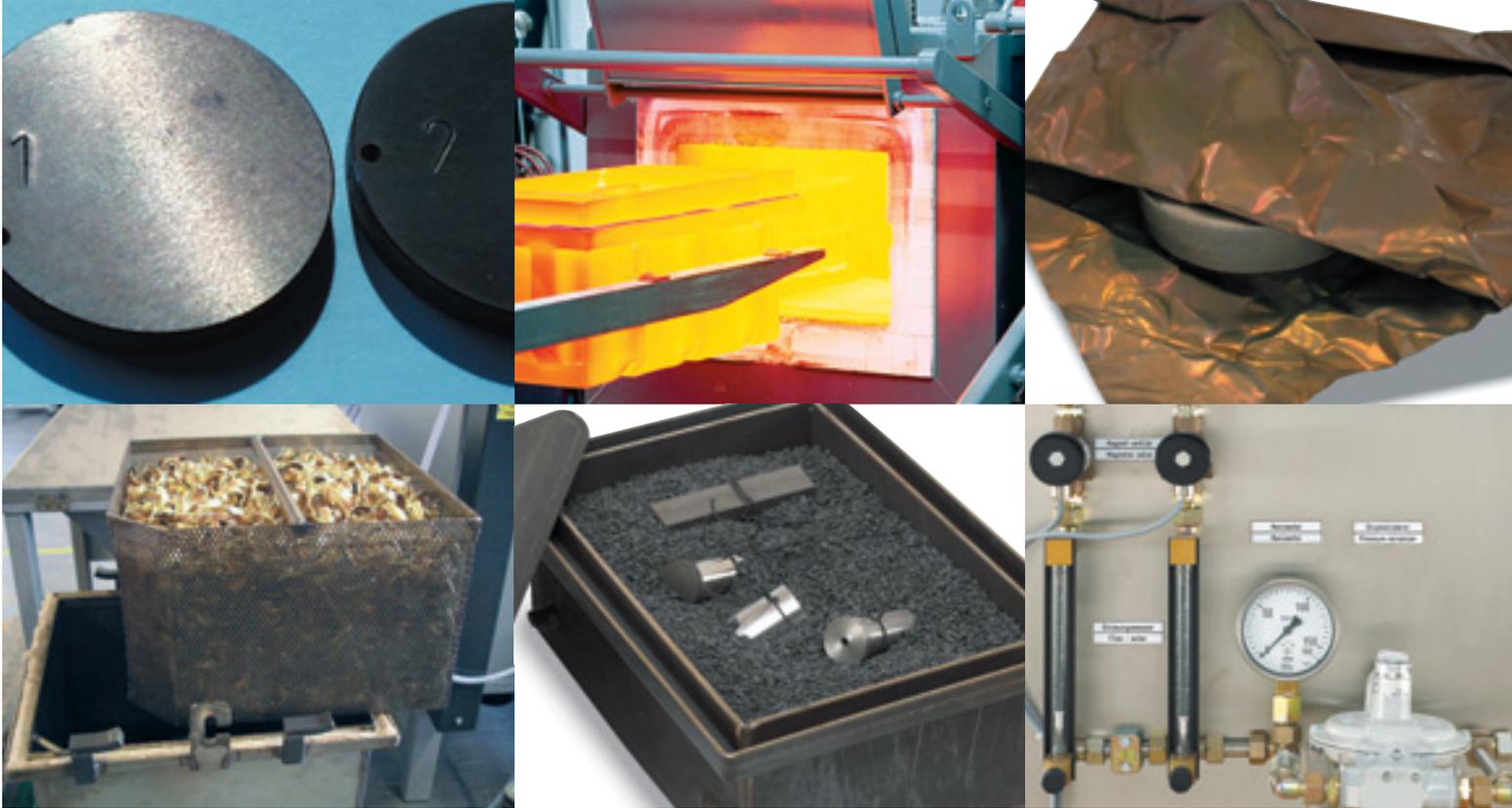


Heat Treatment II

Annealing, Hardening, Brazing, Forging, Nitriding



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

Made in Germany

Nabertherm, and our more than 300 employees worldwide, have developed and manufactured industrial furnaces and heat treatment systems used in a wide range of applications for over 50 years. 150.000 satisfied customers in 100 countries demonstrate our commitment to building cost-effective, quality equipment. Strong vertical integration and a wide range of standard furnaces allow us to deliver solutions tailored to your needs quickly and for an exceptional value.

Long-term sales and distribution partners in all important world markets ensure individual on-site customer service and consultation.

Setting Standards in Quality and Reliability

Our products range from standard furnaces to flexible, fully automated, state-of-the-art systems and plants with materials handling technology. We can design a customized solution for all your heat treatment production processes.

More Than Heat – Broad Industry Experience in Thermal Processing

In addition to furnaces for heat treatment, Nabertherm offers a wide range of standard furnaces and accessories such as hardening boxes for annealing in neutral atmospheres, carburizing and powder nitriding, protective gas boxes and annealing bags for bright annealing and hardening with protective gas as well as charging media and consumables. The modular design of our products allows us to customize a solution for your problem areas without costly modifications. Our professional R&D department will be pleased to test samples and assist you in the selection of heat treatment equipment you require.

A Global Network – Never Far Away

With our global sales network, we can offer on-site customer service wherever you choose to produce. We can introduce you to reference customers in your neighborhood who have similar furnaces or systems.

Customer Service and Spare Parts

Our experts on our customer service team are available for your every question. We can solve most problems over the telephone, if not we are ready to dispatch a technician to your site. With our larger systems, we recommend our teleservice modem to allow for fast remote diagnosis. We are particularly proud of our worldwide spare parts service. Wherever you are in the world – we are there for you in no time.



