Nabertherm
MORE THAN HEAT 30-3000 °C

Operating Instructions

Chamber Furnaces for Annealing, Hardening and Brazing

N 7/H - N 87/H

M01.1071 ENGLISCH

Original instructions

Made
in
Germany

www.nabertherm.com

Reg: M01.1071 ENGLISCH
Rev: 2022-09

1 Introduction

These documents are intended only for buyers of our products and may not be copied or disclosed to third parties without our written consent. (Law governing copyright and associated protective rights, German Copyright Law from Sept. 9, 1965)

Nabertherm GmbH owns all rights to drawings, other documents and authorizations, also in case of applications for protective rights.

All the figures in the instructions have a descriptive character; in other words, they do not represent the exact details of the furnace.

1.1 Explanation of the Symbols and Warnings

Note

In the following operating instructions, specific warnings are given to draw attention to residual risks that cannot be avoided when the furnace is operating. These residual risks include dangers for humans/products/ the furnace, and the environment.

The symbols used in the operating instructions are especially intended to draw attention to safety information.

The symbols used cannot replace the text of the safety information. Therefore, always read the entire text.

Graphic symbols correspond to **ISO 3864**. In accordance with the **A**merican **N**ational **S**tandard **I**nstitute (ANSI) **Z535.6** the following warning information and words are used in this document:

The general hazard symbol, in combination with the words **CAUTION**, **WARNING** and **DANGER** warns about the risk of serious injury. Observe the following information to prevent injury or death.

NOTE	Refers to a hazard that could damage or destroy the equipment.
CAUTION	Refers to a hazard with a minor or medium risk of injury.
WARNING	Refers to a hazard that could cause death, serious or irreversible injury.
DANGER	Refers to a hazard that could directly cause death, serious or irreversible injury.

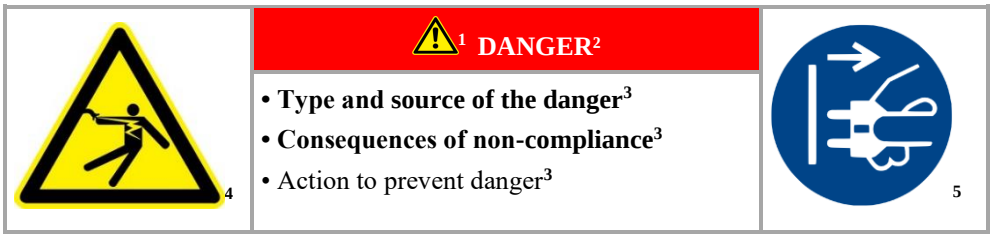
Structure of the Warning:

All Warnings are Structured as Follows

⚠[1] WARNING[2]

- **Type and source of the danger[3]**
- **Consequences of non-compliance[3]**
- Action to prevent danger[3]

or



Position	Description	Explanation
1	Hazard Symbol	Indicates the risk of injury
2	Signal Word	Classifies the danger
3	Reference Texts	• Type and source of the danger • Possible consequences of non-compliance • Measures/prohibitions
4	Graphical Symbols (optional) According to ISO 3864	Consequences, measures, and prohibitions
5	Graphical Symbols (optional) According to ISO 3864	Instructions or prohibitions

Information Symbols in the Instructions:

Note
Below this symbol you will find instructions and particularly useful information.

Rule - Rule Sign
This symbol draws attention to important rules that must be observed. Rule signs protect people against injury and show what is to be done in certain situations.

Rule – Important Information for Operators
This symbol draws the operator's attention to important information and operating instructions that must be observed.

Rule – Important Information for Maintenance Personnel
This symbol draws the maintenance personnel's attention to important operating and maintenance instructions (service) that must be observed.

Rule – Pull Out the Power Plug
This symbol tells the operator to pull out the power plug.

Rule – Disconnect the Furnace

This symbol informs the operator that before beginning any work the furnace must be disconnected from the power supply and the applicable safety rules and accident prevention regulations must be observed.

Rule – Lift only with Several People

This symbol draws the personnel's attention to the fact that this device may only be lifted and moved to its final destination by several people.

Caution – Fingers or Hands May Be Crushed

This symbol warns the operator of the potential for fingers or hands to be crushed. Ignoring this can lead to injury.

Warning – Hot Surface, Do Not Touch

This symbol warns the operator that the surface is hot and should not be touched.

Warning – Danger of Electric Shock

This symbol warns the operator that there is a risk of an electric shock if the following warnings are not heeded.

Warning – Risk of Device Toppling Over

This symbol tells the operator that there is a risk of the device toppling over if the following warnings are not heeded.

Warning – Suspended Load

This symbol warns the operator of potential dangers of suspended loads. Working below a suspended load is strictly forbidden. Ignoring this can lead to fatal injury.

Warning – Danger if Heavy Loads are Lifted

This symbol warns the operator of the potential dangers of lifting heavy loads. Ignoring this can lead to injury.

Warning – Risk to the Environment

This symbol warns the operator of the risk to the environment if the following information is not heeded. The operator must ensure that national environmental regulations are observed.

Warning – Fire Danger

This symbol warns operators of the danger of fire if the following information is not followed.

Warning – Risk of Explosive Substances or Explosive Atmosphere

These symbols warn the operator of explosive substances or an explosive atmosphere

Prohibited – Important Information for Operators

This symbol warns the operator that water or cleaning products must NOT be poured over the objects. A high-pressure cleaning device must also not be used.

Warning Signs on the Furnace:

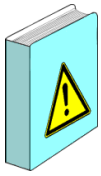
Warning – Hot Surface, Danger of Burning – Do Not Touch

You may not always realize that surfaces, such as furnace components, furnace walls, doors and materials, and even liquids are hot. Do not touch the surface.

Warning – Danger of Electric Shock!

Warning, dangerous electric voltage

1.2 Product Description



These electrically heated furnaces are a high-quality product which will give you many years of reliable service if they are properly cared for and maintained. One basic prerequisite is that the furnace is used the way it was designed to be used.

During development and production a high priority was placed on safety, functionality and economy.

These universal chamber furnaces with radiation heating are designed for tough heat treatment applications. They are perfect for processes in toolmaking and in the hardening shop, such as annealing, hardening and forging. A wide variety of accessories enables these furnaces to be tailored to the relevant application.

