hot-working steels

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Cr	Mo	Ni	V	Warm forming temperature [°C]
1.2343	X 38 CrMoV 5 1	H11	0,36 - 0,42	0,90 - 1,20	0,30 - 0,50	≤ 0,030	≤ 0,030	4,80 - 5,50	1,10 - 1,40	-	0,25 - 0,50	1100 - 900
1.2365	X 32 CrMoV 3 3	H10	0,28 - 0,35	0,10 - 0,40	0,15 - 0,45	≤ 0,030	≤ 0,030	2,70 - 3,20	2,60 - 3,00	-	0,40 - 0,70	1050 - 900
1.2714	56 NiCrMoV 7	L6	0,50 - 0,60	0,10 - 0,40	0,65 - 0,95	≤ 0,030	≤ 0,030	1,00 - 1,20	0,45 - 0,55	1,50 - 1,80	0,07 - 0,12	1050 - 850

High speed steels

Description			Analysis in %									
Material	DIN	SAE/AISI	C	Si	Mn	P	S	Co	Cr	Mo	V	W
1.3202	S 12 - 1 - 4 - 5	T15	1,30 - 1,45	≤ 0,45	≤ 0,40	≤ 0,030	≤ 0,030	4,50 - 5,00	3,80 - 4,50	0,70 - 1,00	3,50 - 4,00	11,5 - 12,5
1.3243	S 6 - 5 - 2 - 5	M41	0,88 - 0,96	≤ 0,45	≤ 0,40	≤ 0,030	≤ 0,030	4,50 - 5,00	3,80 - 4,50	4,70 - 5,20	1,70 - 2,00	6,00 - 6,70
1.3255	S 18 - 1 - 2 - 5	T4	0,75 - 0,83	≤ 0,45	≤ 0,40	≤ 0,030	≤ 0,030	4,50 - 5,00	3,80 - 4,50	0,50 - 0,80	1,40 - 1,70	17,5 - 18,5
1.3343	S 6 - 5 - 2	M2	0,86 - 0,94	≤ 0,45	≤ 0,40	≤ 0,030	≤ 0,030	-	3,80 - 4,50	4,70 - 5,20	1,70 - 2,00	6,00 - 6,70

[1]) W = Water, WB = Warmbath, O = Oil, A = Air, Temperatures acc. to steel manufacturer
[2]) Surface hardness after case hardening

Heat treatment						
Soft annealing [°C]	Carburizing [°C]	Core hardening [°C]	Intermediate annealing [°C]	Surface hardening [°C]	Quenching medium[1])	Tempering [°C]
650 - 700	880 - 980	880 - 920	-	780 - 820	-	150 - 200
650 - 700	880 - 980	830 - 870	630 - 650	780 - 820	O/WB	150 - 200
650 - 700	880 - 980	830 - 870	630 - 650	780 - 820	O/WB	150 - 200
650 - 700	880 - 980	860 - 900	-	780 - 820	O/WB	150 - 200

Heat treatment					
Soft annealing [°C]	Brinell hardness HB30 soft annealed	Normalizing [°C]	Tempering [°C]	Quenching medium[1])	Tempering [°C]
650 - 700	≤ 207	840 - 880	820 - 860	W/O	550 - 660
650 - 700	≤ 248	850 - 880	820 - 850	W/O	540 - 680
650 - 700	≤ 248	850 - 880	830 - 860	O	540 - 680
680 - 720	≤ 223	850 - 890	830 - 870	W/O	540 - 680
680 - 720	≤ 223	850 - 890	830 - 870	W/O	540 - 680
680 - 720	≤ 248	840 - 880	820 - 860	O	540 - 680
680 - 720	≤ 248	840 - 880	820 - 860	O	540 - 680

Heat treatment							
Soft annealing [°C]	Brinell hardness HB30 soft annealed	Hardening [°C]	Quenching medium[1])	Tempering [°C]	Stress relieving after mech. processing [°C]	Nitriding [°C]	Nitriding hardness HV1
650 - 700	≤ 248	900 - 940	W/O	570 - 650	550 - 570	500 - 520	950
680 - 720	≤ 248	840 - 880	W/O	570 - 680	550 - 580	500 - 520	800
650 - 700	≤ 248	850 - 890	O	570 - 660	550 - 580	500 - 520	950

Heat treatment									
Soft annealing [°C]	Brinell hardness HB30 soft annealed	Hardening [°C]	Quenching medium[1])	Hardness [HRC]	Hardness depth [mm]	Tempering [°C]	Surface hardness in HRC after tempering at		
							Tempering at 100 °C	Tempering at 200 °C	Tempering at 300 °C
680 - 710	≤ 190	770 - 800	W	65	2,0 - 3,0	180 - 300	64	62	56
680 - 710	≤ 207	800 - 830	O	58	3,5 - 5,0	180 - 300	58	54	48