**Heat Treatment of Metals and
Plastics & Surface Finishing**

Furnaces and Systems for
Tempering
Annealing
Hardening
Quenching and Tempering
Solution Annealing
Forging
Precipitation Hardening/Curing
Preheating
Drying
Curing

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Made
in
Germany

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

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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 extended 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 decarburizing 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 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 embedded in protective grooves
- 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 distribution 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 above, plus

- Upper door area armored 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

Standard Version N 81/H - N 1491/H, like above, except

- Door movement with counterweight and gas spring; opening upward
- Models N 761 + N 1491 equipped with electro-hydraulic lift door
- Freely radiating heating elements on support tubes

For additional features see separate heat treatment catalog



N 41/H



N 641 with annealing box and lift trolley

Model	Tmax °C	Inner dimensions in mm			Volume in l	Exterior dimensions in mm			Supply power/kW	Supply voltage	Weight in kg
		W	D	H		W	D	H			
N 7/H ¹	1280	250	250	120	7	720	640	510	3.0	single-phase	60
N 11/H ¹	1280	250	350	140	11	720	760	510	3.6	single-phase	70
N 11/HR ¹	1280	250	350	140	11	720	760	510	5.5	three-phase	70
N 17/HR ¹	1280	250	500	140	17	720	890	510	6.5	three-phase	90
N 31/H	1280	350	350	250	30	840	950	1320	15.0	three-phase	210
N 41/H	1280	350	500	250	40	840	1100	1320	15.0	three-phase	260
N 61/H	1280	350	750	250	60	840	1350	1320	20.0	three-phase	400
N 81	1200	500	750	250	80	1140	1900	1790	20.0	three-phase	820
N 161	1200	550	750	400	160	1180	1930	1980	30.0	three-phase	910
N 321	1200	750	1100	400	320	1400	2270	2040	47.0	three-phase	1300
N 641	1200	1000	1300	500	640	1690	2670	2240	70.0	three-phase	2100
N 761	1200	800	1900	500	760	1550	2540	2650	75.0	three-phase	2400
N 1491	1200	1660	1200	750	1490	2430	1840	3150	110.0	three-phase	5400
N 81/13	1300	500	750	250	80	1220	1960	1840	22.0	three-phase	900
N 161/13	1300	550	750	400	160	1260	1990	2030	35.0	three-phase	1000
N 321/13	1300	750	1100	400	320	1480	2330	2090	60.0	three-phase	1500
N 641/13	1300	1000	1300	500	640	1770	2730	2290	80.0	three-phase	2500

¹ Table-top model

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 1.4841 (314)
- 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 1.4841 (314) 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 1.4841 (314)
- Larger boxes and custom dimensions available upon request



Hardening boxes on stacker

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

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

Neutral Annealing Coal

- For protection of tool steel against oxidation and carburizing, 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



Nitriding powder

Boriding powder upon request.

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

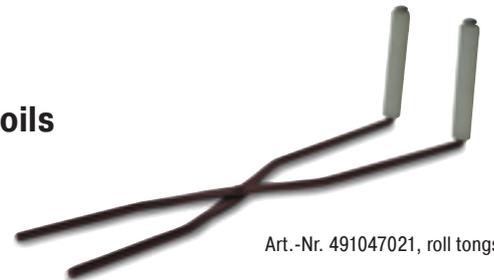
- Tmax 1200 °C
- Stainless steel heat treating foil for single use
- Ultra-thin stainless steel heat treating foil for bright annealing of workpieces in all shapes and sizes
- Foil is cut to the correct size
- Workpieces are packed into the foil as closely as possible
- Airtight lock by means of folds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

Article no.	Dimensions	
	Width in mm	Length in m
491020310	310.0	30.0
491020610	610.0	15.0
491020615	610.0	7.5

Accessory Equipment for processing Bags, Envelopes and Foils



Art.-Nr. 491047010, fold lock



Art.-Nr. 491047021, roll tongs

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

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

Annealing Envelopes



Annealing envelopes

- Annealing envelopes useful up to 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.

The charge is placed on the charge carrier and covered with the protective gas annealing bag. The bag is preflushed 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 occurring. Due to thin-walled foil very rapid cooling times can be achieved.

The protective gas annealing bag is also suitable for quenching workpieces in oil or water. The protective gas annealing bag with holder is taken out of the hot furnace after the heating time. The bag is pulled off the holder above the quenching bath using a heat protection glove (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.

- 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 1.4841 (314)
- Charge thermocouple type K
- Digital temperature display (page 16) and protective gas systems (page 15) optional
- Charging trolley optional (page 30)



Holder with protective gas annealing bag



Thermocouple integrated in holder

Article no.	Furnace	Inner dimensions in mm			Max. workpiece length in mm	Replacement hood (article no.)	Preflush/cooling rate l/min	Process flush rate l/min
		W	D	H				
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

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 inlet and outlet.

A box with protective gas is advisable for larger workpieces requiring defined heat treating. We would be pleased to carry out trials at our technical center. 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).

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 1.4841 (314)
- Charge thermocouple type K

Additional Equipment

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



Box with protective gas connection



Winch stacker with hardening box and furnace



N 11 with protective gas box

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		
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
631000388	N 31, N 31/H	294	294	147	330	330	172	20 - 25	10 - 15
631000389	N 21, N 41, N 41/H	194	294	147	230	330	172	20 - 25	10 - 15
631000390	N 41, N 41/H	244	344	177	280	380	200	20 - 25	10 - 15
631000391	N 41, N 41/H	294	394	197	330	430	222	20 - 25	10 - 15
631000392	N 61, N 61/H	274	494	197	310	530	222	20 - 25	10 - 15
631000393	N 81	394	494	197	430	530	222	20 - 25	10 - 15
631000394	N 161	456	556	250	496	596	355	20 - 25	10 - 15
631000606	N 321	472	850	212	581	960	330	20 - 25	10 - 15
631000607	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 Boxes with additional Vacuum Lid for Models N 7 - N 161



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

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 1.4841 (314)
- 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 l/min	Process flush rate l/min
		W	D	H	W	D	H		
631000515	N 7, N 7/H	114	164	77	150	200	102	15 - 20	5 - 8
631000516	N 7/H	174	194	97	210	230	110	15 - 20	5 - 8
631000517	N 11, N 11/R	174	244	107	210	280	132	15 - 20	5 - 8
631000518	N 11/H, N 11/HR	194	294	107	230	330	132	15 - 20	5 - 8
631000519	N 17, N 17/R	174	394	107	210	430	132	15 - 20	5 - 8
631000520	N 17/H, N 17/HR	194	444	107	230	480	132	15 - 20	5 - 8
631000521	N 31/H	294	294	147	330	330	172	20 - 25	10 - 15
631000522	N 21, N 41, N 41/H	194	294	147	230	330	172	20 - 25	10 - 15
631000523	N 41, N 41/H	244	344	177	280	380	200	20 - 25	10 - 15
631000525	N 61, N 61/H	274	494	197	310	530	222	20 - 25	10 - 15
631000526	N 81	394	494	197	430	530	222	20 - 25	10 - 15
631000527	N 161	456	556	250	496	596	355	20 - 25	10 - 15

Larger boxes and custom dimensions available upon request

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.