Other Characteristics of this Product are:

- Heating from three sides (both sides and the floor)
- Heating elements on carrier tubes ensure free heat radiation and a long service life
- Bottom heating protected by heat-resistant SiC tiles
- Multi-layer insulation with high-quality refractory insulation inside the furnace
- Exhaust air opening on the left side of the furnace, from N 31/H in the rear wall
- Models N 7/H – N 17/HR are designed as tabletop models
- Base included from model N 31/H
- Parallel swing door that opens downward
- Top part of door with stainless steel plates to prevent burning when the door is opened at high temperatures (from model N 31/H)
- Temperature uniformity according to DIN 17052-1 to +/- 10 °C
- Door movement cushioned with gas springs (from model N 31/H)

Additional Equipment

- Over-temperature limiter with manual reset as over-temperature protection for the furnace and the charge
- Process control and documentation via VCD software package for monitoring, documentation and control
- Parallel swing door that opens downward, pneumatically driven
- As special model, manual lift door that opens upward; pneumatic as an option

Accessories

- NTLog for Nabertherm controller: Recording process data with a USB flash drive
- Charging plate
- Annealing and hardening foil
- Protective gas boxes for protective gas atmosphere with additional charge thermocouple Type K
- Manual or automatic gas supply system
- Charging cart (from N 31/H)
- Digital temperature measurement device to measure the temperature in the protective gas boxes
- Cooling bench

1.3 Overview of the Complete System

Furnace model N 7/H – N17/HR (similar to picture)

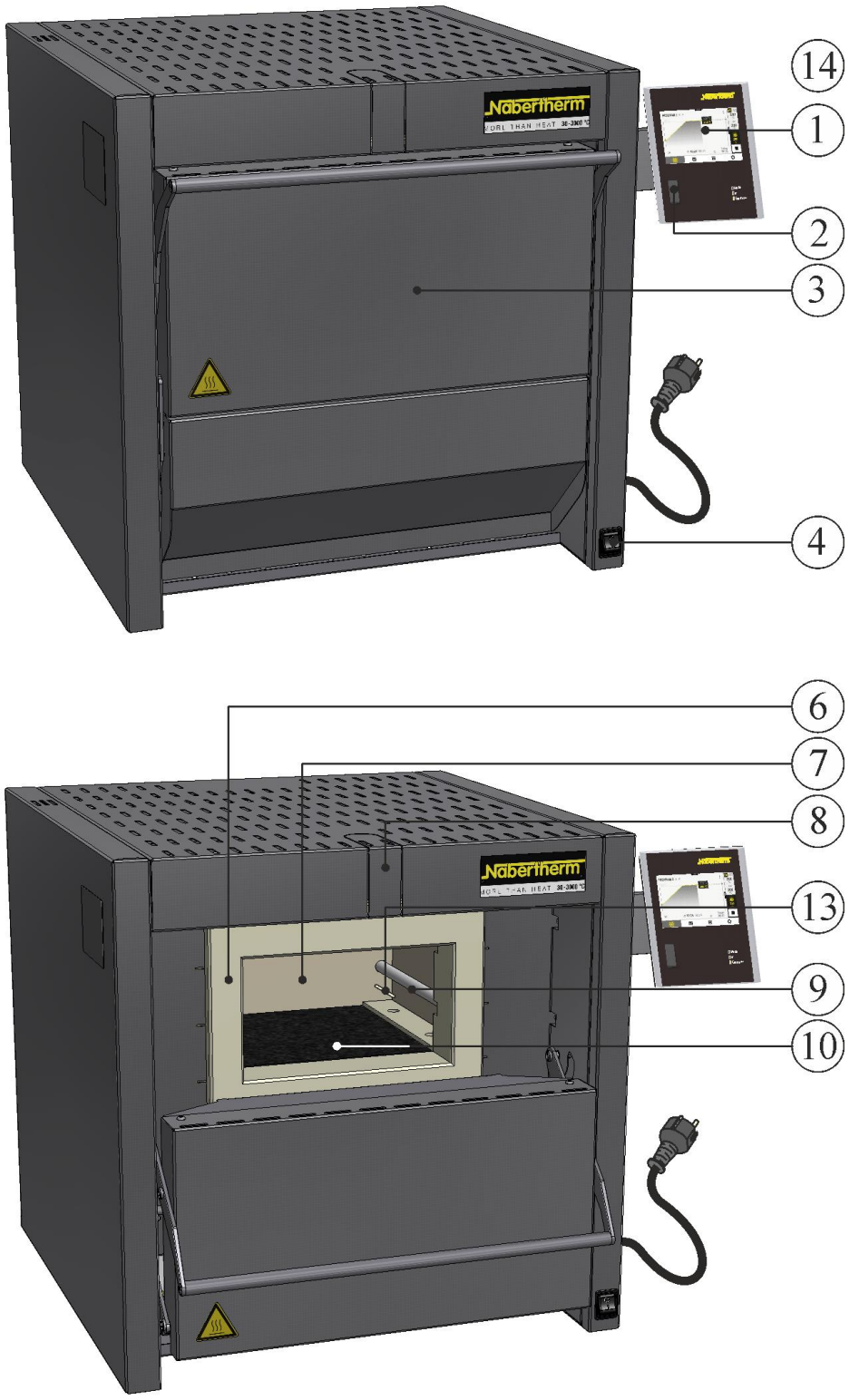


Fig. 1: Complete view: The example shows chamber furnace N 7/H (tabletop model) (similar to picture)

Furnace model N 31/H - N 87/H (similar to picture)