Heat treatment											
Soft annealing [°C]	Brinell hardness HB30 soft annealed	Hardening [°C]	Quenching medium[1])	Tempering [°C]	Surface hardness in HRC after tempering at						
					Hardening	Tempering at 100 °C	Tempering at 200 °C	Tempering at 300 °C	Tempering at 400 °C	Tempering at 500 °C
680 - 710	≤ 215	810 - 840	O/WB	150 - 180	62[2])	61[2])	60[2])	57[2])	54[2])	50[2])
710 - 740	≤ 220	760 - 840	W/O	180 - 250	64	64	61	58	51	44
780 - 820	≤ 250	1000 - 1040	O/WB	650 - 700	49	49	47	46	46	44
800 - 840	≤ 255	950 - 980	O/A/WB	180 - 250	64	63	62	60	58	56
710 - 750	≤ 225	870 - 900	O/WB	180 - 300	60	60	58	56	52	48
610 - 650	≤ 260	840 - 870	O/A/WB	160 - 250	56	56	54	50	46	42

Heat treatment										
Soft annealing [°C]	Brinell hardness HB30 soft annealed	Hardening [°C]	Quenching medium[1])	Tempering [°C]	Tensile strength ~ [N/mm²] after					
					Hardening	Tempering at 400 °C	Tempering at 500 °C	Tempering at 600 °C	Tempering at 700 °C	Usable hardness N/mm²
760 - 780	≤ 235	1020 - 1050	O/A/WB	550 - 650	1960	-	2060	1620	980	1180 - 1770
760 - 780	≤ 230	1020 - 1050	O/A/WB	500 - 670	1720	-	1670	1570	1030	1180 - 1670
680 - 710	≤ 250	840 - 870	O	400 - 650	2060	1770	1570	1320	-	1180 - 1770

Heat treatment										
Warm forming temperature [°C]	Soft annealing [°C]	Brinell hardness HB30 soft annealed	Hardening process							
			Preheating [°C]	Preheating 1. Level [°C]	Preheating 2. Level [°C]	Hardening [°C]	Quenching medium[1])	Tempering [°C]	Tempering hardness [HRC]
1100 - 900	780 - 810	240 - 300	450 - 600	850	1050	1210 - 1250	O/WB/A	550 - 570	≤ 65
1100 - 900	790 - 820	240 - 300	450 - 600	850	1050	1200 - 1240	O/WB/A	550 - 570	≤ 64
1150 - 900	820 - 850	240 - 300	450 - 600	850	1050	1260 - 1300	O/WB/A	550 - 570	≤ 64
1100 - 900	790 - 820	240 - 300	450 - 600	850	1050	1190 - 1230	O/WB/A	550 - 570	≤ 64

Nabertherm
MORE THAN HEAT 30-3000 °C

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 our products.

In addition to our current calendar of trade fairs and training dates, there is also the opportunity to get in touch directly with your local sales office or nearest dealer world-wide.

Professional Solutions for:

- **Arts & Crafts**
- **Glass**
- **Ceramics**
- **Laboratory/Dental**
- **Heat Treatment of Metals, Plastics and Surface Finishing**
- **Foundry**

Sales and Service Subsidiaries:

Nabertherm GmbH
Bahnhofstr. 20
28865 Lilienthal, Germany
contact@nabertherm.de
Phone: (+49) 4298 922-0
Fax: (+49) 4298 922-129

Nabertherm Shanghai Ltd.
150 Lane, No. 158 Pingbei Road, Minhang District
201109 Shanghai, China
contact@nabertherm-cn.com
Phone: (+86) 21 6490 2960
Fax: (+86) 21 6490 3107

Nabertherm S.A.S
51 Rue de Presles
93531 Aubervilliers, France
contact@nabertherm.fr
Phone: (+33) 1 5356 1800
Fax: (+33) 1 5356 1809

Nabertherm Italia
via Trento N° 17
50139 Florence, Italy
nabertherm.florence@tin.it
Phone: (+39) 348 3820278
Fax: (+39) 055 480835

Nabertherm Schweiz AG
Batterieweg 6
4614 Hägendorf, Switzerland
contact@nabertherm.ch
Phone: (+41) 62 209 6070
Fax: (+41) 62 209 6071

Nabertherm Ltd.
Vigo Place, Aldridge
West Midlands WS9 8YB, United Kingdom
contact@nabertherm.co.uk
Phone: (+44) 1922 455 521
Fax: (+44) 1922 455 277

Nabertherm Inc.
54 Reads Way
New Castle, DE 19720, USA
contact@nabertherm-usa.com
Phone: (+1) 302 322 3665
Fax: (+1) 302 322 3215

Nabertherm Ibérica, S.L.
Av. de les Corts Catalanes 9 - 11
Despacho 4E - Entidad 12 - 13
08173 Sant Cugat de Vallés (Barcelona), Spain
contact@nabertherm.es
Phone: (+34) 93 553 0887
Fax: (+34) 93 583 9585

www.nabertherm.com