Vacuum pump

Article no.	Exterior dimensions in mm			Connections on suction side		Supply power	Supply voltage	Nominal suction power m³/h	Suction capacity m³ h-l
	W	D	H						
542400366	215	281	199	3/4"	1/2" inner thread	0.55 KW	230 V	16	15

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

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.



Protective gas box with hinged lid

- 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
- Up to N 17/HR with manipulating fork
- Heat-resistant alloy 1.4841 (314)
- Charge thermocouple type K

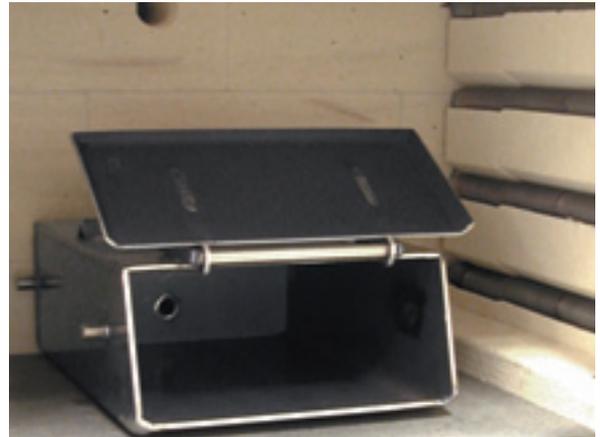
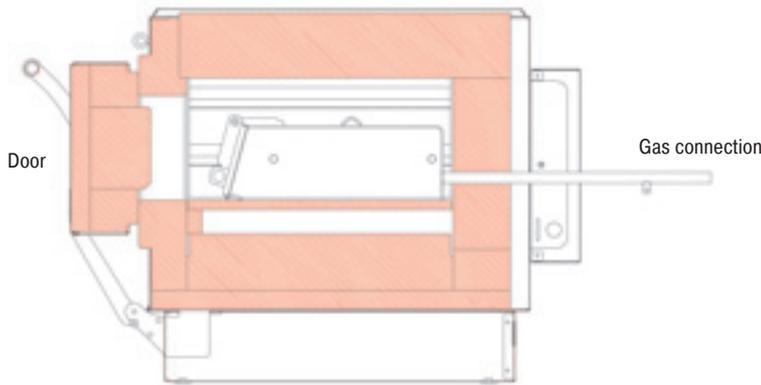
Additional Equipment

- 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
631000576	N 41, N 41/H	209	265	134	245	316	154	20 - 25	10 - 15
631000577	N 41, N 41/H	209	265	184	245	316	204	20 - 25	10 - 15
631000578	N 41, N 41/H	289	405	184	325	456	204	20 - 25	10 - 15
631000579	N 61, N 61/H	289	655	184	325	706	204	20 - 25	10 - 15
631000580	N 81	389	655	184	425	706	204	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 1.4841 (314)
- 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	289	405	184	325	456	204	20 - 25	10 - 15
631000591	N 61, N 61/H	289	655	184	325	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 induced.

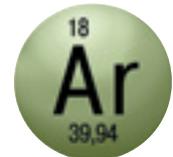
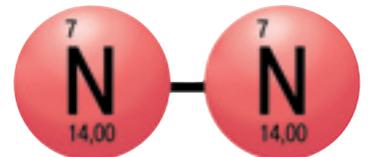
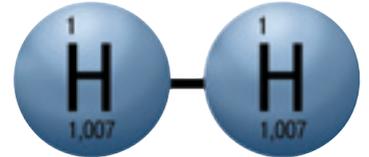
In many cases, nitrogen is used as protective gas. Our experience shows that nitrogen does not always lead to sufficient results. A longer preflush time must also be used.

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

For N 21 - N 641/13, 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

For N 21 - N 641/13

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, interface, 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

MHS 17 Multi-Hardening System



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.	Article	Exterior dimensions in mm			Volume in l	Charging floor grid dimensions		Supply power/kW	Supply voltage
		W	D	H		Width in mm	length in mm		
631000428	Work platform	1000	610	760	-	-	-	-	-
631000430	Oil bath	270	500	500	50	400	200	-	-
631000431	Water bath	270	500	500	50	400	200	-	-
491005131	Heating element	-	-	-	-	-	-	3.0	single-phase
631000429	Forced cooling system (cooling platform)	556	610	760	-	400	200	0.2	single-phase
631000442	Side platform	556	610	760	-	-	-	-	-

MHS 17 Multi-hardening System



MHS 17



Forced cooling system

The work platform of the system is designed for supporting an N 7/H – N 17/HR series hardening furnace and N 15/65 HA tempering furnace. 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 workpiece should be cleaned in the water bath, dried and immediately tempered in the N 15/65 HA 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.



Optional version for hardening system with vertical design

Model	Tmax °C	Inner dimensions in mm			Volume in l	Exterior dimensions in mm			Supply power/kW	Supply voltage	Weight in kg
		W	D	H		W	D	H			
N 7/H ¹	1280	250	250	120	7	720	640	510	3.0	single-phase	60
N 11/H ¹	1280	250	350	140	11	720	740	510	3.6	single-phase	70
N 11/HR ¹	1280	250	350	140	11	720	740	510	5.5	three-phase	70
N 17/HR ¹	1280	250	500	140	17	720	890	510	6.5	three-phase	90
N 15/65HA ²	650	295	340	170	15	470	845	460	2.7	single-phase	55

¹ See page 5 for furnace description

² Furnace description, see page 23



MHS 17, sample setup

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**

Furnace Model	Tmax °C	Inner dimensions in mm			Volume in l	Exterior dimensions in mm			Supply power/kW	Supply voltage	Weight in kg
		W	D	H		W	D	H			
N 41/H ¹	1280	350	500	250	40	840	1100	1320	15.0	three-phase	260