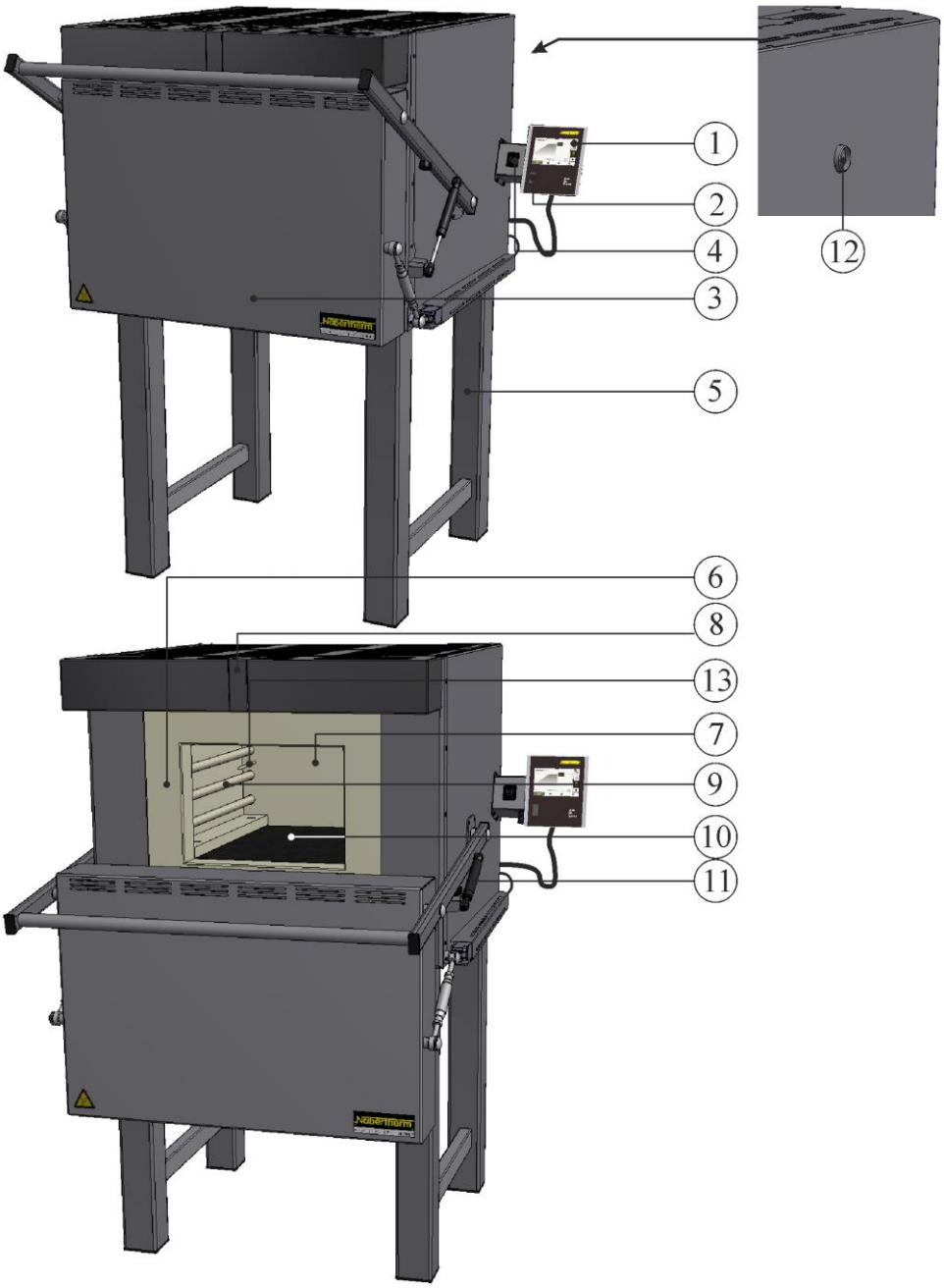


Fig. 2: Complete view: Example chamber furnace N 41/H (similar to picture)

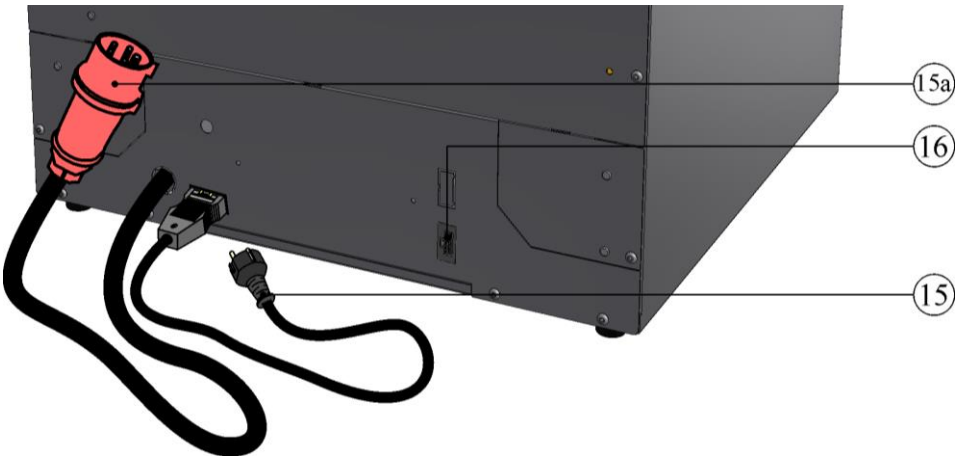
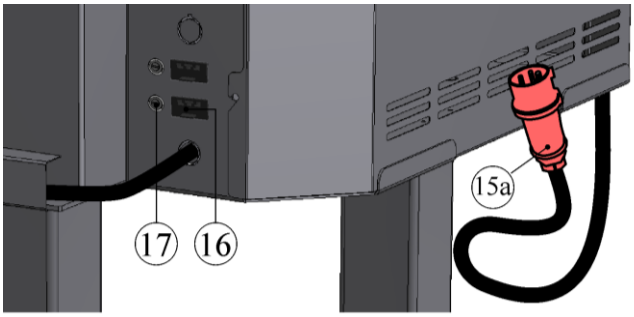
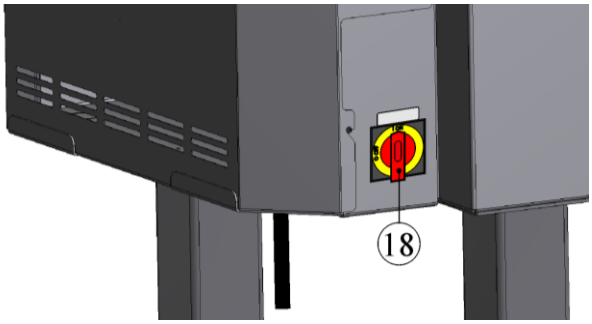


Fig. 3: Chamber furnace, rear view **N 7/H – N 17/HR** (similar to picture)



Furnace model N 31/H – N 87/H with power supply cable (depending on connection voltage)



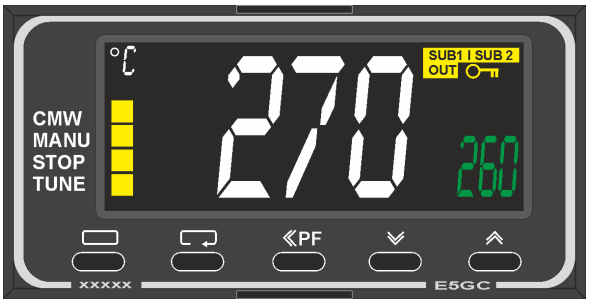
Furnace model N 31/H – N 87/H with fixed power connection and main switch (depending on connection voltage)

Fig. 4: Chamber furnace, rear view **N 31/H – N 87/H** (similar to picture)

No.	Name
1	Controller B500/C540/P570 (depending on model)
2	USB interface (NTLog for Nabertherm controller: Recording process data with a USB flash drive)
3	Parallel swing door, opens downward
4	Power switch with integrated fuse (for switching furnace on/off)
5	Base included from model N 31/H
6	Multi-layer insulation with high-quality refractory insulation inside the furnace
7	Furnace chamber
8	Opening for a gas supply system (remove perforation)
9	Heating elements on carrier tubes ensure free heat radiation and a long service life
10	Bottom heating protected by heat-resistant SiC tiles
11	Door movement cushioned with gas springs (from model N 31/H – N 87/H)
12	Exhaust air opening

No.	Name
13	Thermocouple
15	Power plug with snap-in coupling (to 3600 watts)
15a	CEE power plug (from 3600 watts) (depending on connection voltage)
16	Additional power connection (for accessories)
17	Fuse for additional power connection (for accessories)
18	Main switch (depending on connection voltage)

Additional Equipment



Over-temperature limiter with manual reset according to DIN EN IEC 60519-1 as over-temperature protection for the furnace and the charge

Abb. 5: Beispiel (Abbildung ähnlich)

1.4 Key to the Model Names

Example	Explanation
N 11/H	**N** = Chamber furnace
N **11**/H	**7** = 9-liter furnace chamber (Volume in L) **11** = 11-liter furnace chamber (volume in L) **17** = 17-liter furnace chamber (Volume in L) **31** = 31-liter furnace chamber (Volume in L) **41** = 41-liter furnace chamber (volume in L) **61** = 61-liter furnace chamber (volume in L) **87** = 87-liter furnace chamber (volume in L)
N 11/**HR**	**H** = high temperature Tmax. 1280 °C (2336 °F) **R** = increased power

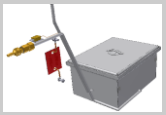
Nabertherm GmbH
Bahnhofstr. 20, 28865 Lilienthal/Bremen ,Germany
Tel +49 (04298) 922-0, Fax +49 (04298) 922-129
contact@nabertherm.de
www.nabertherm.com
Made in Germany

N 41/H	SN 123456	2016
xxxxxxxxx	1280 °C	-
-	400 3/N/PE	-
50 Hz	19,7/19,7/19,7 A	15,0 kW

Fig. 6: Example model designation (type plate)

1.5 Scope of Delivery

The scope of delivery includes:

	System components	Quantity	Comment
	Chamber furnace	1 x	Nabertherm GmbH
	Power cable[1)]	1 x	Nabertherm GmbH
	SiC floor tile	1 x	Nabertherm GmbH
	Charging plate[2)]	1 x	Nabertherm GmbH
	Annealing and hardening foil[2)]	[4)]	Nabertherm GmbH
	Protective gas box[1)]	1 x	Nabertherm GmbH
	Other components, depending on model	- - -	See shipping documents

	Document type	Quantity	Comment
	Operating Instructions	1 x	Nabertherm GmbH
	Operating manual for controller	1 x	Nabertherm GmbH
	Operating instructions for protective gas and carburization systems[1)]	1 x	Nabertherm GmbH
	Other documents, depending on model	1 x	

[1)] included with delivery depending on design/oven model
[2)] included with delivery if required, see shipping documents
[3)] quantity depending on furnace model
[4)] quantity as required, see shipping documents

Note

Keep all documents for future reference. All functions of this furnace system were tested during manufacturing and prior to shipping.

Note

The documents included do not always contain the electrical schematics and pneumatic diagrams.

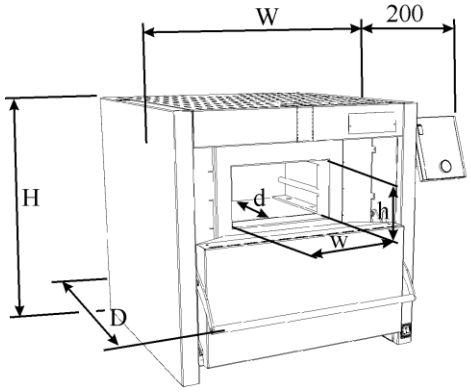
If you need the respective diagrams, they can be ordered from Nabertherm Service.

2 Specifications

Electrical specifications are on the type plate located on the side of the furnace.

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions in mm			Connected load	Weight	Minutes
	°C	w	d	h	in L	W	D	H	in kW	in kg	to Tmax[2]
N 7/H[1]	1280	250	250	140	9	600	650	600	3.0	60	180
N 11/H[1]	1280	250	350	140	11	600	750	600	3.5	70	180
N 11/HR[1]	1280	250	350	140	11	600	750	600	5.5	70	120
N 17/HR[1]	1280	250	500	140	17	600	900	600	6.4	90	120
N 31/H	1280	350	350	250	31	880	1100	1340	15.0	210	105
N 41/H	1280	350	500	250	41	880	1250	1340	15.0	260	120
N 61/H	1280	350	750	250	61	880	1500	1340	20.0	400	120
N 87/H	1280	350	1000	250	87	880	1750	1340	25.0	480	120