Protective gas hardening system	bell size in mm			Oil quench bath size in liters	max. load Weight	max. quench yield/h	Preflush rate	Process flush rate	Supply power/kW	Supply voltage
	W	D	H							
SHS 41	260	380	180	300	25 kg	20 kg	20-25	10-15	15.0	three-phase

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 kW	Supply voltage	Comments
		W	D	H			
631000429	Up to N 17/HR	550	610	760	0.2	230 V	The same as forced cooling system MHS 17, see p. 17
631000529	Up to N 61/H	335	1100	880-920	0.2	230 V	The same as CWK1 charging trolley, see p. 30
631000294	Up to N 161	700	800	900	0.9	230 V	

- Customer-configured tables upon 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 immediately extinguish ignited oil. For optimal results, pre-tempering water baths for cleaning workpieces should have an appropriate degreasing additive mixed in to the water bath 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 in l	Quenchant performance in kg/h	max. load weight in kg
		W	D	H			
101300010	Q 50	350	350	700	50	5-10	
101300020	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 1/N
491007025	Q 200	6	400 V 3/N

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.



Q 200 D

Article no.	Bath	Exterior dimensions in mm			Volume in l Oil/water	max. load weight in kg
		W	D	H		
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 3/N
Q 400 D	9	400 V 3/N
Q 600 D	15	400 V 3/N

Charging aid manual + electric	Total height in mm	Max. load weight in kg	Compressed air in bar	Supply power/kW	Supply voltage
Q 200 D	1800	50	6-9	-	-
Q 400 D	2480	80	-	0.3	230 V
Q 600 D	2480	100	-	0.3	230 V

Oil cooler	max. quenchant performance in kg/h	Supply power/kW	Supply voltage
Q 200 D	approx. 100	0.55	400 V
Q 400 D	approx. 200	2.2	400 V
Q 600 D	approx. 300	2.2	400 V

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
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)

Heat-Resistant 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.

- 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 distribution 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



N 15/65 HA

Model	Tmax °C	Inner dimensions in mm			Volume in l	Exterior dimensions in mm			Supply power/kW	Supply voltage	Weight in kg
		W	D	H		W	D	H			
N 30/45HA	450	290	420	260	30	607+255	1175	1315	3.6	single-phase	195
N 60/45HA	450	350	500	350	60	667+255	1250	1400	6.6	single-phase	240
N 120/45HA	450	450	600	450	120	767+255	1350	1500	9.6	three-phase	310
N 250/45HA	450	600	750	600	250	1002+255	1636	1860	19.0	three-phase	6110
N 500/45HA	450	750	1000	750	500	1152+255	1886	2010	28.0	three-phase	1030
N 15/65HA ¹	650	295	340	170	15	470	845	460	2.7	single-phase	55
N 30/65HA	650	290	420	260	30	607+255	1175	1315	6.0	single-phase	195
N 60/65HA	650	350	500	350	60	667+255	1250	1400	9.6	three-phase	240
N 120/65HA	650	450	600	450	120	767+255	1350	1500	13.6	three-phase	310
N 250/65HA	650	600	750	600	250	1002+255	1636	1860	21.0	three-phase	610
N 500/65HA	650	750	1000	750	500	1152+255	1886	2010	31.0	three-phase	1030
N 30/85HA	850	290	420	260	30	607+255	1175	1315	6.0	three-phase	195
N 60/85HA	850	350	500	350	60	667+255	1250	1400	9.6	three-phase	240
N 120/85HA	850	450	600	450	120	767+255	1350	1500	13.6	three-phase	310
N 250/85HA	850	600	750	600	250	1002+255	1636	1860	21.0	three-phase	610
N 500/85HA	850	750	1000	750	500	1152+255	1886	2010	31.0	three-phase	1030

¹ Table-top model



Air circulation furnace with protective gas box

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

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 % H₂ (observe national regulations)
- Protective gas box with lid, protective gas supply and return line through the furnace collar
- 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 - 1.4301 (304), 650 °C - 1.4541 (321) or 850 °C - 1.4828 (309)
- 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
- Charge thermocouple type K

Additional Equipment

- Digital temperature display (page 16)
- Protective gas systems (page 15)



Protective gas box (open)



Protective gas box with lid

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

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
- 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
- Made of heat-resistant alloys: 450 °C - 1.4301 (304), 650 °C - 1.4541 (321) or 850 °C - 1.4828 (309)

Additional Equipment

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



Protective gas box with vacuum lid

Article no.	Furnace	Inner dimensions in mm			Exterior dimensions in mm		
		W	D	H	W	D	H
631000549	N 30/45HA	220	320	160	282	376	242
631000550	N 60/45HA	270	420	260	332	476	342
631000551	N 120/45HA	370	520	350	436	560	430
631000552	N 250/45HA	480	630	460	546	680	600
631000553	N 500/45HA	630	780	610	696	836	760
631000554	N 30/65HA	220	320	160	272	376	242
631000555	N 60/65HA	270	420	260	332	476	342
631000556	N 120/65HA	370	520	350	436	560	430
631000557	N 250/65HA	480	630	460	546	680	600
631000558	N 500/65HA	630	780	610	696	836	760
631000559	N 30/85HA	220	320	160	272	376	242
631000560	N 60/85HA	270	420	260	332	476	342
631000561	N 120/85HA	370	520	350	436	560	430
631000562	N 250/85HA	480	630	460	546	680	600
631000563	N 500/85HA	630	780	610	696	836	700

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

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 distribution 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