[1]tabletop model
[2]when connected to 230 V 1/N/PE or 400 V 3/N/PE



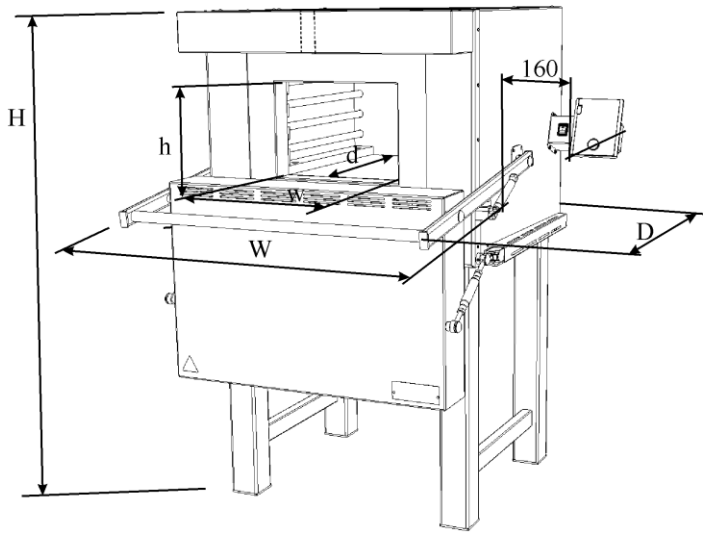


Fig. 7: Dimensions

Electrical connection		**1-phase:**	**3-phase:**
Furnace model		N 7/H N 11/H	N 11/HR[1], N 17/HR[1] N 31/H, N 41/H N 61/H, N 87/H
	Voltage (V):	See type plate on furnace	
	Frequency (Hz):	See type plate on furnace	
Thermal protection class	Furnaces:	according to DIN EN IEC 60519-1	
Protection class	Furnaces	1	
Protection type		IP20	
Ambient conditions for electrical equipment	Temperature: Humidity:	+5 °C to +40 °C max. 80% non-condensing	
Weights	Furnace with accessories	Depending on design (see shipping documents)	
Emissions	Continuous sound pressure level:	< 80 dB(A)	
[1]Heating only between two phases			

3 Warranty and Liability

§

As regards warranty and liability, the normal Nabertherm warranty terms apply, unless individual terms and conditions have been agreed. However, the following conditions also apply:

Warranty and liability claims for personal injury or damage to property shall be excluded if they are attributable to one or more of the following causes:

- All persons involved in operation, installation, maintenance, or repair of the furnace must have read and understood the operating instructions. No liability will be accepted for damage or disruption to operation resulting from non-compliance with the operating instructions.
- Not using the furnace as intended
- Improper installation, start-up, operation, or maintenance of the furnace,
- Operation of the furnace with defective safety equipment or improperly installed or non-functioning safety and protective equipment
- Not observing the information in the operating instructions with respect to transportation, storage, installation, start-up, operation, maintenance, or equipping the furnace
- Making unauthorized changes to the furnace
- Making unauthorized changes to the operating parameters
- Making unauthorized changes to the parameterization, the settings, or the program
- Nabertherm accepts absolutely no liability for damage caused by using parts that are not original Nabertherm parts. Original parts and accessories are designed especially for Nabertherm furnaces. Replace parts only with original Nabertherm parts. Otherwise the warranty will be void.
- Catastrophes due to third-party causes and force majeure

4 Safety

4.1 Defined Application

The Nabertherm furnace was designed and built in conformance with a careful selection of the applicable harmonized standards and other technical specifications. Hence, it corresponds to the state of the art and assures the greatest degree of safety.

Only materials whose characteristics and melting temperatures are known may be heated. Consult any available safety-related material data sheets.

These universal chamber furnaces with radiation heating are designed for tough heat treatment applications. They are perfect for processes in toolmaking and in the hardening shop, such as annealing, hardening and forging. A wide variety of accessories enables these furnaces to be tailored to the relevant application.

- Under certain circumstances gases or materials may be released from the materials in the furnaces that settle on the insulation or the heating elements and destroy them. **If applicable, read the labels and instructions on the packaging of materials that you use.**
- Only materials whose characteristics and melting temperatures are known may be heated. Consult any available safety data sheets of the materials. Any other use beyond this is improper, including the processing of products other than those for which the furnace was intended as well as handling hazardous materials or materials dangerous to health, and must be approved in writing by the manufacturer Nabertherm GmbH.
- Any other use, such as processing of products other than those for which the furnace was intended as well as handling hazardous materials or materials dangerous to health is deemed IMPROPER.
- Furnaces with over-temperature limit controllers must have their shut-down temperatures set to prevent any overheating of the material.
- The set-up instructions and safety regulations must be followed, otherwise the furnace will be considered improperly used, effectively cancelling any claims against Nabertherm GmbH. The EC Declaration of Conformity will cease to be valid if any modifications are made to the machine without our approval.
- The set-up instructions and safety regulations must be followed, otherwise the furnace will be considered improperly used, effectively cancelling any claims against Nabertherm GmbH.
- Opening the furnace while it is still hot, over 200 °C (392 °F), can lead to increased wear of the following components: insulation, door seal, heating elements and furnace housing. No liability shall be accepted for any damage to the goods or the furnace resulting from non-compliance with this warning.

Operation with power sources, products, operating equipment, auxiliary materials, etc., which are listed as hazardous or which may in any way harm the health of the operator is prohibited.

The furnace must not be filled with materials or substances that release explosive gases or vapors. Only materials and substances whose properties are known may be used.

This furnace was designed for **commercial** use. The furnace is **NOT** designed for heating food, animals, wood, grain, etc.

The furnace must not be used to heat the workplace.

Do not use the furnace to melt ice or for similar purposes.

Do not use the furnace as a clothes dryer.

Target group

The instructions are intended for operators and qualified specialists. Persons who work with the furnace system should pay special attention. Only people with the necessary training or who have received the necessary instructions may work with the furnace.

In accordance with EN 60335-1, the following standards apply

This furnace may be used by children aged 8 years and above and by persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge, provided they are supervised or have received instructions in using the furnace safely and they understand the hazards involved. Children must not be allowed to play with the furnace.

The operator is liable for any resulting damages.

For all furnace systems

Operation with explosive gases or mixtures or explosive gases or mixtures formed during the process is prohibited.

These furnace systems have no safety technology for processes in which combustible mixtures can form (design does not meet the safety requirements of EN 1539)

The concentration of organic gases must at no time exceed 3% of the lower explosion limit (LEL) in the furnace. This requirement not only applies to normal operation, but also in particular to exceptional circumstances, such as process malfunctions (due to the breakdown of a unit, etc.).

Nabertherm offers a wide range of furnaces that have been especially developed for processes with combustible gases.

Note

This product does not comply with the ATEX Directive and may not be used in ignitable atmospheres. The system must not be operated with explosive gases or mixtures and it must be ensured that explosive gases or mixtures do not form during the process.

4.2 Requirements for the Furnace Operator

The set-up instructions and safety regulations must be followed, otherwise the furnace will be deemed to have been used improperly, effectively cancelling any claims against Nabertherm GmbH.

This level of safety when operating the furnace can be achieved only if all the necessary measures have been taken. It depends on the furnace operator's diligence in planning these measures and controlling how they are carried out.

The Operator must ensure that

- all harmful gases are removed from the workplace, for example by an extraction system,
- the extraction system is switched on,
- the workplace is properly ventilated,

- the furnace is operated only in a perfect operating condition and, in particular, that the functions of the safety components are checked regularly.
- the required personal protective equipment is available for and used by the operating, maintenance, and repair personnel.
- these operating instructions, including the supplier documentation, are kept near the furnace. These instructions must be available at all times for anyone working with or on the furnace;
- all the safety and operating instruction signs on the furnace can be read properly. Damaged or unreadable signs must be replaced immediately,
- furnace personnel are informed regularly about all issues involving occupational safety and environmental protection and are familiar with all the operating instructions, especially those involving safety,
- a risk assessment is carried out (in Germany, covered of the Occupational Safety Act) to determine any other hazards that may result from the working conditions particular to the furnace's location,
- all other instructions and safety guidelines that have been determined in a risk assessment for the workplace are compiled in an operation manual (in Germany, covered of the Ordinance Regulating the Use of Operating Equipment).
- Only sufficiently qualified and authorized personnel may operate, maintain and repair the system. This personnel must be trained in how to operate the furnace and must confirm their participation in the training with a personal signature. The training program must be documented in detail. In case an operator is replaced, additional training must also take place. The additional training may only be performed by authorized, trained individuals familiar with the system. The additional training must be painstakingly documented and participation must be evidenced by the names and signatures of the participating employees.

Operating the Furnace

- Operating the furnace with explosive gases or mixtures, i.e., including any explosive gases or mixtures created as a result of heating/drying, is prohibited.
- A furnace opened while still hot radiates enormous heat energy, which can cause burns.
- Working with the furnace, for example opening the furnace door, etc., is only permissible when the whole space needed for the door to swing out, the danger zone, is visible to the operator.
- When working at the furnace with high temperatures, the appropriate protective clothing and protective goggles must be worn.
- Danger! Risk of burns:
  Several spots on the housing and components of the control box can become hot enough during normal operation to cause skin burns.
- When the vent supports are hot, touching them will lead to burns.

Note

If the protective gas boxes are used, a working temperature to 1100 °C (2012 °F) is recommended; with working temperatures to 1150 °C (2102 °F) the boxes will suffer increased wear.

Note

In Germany, the general accident protection guidelines must be observed. The accident prevention regulations applicable in the country where the furnace is installed must be observed.

4.3 Requirements for the Operating Personnel

All persons involved in operation, installation, maintenance, or repair of the furnace must have read and understood the operating instructions. No liability will be accepted for damage or disruptions to operation resulting from non-compliance with the operating instructions.

Only adequately qualified and authorized persons may operate, maintain, and repair the system.
These personnel are informed regularly about all issues involving occupational safety and environmental protection and are familiar with all the operating instructions, especially those involving safety,

Only trained personnel may operate the control and safety equipment.

DANGER

- **Danger caused by incorrectly entered cut-off temperature at the over-temperature limiter/over-temperature limiter with motor driven reset**
- **Risk of fatal injury**
- If, as a result of over-temperature from the charge and/or the operating equipment, a charge is likely to be damaged at this pre-set cut-off temperature of the over-temperature limiter/over-temperature limiter with motor driven reset, or if the charge itself becomes a source of danger for the furnace or its surroundings, the cut-off temperature must be reduced on the over-temperature limiter/over-temperature limiter with motor driven reset to the maximum permissible value.

4.4 Protective Clothing

When close to furnaces, heat treatment accessories and similar components, wear protective clothing that is resistant to heat and splashes of quenching media.

Wear a full-face mask that is resistant to heat and splashes of quenching media.

Protect your hands when handling heat treatment accessories and similar components by wearing heat-resistant gloves.

Protect your hands when cutting annealing and hardening foil/annealing envelopes by wearing firm gloves.

Wear safety boots to protect your feet.

4.5 Basic Measures During Normal Operation

Risks during Normal Operation!

Before switching the furnace on, check and ensure that only authorized persons are in the working area of the furnace and that no one can be injured as a result of operating the furnace.

Before starting production each time, check and ensure that all the safety equipment works properly.

Before starting production each time, check the furnace for obvious damage and ensure that it is operated only in a perfect condition. Report any defects to a supervisor immediately.

Before starting production each time, remove all materials and objects that are not needed for production from the working area.

At Least once every Day (see also Servicing and Maintenance) Check the Following:

- Check the furnace for obvious external damage,
- Check all hydraulic or pneumatic hoses, make sure that they are not leaking and that they are connected properly (if applicable),
- Check all gas and oil lines, make sure that they are not leaking and that they are connected properly (if applicable),
- Check that the fan works properly (if applicable)

4.6 Basic Measures in Case of Emergency

4.6.1 What to Do in an Emergency

Furnaces with Power Plug

Note

The power plug is to be pulled out to stop the furnace in case of an emergency. Therefore, the power plug must be accessible at all times when the furnace is operating so that it can be pulled out quickly in case of an emergency.

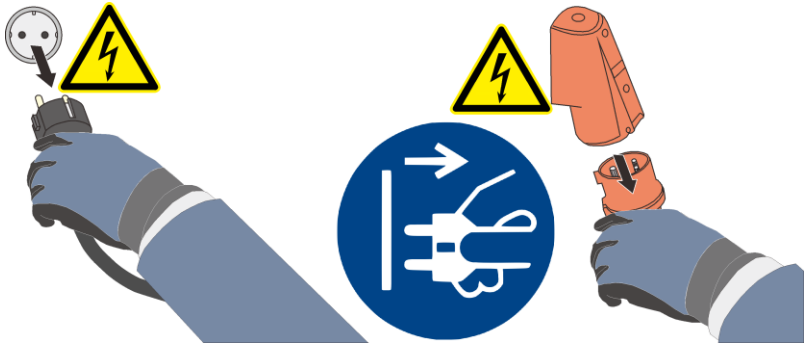
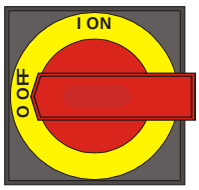


Fig. 8: Pull the power plug (similar to picture)

Furnaces with Main Switch



Note

In an emergency, **immediately** switch off the voltage supply to the furnace at the **main switch** (position "**O/OFF**"). Wait until the furnace chamber and attaching parts have cooled to room temperature.