Model	Tmax °C	Inner dimensions in mm			Volume in l	Exterior dimensions in mm			Supply power/kW	Supply voltage	Weight in kg
		W	D	H		W	D	H			
S 30/45A	450	300	250	400	30	520	460	920	3.6	single-phase	130
S 60/45A	450	350	350	500	60	570	560	1020	6.6	single-phase	225
S 120/45A	450	450	450	600	120	670	660	1120	9.6	three-phase	280
S 250/45A	450	600	600	750	250	820	810	1350	19.0	three-phase	750
S 500/45A	450	750	750	900	500	970	960	1500	28.0	three-phase	980
S 30/65A	650	300	250	400	30	530	520	1020	6.0	single-phase	130
S 60/65A	650	350	350	500	60	580	620	1120	9.6	three-phase	225
S 120/65A	650	450	450	600	120	680	720	1220	13.6	three-phase	280
S 250/65A	650	600	600	750	250	830	870	1450	21.0	three-phase	750
S 500/65A	650	750	750	900	500	980	1020	1600	31.0	three-phase	980
S 30/85A	850	300	250	400	30	600	740	1000	6.0	three-phase	130
S 60/85A	850	350	350	500	60	710	840	1100	9.6	three-phase	225
S 120/85A	850	450	450	600	120	810	940	1200	13.6	three-phase	280
S 250/85A	850	600	600	750	250	960	1090	1350	21.0	three-phase	750
S 500/85A	850	750	750	900	500	1100	1240	1500	31.0	three-phase	980

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

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



Protective gas box with sealing lock

- For the non-combustible protective gases argon, nitrogen and forming gas 95/5 with less than 5 % H₂ (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 - 1.4301 (304), 650 °C - 1.4541 (321) or 850 °C - 1.4828 (309)
- 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 (Top Charging) for Models S 30/45 A - S 500/85A

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 - 1.4301 (304), 650 °C - 1.4541 (321) or 850 °C - 1.4828 (309)

Article no.	Furnace	Inner dimensions in mm		
		W	D	H
631000477	S 30/45A	210	260	300
631000478	S 60/45A	310	310	400
631000479	S 120/45A	410	410	500
631000480	S 250/45A	560	560	650
631000481	S 500/45A	710	710	800
631000266	S 30/65A	210	260	300
631000267	S 60/65A	310	310	400
631000268	S 120/65A	410	410	500
631000269	S 250/65A	560	560	650
631000270	S 500/65A	710	710	800
631000482	S 30/85A	210	260	300
631000483	S 60/85A	310	310	400
631000484	S 120/85A	410	410	500
631000485	S 250/85A	560	560	650
631000486	S 500/85A	710	710	800



Charging basket for top charging

Charging Baskets (Side Charging) for Models S 30/45 A - S 500/85A

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 10mm
- Made of heat-resistant alloys: 450 °C - 1.4301 (304), 650 °C - 1.4541 (321) or 850 °C - 1.4828 (309)

Article no.	Furnace	Inner dimensions in mm		
		W	D	H
631006035	S 30/45A	230	180	400
631006036	S 60/45A	280	280	500
631006037	S 120/45A	344	344	500
631006038	S 250/45A	490	490	720
631006039	S 500/45A	644	644	800
631006040	S 30/65A	230	180	400
631006041	S 60/65A	280	280	500
631006042	S 120/65A	344	344	500
631006043	S 250/65A	490	490	720
631006044	S 500/65A	644	644	800
631006045	S 30/85A	230	180	400
631006046	S 60/85A	280	280	500
631006047	S 120/85A	344	344	500
631006048	S 250/85A	490	490	720
631006049	S 500/85A	644	644	800



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

Martempering Furnaces using Neutral Salts



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 distribution. 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 distribution 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.



WB 30 with charging aid

- Tmax 500 °C
- Optimal temperature distribution
- Martemper bath temperature control
- Over-temperature selection limiter 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



Salt-bath hardening in practice

Additional Equipment

- Charging aid mounted on side of furnace



Double martempering bath

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Supply power/kW	Supply voltage	Weight in kg
		W	D	H		W	D	H			
WB 10	500	220	200	300	10	550	450	570	1.0	single-phase	60
WB 20	500	300	210	460	20	610	580	920	2.6	single-phase	110
WB 30	500	300	210	580	30	610	580	920	3.2	single-phase	140
WB 70	500	400	300	680	70	750	680	980	7.5	three-phase	240
WB 200	500	540	520	880	200	900	900	1200	18.0	three-phase	660
WB 400	500	730	720	980	400	1100	1100	1300	24.0	three-phase	1150

Information about salts by Petrofer and Durferit and their application

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

Salt-Bath Furnaces using Neutral and Active Salts



TSB 30/30
with exhaust gas
collection at crucible rim



TS 40/30
with exhaust gas
collection at crucible rim

TS 20/15 - TS(B) 70/90

Salt bath furnaces are outstanding for their high temperature uniformity and excellent heat transmission to the workpiece owing to a direct heat flow which results in shorter cycles. Salt bath furnaces offer great flexibility and provide high economic benefits for heat treating small series of metals in neutral and active salt baths. Processes such as Tenifer nitriding up to 600 °C, carburizing up to 950 °C or bright annealing up to 1000 °C can be carried out.

- Tmax. 750 °C or 1000 °C
- Insulated swing-away lid
- Electric all-round heating (TS) or gas heating (TSB)
- Removable collar plate made of steel
- Optimal temperature distribution in accordance with DIN 17052-1 up to ΔT 4 K in salt bath
- Over-temperature selection limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter for furnace and product
- Cascade control of salt bath and furnace chamber, control via salt bath temperature



Exhaust gas collection at crucible rim

Crucibles

- Crucible 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
- Crucible type C: high alloy CrNi steel for neutral salt and annealing baths up to 1000 °C

Additional Equipment

- Exhaust gas collection at crucible rim
- Custom dimensions and modified furnace geometry
- Enhanced safety systems heat treating aluminum and magnesium in salt bath



Salt bath plant for annealing aluminum components in the aviation industry

Model	Tmax °C*	Inner dimensions Ø in mm	Salt bath crucible h in mm	Volume in l	Exterior dimensions in mm ¹			Supply power/kW ¹	Supply voltage	Weight in kg ¹
					W	D	H			
TS 20/15	750	230	500	20	850	970	800	16	three-phase	650
TS 30/18	750	300	500	30	950	1070	800	20	three-phase	700
TS 40/30	750	400	500	60	1050	1170	800	33	three-phase	750
TS 50/48	750	500	600	110	1150	1270	970	58	three-phase	1000
TS 60/63	750	610	800	280	1250	1370	1170	70	three-phase	1200
TS 70/72	750	700	1000	370	1350	1470	1370	80	three-phase	1500
TS(B)20/20	1000	230	500	20	850	970	800	21	three-phase	650
TS(B)30/30	1000	300	500	30	950	1070	800	33	three-phase	700
TS(B)40/40	1000	400	500	60	1050	1170	800	44	three-phase	750
TS(B)50/60	1000	500	600	110	1150	1270	970	66	three-phase	1000
TS(B)60/72	1000	610	800	220	1250	1370	1170	80	three-phase	1200
TS(B)70/90	1000	700	1000	370	1350	1470	1370	100	three-phase	1500