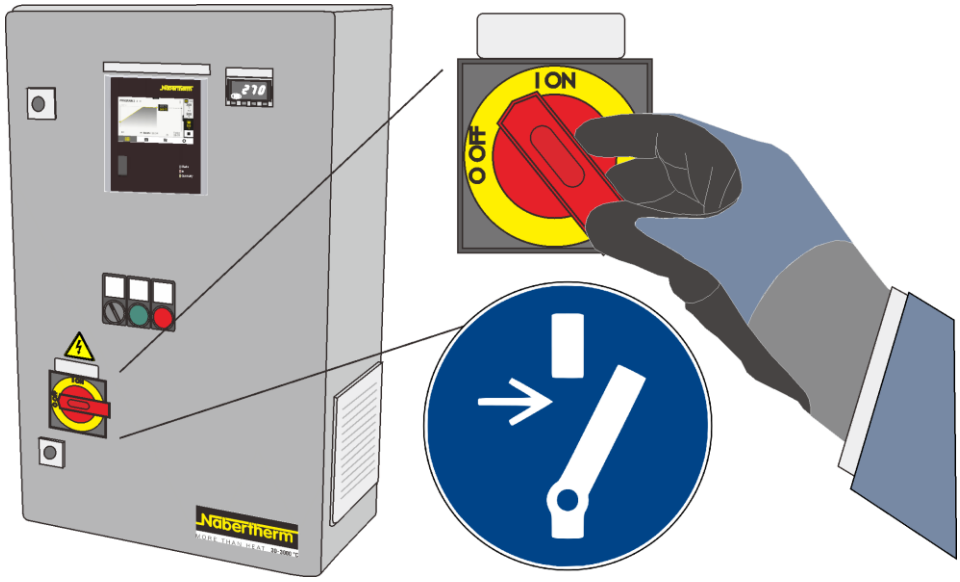
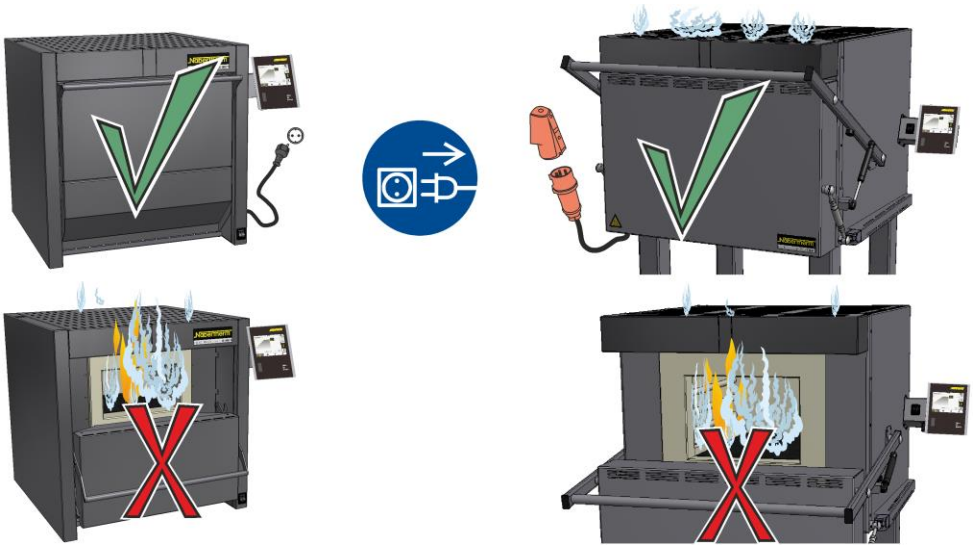


Fig. 9: Disconnecting the system via the main switch (similar to picture)

Risks during Normal Operation!

Switch the furnace off immediately in case of unexpected occurrences in the furnace (e.g. a lot of smoke or unusual smells). Wait until the furnace has cooled naturally to room temperature.

In case of fire, keep the door closed. This prevents smoke spreading and oxygen entering the furnace.



	**DANGER** • **Danger of electric shock.** • **Risk of fatal injury.** • Work on the electrical equipment may be performed only by qualified electricians or by technicians authorized by Nabertherm • Switch off the furnace	

Warning – Danger of Electric Shock!
Work on the electrical equipment may be done only by qualified, authorized electricians.

4.7 Basic Measures for Servicing and Maintenance

Maintenance work must be performed only by authorized persons, observing the maintenance instructions and the accident prevention regulations. We recommend that maintenance and repair work be carried out by the service team of Nabertherm GmbH. Non-compliance may cause injuries, death, or considerable damage to property.

Switch off the system and make sure it cannot be switched on again inadvertently (lock the main switch and secure it with a padlock), or pull out the power plug.

Clear an adequate area around the system to facilitate the repair work.
Suspended loads are dangerous. Working beneath a suspended load is prohibited. There is a risk of fatal injury.
Relieve the pressure on hydraulic and pneumatic equipment before carrying out maintenance or repair work. (if applicable).

When cleaning furnaces, control cabinets, or electrical equipment housings, never spray them with water.

When maintenance or repair work has been completed, before recommencing production ensure the following:

- Check that loosened screw connections have been re-tightened,
- Reinstall protective equipment, screens, and filters,
- Remove all material, tools, and other equipment used for the maintenance or repair work from the working area of the system,
- Remove any liquids that have leaked,
- Check that all safety functions (e.g. EMERGENCY STOP button) work properly,
- Power cables may be replaced only with similar, approved cables

4.8 Environmental Regulations

All statutory duties regarding waste avoidance, proper recycling, and disposal must be observed when work is carried out on and with the furnace.

Problem materials that are no longer needed, such as lubricants or batteries, must not be placed in normal waste disposal systems or allowed to enter the sewage system.

During installation, repair, and maintenance work, substances that are hazardous to water, such as

- lubricating grease and oils
- hydraulic oils
- refrigerants

- solvent-based cleaning fluids must not be allowed to contaminate the soil or enter the sewage system.