* Salt bath temperature

TS= electrically heated, TSB= gas heated, TS(B)= electrically or gas heated

¹ only for electric version

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 kW	Supply voltage
			W	D		
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	single-phase
631000470	N 321	CWK 3	750	1100	0.9	single-phase
631000471	N 641	CWK 4	1000	1300	0.9	single-phase



WS charging trolley

WS Charging Stackers

- 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	Designation
631000473	N 81	WS 81
631000425	N 161	WS 161
631000370	N 321	WS 321
631000426	N 641	WS 641
631000299	N 250/..HA	WS 25
631000532	N 500/..HA	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

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



Hardness tester **RAS(N)**

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

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



Hardness tester **PR1** in wooden case

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



Supply Voltages for Nabertherm Furnaces

Single-phase: all furnaces are available for supply voltages of 110 V - 240 V, 50 or 60 Hz.

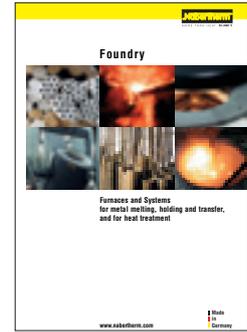
Three-phase: all furnaces are available for supply voltages of 200 V - 240 V or 380 V - 480 V, 50 or 60 Hz.

The Nabertherm Product Range

Foundry

Starting from electrically or gas heated melting furnaces up to fully automatic annealing plants for aluminum parts we provide solutions for the foundry industry in the most professional manner.

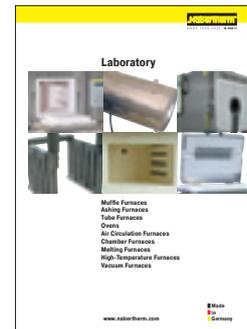
www.nabertherm.com/Products/Foundry



Laboratory

Laboratory furnaces are available for a variety of applications from 30 to 3000 °C. Our standard product range includes muffle, tube, air circulation, melting, assay, high-temperature, or chamber furnaces.

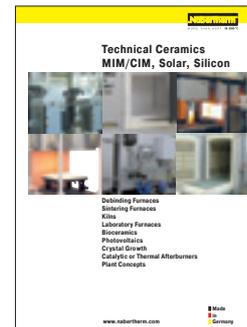
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Ceramics

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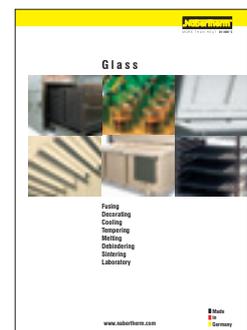
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Glass

Various system concepts for bending and slumping, decorating, tempering and fusing makes Nabertherm your strong partner for heat treatment of glass.

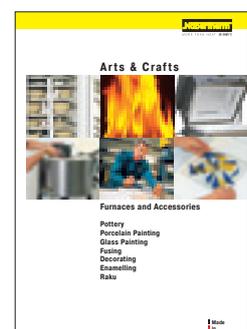
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Arts & Crafts

No matter if for pottery, glass or pocolain painting, fusing or enameling, we have the right furnace model for your needs.

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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.

No.	DIN	SAE/AISI	Reference analysis in %									Soft annealing		Hardening °C		Quenching g)	Tempering °C	Tensile strength N/mm ²
			C	Si	Mn	Cr	Mo	Ni	V	W	Other	Temp. °C	Hardening HB	Core	Edge			
Case hardening steels																		
1.1141	Ck15	1015	0.15	0.25	0.45							650-700	131	900	790	W/MB/Oil	150-180	590-780 1)
1.5752	14NiCr14	3310	0.14	0.30	0.55	0.75			3.50			610-650	230	850	790	MB/Oil	170-200	930-1230 1)
1.5919	15CrNi6	3215	0.15	0.30	0.50	1.55			1.55			650-700	217	860	810	MB/Oil	170-210	880-1180 1)
1.6587	17CrNiMo6		0.17	0.30	0.50	1.65	0.30		1.55			650-700	229	860	810	MB/Oil	170-210	1080-1320 1)
1.7131	16MnCr5	5115	0.16	0.30	1.15	0.95						650-700	207	870	820	MB/Oil	170-210	780-1080 1)
1.7147	20MnCr5	5120	0.20	0.30	1.25	1.15						650-700	217	870	820	MB/Oil	170-210	980-1270 1)
Quenching steels																		
Hardening temperature °C																		
1.1191	Ck45	1045	0.45	0.40	0.65							650-700	207	830-860		W/Oil	550-650	730-660 1)
1.6580	36CrNiMo8		0.30	0.40	0.45	2.00	0.40					650-700	248	830-860		Oil	550-650	1280-920 1)
1.6582	34CrNiMo6	4340	0.45	0.40	0.55	1.55	0.25	1.55				650-700	235	830-860		Oil	550-650	1170-900 1)
1.7033	34Cr4	5132	0.34	0.40	0.75	1.05						680-720	217	840-870		W/Oil	550-650	930-800 1)
1.7218	25CrMo4	4130	0.25	0.40	0.75	1.05	0.25					680-720	212	850-880		W/Oil	550-650	900-700 1)
1.7220	34CrMo4	4137	0.34	0.40	0.75	1.05	0.25					680-720	217	840-870		W/Oil	550-650	990-800 1)
1.7225	42CrMo4	4140	0.42	0.40	0.65	1.05	0.25					680-720	217	830-860		W/Oil	550-650	1090-840 1)
1.7228	50CrMo4	4150	0.50	0.40	0.65	1.05	0.25					680-720	235	830-860		W/Oil	550-650	1180-920 1)
1.8159	50CrV4	6150	0.50	0.40	0.90	1.05			0.15			680-720	235	830-860		W/Oil	550-650	1260-980 1)
Nitriding steels																		
Hardness																		
1.8507	34CrAlMo5		0.34	0.40	0.65	1.15	0.20			1.0 A	1.0 A	650-700	248	570-650		W/Oil	570-650	approx. 950 HV 3)
1.8519	31CrMoV9		0.31	0.40	0.55	2.50	0.20		0.15			650-700	248	850-870		W/Oil	580-630	approx. 750 HV 3)
1.8550	34CrAlNi7		0.34	0.40	0.55	1.65	0.20	1.00		1.0 A	1.0 A	650-700	245	850-900		Oil	580-660	approx. 950 HV 3)
Cold-working steels																		
1.1545	C105W1	W1	1.05	0.20	0.20							680-710	190	770-800		W	180-300	64-56 HRC 2)
1.1730	C45W3		0.45	0.30	0.70							680-710	190	800-830		W	180-300	56-49 HRC 2)
1.2080	X210Cr12	D3	2.10	0.25	0.30	11.50						800-830	231	930-980		Oil/MB/A	180-300	63-60 HRC 2)
1.2162	21MnCr5	5120	0.21	0.25	1.25	1.15						680-710	217	810-830		Oil/MB	150-180	60 HRC 4)
1.2210	115CrV3	L2	1.15	0.25	0.30	0.65			0.10			710-740	211	810-830		W/Oil	180-250	62-60 HRC 2)
1.2312	40CrMnMoS86		0.40	0.40	1.50	1.90	0.20					740-760	230	830-870		Oil/MB/A	180-400	53-48 HRC 2)
1.2316	X36CrMo17		0.40	1.00	1.00	16.00	1.20	1.00				780-820	240	1000-1030		Oil/MB	180-300	48-42 HRC 2)
1.2363	X100CrMoV51	A2	1.00	0.20	0.60	5.30	1.10		0.20			850	210	930-970		Oil/MB	180-400	62-57 HRC 2)
1.2379	X155CrVMo121	D2	1.55	0.25	0.30	12.00	0.70		1.00			840-860	240	1000-1030		Oil/MB/A	180-250	62-60 HRC 2)
1.2436	X210CrW12	D6	2.10	0.25	0.30	11.50				0.70		800-830	240	930-980		Oil/MB/A	180-250	63-60 HRC 2)
1.2510	100MnCrW4	01	0.90	0.30	1.20	0.50			0.10	0.50		780	190	780-820		Oil/MB	180-250	62-58 HRC 2)
1.2542	45WCrV7		0.45	0.95	0.30	1.05			0.15	2.00		720-750	225	890-920		Oil	180-300	56-54 HRC 2)
1.2550	60WCrV7	S1	0.65	0.60	0.30	1.10			0.20	2.00		720-750	230	860-900		Oil	180-300	59-56 HRC 2)
1.2601	X165CrMoV12	D2	1.65	0.30	0.30	11.50	0.60		0.30			800-830	240	980-1020		Oil/MB/A	180-250	61-59 HRC 2)
1.2721	50NiCr13		0.55	0.30	0.50	1.00	0.30	3.00				760	230	840-870		Oil/A	160-300	57-52 HRC 2)
1.2767	X45NiCrMo4		0.45	0.25	0.30	1.35		4.00				610-640	250	840-870		Oil/A	160-250	55-53 HRC 2)
1.2842	90MnCrV8	O2	0.90	0.25	2.00	0.35			0.10			690-720	210	760-820		Oil/MB	150-250	63-59 HRC 2)
Hot-working steels																		
1.2343	X38CrMoV51	H11	0.38	1.00	0.40	5.30	1.10		0.40			750-780	235	1020-1050		Oil/MB/A	550-650	52-37 HRC 2)
1.2344	X40CrMoV51	H13	0.40	1.00	0.40	5.30	1.40		1.00			750-800	240	1020-1050		Oil/MB/A	550-650	55-40 HRC 2)
1.2365	X32CrMoV33	H10	0.32	0.25	0.30	3.00	2.80		0.50			750-800	235	1020-1050		Oil/MB/A	500-650	51-41 HRC 2)
1.2567	X30WCrV53		0.32	0.20	0.30	2.40			0.60	4.30		760-800	240	1050-1100		Oil/MB	600-700	50-36 HRC 2)
1.2581	X30WCrV93	H21	0.30	0.25	0.30	2.60			0.40	8.50		740-780	250	1100-1150		Oil/MB/A	550-700	52-38 HRC 2)
1.2714	56NiCrMoV7	L6	0.55	0.25	0.80	1.10	0.50	1.70	0.10			650-700	250	840-870		Oil	400-650	50-36 HRC 2)
High-speed steels																		
1.3207	S10-4-3-10	C1	1.23	0.25	0.30	4.00	3.80		3.30	9.30	10.5 Co	770-840	300	1210-1240 5)		Oil/MB/A	550-570	65-67 HRC 2)
1.3243	S6-5-2-5	M41	0.92	0.40	0.30	4.00	5.00		1.90	6.40	4.8 Co	770-840	280	1210-1250 5)		Oil/MB/A	550-570	64-66 HRC 2)
1.3247	S2-10-1-8	M42	1.10	0.25	0.25	4.00	9.20		1.20	1.40	8.0 Co	770-840	280	1170-1210 5)		Oil/MB/A	530-560	67-69 HRC 2)
1.3265	S18-1-2-10	T5	0.76	0.25	0.30	4.20	0.65		1.55	18.0	9.5 Co	820-850	300	1260-1300 5)		Oil/MB/A	560-580	64-66 HRC 2)
1.3343	S6-5-2	M2	0.90	0.25	0.30	4.10	5.00		1.90	6.40		770-840	280	1200-1240 5)		Oil/MB/A	540-560	64-66 HRC 2)
1.3344	S6-5-3	M3	1.22	0.25	0.30	4.00	5.00		2.90	6.40		770-840	280	1200-1240 5)		Oil/MB/A	550-570	64-66 HRC 2)
1.3346	S2-9-1	M1	0.80	0.40	0.30	4.00	8.60		1.15	1.75		790-820	280	1180-1220 5)		Oil/MB/A	530-550	64-66 HRC 2)
1.3355	S18-0-1	T1	0.75	0.20	0.30	4.20			1.10	18.0		770-840	280	1250-1290 5)		Oil/MB/A	550-570	64-66 HRC 2)

- 1) Tensile strength after case hardening in the core in N/mm² at Ø 30 mm
- 2) Hardness values after tempering at lowest and highest temperature
- 3) Approx. surface hardness after nitriding in HV

- 4) After case hardening
- 5) Using lower hardening temperatures for possible cold working is common practice
- 6) W=water/MB=martempering bath/A=air

Areas of application
<p>Case hardening steels</p> <p>Non-alloyed steel for small dimensions Nickel/chromium alloyed for heavy loads</p> <p>Cr/Ni/Mo alloyed for larger dimensions Manganese/chromium alloyed for normal to high loads and medium cross-sections</p>
<p>Quenching steels</p> <p>For smaller cross-sections and loads CrNiMo steels for high demand large parts in machine and gearbox construction Drive parts, axles, steering parts, etc.</p> <p>CrMo steels for high toughness and strength requirements in medium and larger cross-sections, e.g. connecting rods and drive shafts, etc.</p> <p>Springs, etc. with high toughness and elasticity</p>
<p>Nitriding steels</p> <p>Are supplied quenched and tempered (approx. 100 N/mm² tensile strength) and nitrided for most orders</p>
<p>Cold-working steels</p> <p>Impact and cutting tools Hand tools, guide plates, etc. High-performance steel, highly anti-corrosive Plastic molds, cold sinking possible (can be implemented) Drilling, frequently engraving in carbon tool steel Tough cold shear knives, etc. Non-corrosive against chem. attack such as PVC Universal steel with good toughness Tough high-performance steel, good cutting edge retention High-performance steel, high cutting edge retention Universal plate, all-around quality Special cold-working steel As above, slightly harder Tough high-performance steel, retains a cutting edge Tough hard, closed die coning, plastic molds Cutlery and plastic molds, bending strips Universally usable tool steel</p>
<p>Hot-working Steels</p> <p>Tough/high temperature stable Cr. alloy qualities for light metal alloy, compression mold cast and pin dies, hot shears, etc. For processing heavy metals W alloys for heavy duty tools, die inserts As above, outstanding elevated temperature hardness due to increased W content High-performance swage/die inserts up to large dimensions, etc.</p>
<p>High-speed steels</p> <p>Dressing, roughing, wood processing, cold tools Turning and planing, wood processing, milling cutters, etc. Mills, drills, reamers, cold work tools Turning and planing tools for roughing-down work Drills, saws, etc., cold-working tools As above and circular saw segments Reamers, threading and broaching tools Turning and shaping tools, drills and mills</p>

Selecting proper hardness	Hardness HRC	Material number (AISI) 1)
<p>Tools made of high speed steel: For metal cutting processing such as lathe tools, milling cutters, etc. For cold cut-off processing such as cut-offs, fine or precision blanking, etc.</p>	65 62	1.3343 (M2) 1.3343 (M2) or PM qualities
<p>Steel types for cutting tools: For thin sheet thickness For thick sheet thickness</p>	62 57	1.2510 (O1)-1.2080 (D3) 1.2363 (A2)-1.2379 (D2)
<p>Steel types for cold working tools: Where material thickness is altered such as in metal stamping and embossing also for bending tools and shallow Forming: For thin sheet thickness For thick sheet thickness</p>	60 56	1.2510 (O1)-1.2363 (A2) 1.2721 (O1)
<p>Steel types for hot working processes: Such as forging and press dies, extrusion molds, die casting dies, etc: For mild and Severe forming</p>	50 44	1.2344 (H13) 1.2344 (H13)
<p>Drilling and thread-cutting tools: For machine processing For manual processing</p>	64 62	1.3343 (M2) 1.2510 (O2)-1.2363 (A2)
<p>Thread rolling dies and thread rolls: High degree of hardness, free from wear and sufficiently tough</p>	60	1.2379 (A2)-1.3343 (M2)
<p>Milling cutters: For metal processing For wood processing</p>	62 64	1.3343 (M2) 1.2379 (A2)-1.3343 (M2)
<p>Hammers: Only for hardening working surfaces</p>	56	1.1730 (SAE 1045)/1.1545-1.2542 (S1)
<p>Bending tools or similar tools Short strips Long strips</p>	54	1.2510 (O1)-1.2721 often flame-hardened; alloy/non-alloy steel
<p>Roller and end flanging tools: Grader, edge forming and knurling rolls</p>	60	1.3343 (M2)-1.2379 (A2)
<p>Rolling mill rolls: Short rolls and profile rolls Long rolls (must resist bending stresses)</p>	60	1.2379 (A2)-1.2363 (A2) low alloy steel
<p>Manual and agricultural tools/implements: Tough and subject to wear Requiring high strength</p>	58 42	1.1730 (SAE 1045) 1.2103-1.2542 (S1)
<p>Steel types for support parts: Such as for punch holding plates, base plates, structural and frame material, pressure plates, etc.</p>	40	1.1730 (SAE 1045)-1.2710 1.2721 (O1)
<p>Machine components: For heavy duty, quenched and tempered steel alloy For light duty; non-alloy quenched and tempered steel</p>	35 25	During use it is difficult to give further instructions due to the large number of alloy
<p>Gears: For light duty: non-alloy case hardened steel or non-alloy tempered steel For heavy duty: alloy case hardened steel or alloy tempered steel</p>		

1) For alternative qualities, please contact your steel supplier

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Our Web site features recent news, industry trade shows and training courses as well as company contact details and information on where your closest international sales office is located.

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info@nabertherm-cn.com
info@nabertherm.fr
nabertherm.florence@tin.it
info@nabertherm.ch
info@nabertherm.es
contact@nabertherm.co.uk
contact@nabertherm-usa.com

Tel (+86) 21 64902960
 Tel (+33) 1 5356 1800
 Tel (+39) 348 3820278
 Tel (+41) 62 209 6070
 Tel (+34) 93 674 8339
 Tel (+44) 1922 455 521
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References