These substances must be stored, transported, collected, and disposed of in suitable containers.

Note

The operator must ensure that national environmental regulations are observed.

When it is delivered, this furnace contains no substances that make a hazardous waste classification necessary. However, residues of process materials may accumulate in the furnace insulation during operation. These may be hazardous to health and/or the environment.

- Dismantle the electronic components and dispose of them as electric scrap.
- Remove the insulation and dispose of it as hazardous waste (see “Servicing, Cleaning, and Maintenance with Ceramic Fiber Material”).
- Dispose of the housing as scrap metal.
- Contact the responsible disposal company to dispose of the materials listed above.

4.9 General Risks with the Furnace

Warning – General hazards!

Risk of burning on the furnace housing

The door handle can be extremely hot when the furnace is operating; wear protective gloves

Risk of crushing from moving parts (door hinges)

Dangerous high voltages are present at the control cabinet (if applicable) and at the terminal boxes on the system.

Do not insert objects into openings in the furnace housing, exhaust-air holes or cooling slits of the switchgear or furnace (if present). Ignoring this warning can result in electric shock.

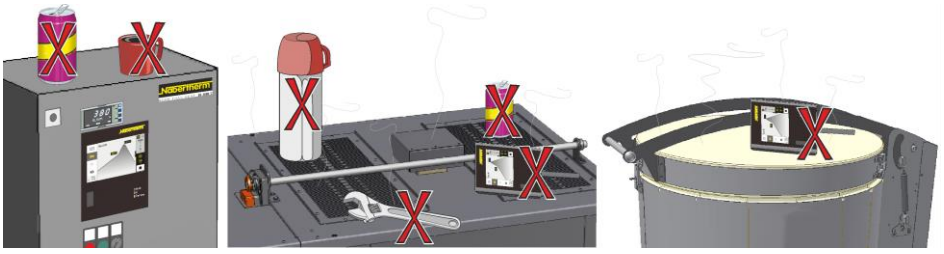
Risk of fire if using an extension cable:

For all furnace models with a plug-in connection:

If an extension cable or a power board are used, their maximum electrical load must not be exceeded. Do not operate the furnace with an extension cable if you are not sure if grounding is guaranteed.

Warning – General Hazards

No objects may be placed or set down on the furnace or switchgear. There is a risk of fire or explosion.



	**DANGER** • **Danger from electrocution** • **If there is no earth connection, or the earth connection is poorly connected, the result may be a deadly electrical shock.** • Do not insert any metallic objects such as thermocouples, sensors or tools into the furnace chamber without having previously ensured that the plant has been correctly earthed. Entrust the job of making a earth connection between the object and the furnace housing to a qualified electrical technician. Any objects inserted into the furnace must be inserted only through those openings intended for this purpose.	

	**DANGER** • **Danger caused by incorrectly entered cut-off temperature at the over-temperature limiter/over-temperature limiter with motor driven reset** • **Risk of fatal injury** • If, as a result of over-temperature from the charge and/or the operating equipment, a charge is likely to be damaged at this pre-set cut-off temperature of the over-temperature limiter/over-temperature limiter with motor driven reset, or if the charge itself becomes a source of danger for the furnace or its surroundings, the cut-off temperature must be reduced on the over-temperature limiter/over-temperature limiter with motor driven reset to the maximum permissible value.

4.10 Safeguarding against Dangers from Excess Temperatures

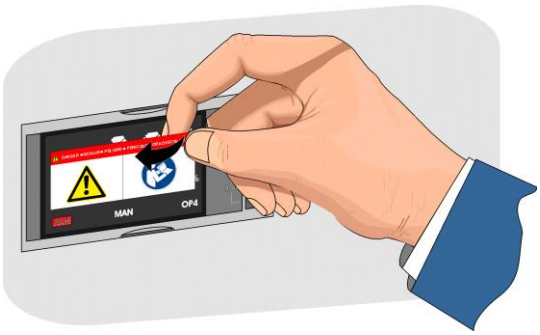
Over-temperature limiters and over-temperature limiters with automatic reset to protect against over-temperature in the furnace are available for Nabertherm GmbH furnaces either as a standard feature (depending on the model series) or as additional equipment (customized design).

Over-temperature limiters and over-temperature limiters with automatic reset monitor the furnace temperature. The display shows the most recently set cut-off temperature. If the furnace temperature rises above the pre-set cut-off temperature, the heating is shut down to protect the furnace, the charge and/or the operating equipment.

	**DANGER** • **Danger caused by incorrectly entered cut-off temperature at the over-temperature limiter/over-temperature limiter with motor driven reset** • **Risk of fatal injury** • If, as a result of over-temperature from the charge and/or the operating equipment, a charge is likely to be damaged at this pre-set cut-off temperature of the over-temperature limiter/over-temperature limiter with motor driven reset, or if the charge itself becomes a source of danger for the furnace or its surroundings, the cut-off temperature must be reduced on the over-temperature limiter/over-temperature limiter with motor driven reset to the maximum permissible value.

Read the operating instructions of the over-temperature limiter/over-temperature limiter with automatic reset before starting the furnace. The safety sticker must be removed from the over-temperature limiter/over-temperature limiter with automatic reset. When a change is made in the heat treatment program, the maximum permissible cut-off temperature (alarm trigger temperature) on the over-temperature limiter/over-temperature limiter with automatic reset must be checked or re-entered.

Depending on the physical characteristics of the furnace, we recommend that you set the maximum target temperature of the heating program in the controller between 5 °C and 30 °C below the trigger temperature of the over-temperature limiter/over-temperature limiter with automatic reset. This prevents unwanted triggering of the over-temperature limiter/over-temperature limiter with automatic reset.



Description and function, see the Operating Instructions of the over-temperature limiter/over-temperature limiter with automatic reset.

Fig. 10: Removing the sticker (similar to picture)

5 Transportation, Installation and Initial Start-Up

5.1 Delivery

Check that Everything is Complete

Compare the delivered items with the delivery note and the purchase order documents. **Immediately** notify the carrier and Nabertherm GmbH of any missing or damaged parts, as complaints at a later date cannot be acknowledged.

Danger of Injury

When the furnace is being lifted, parts of the furnace or the furnace itself could topple over, slip, or fall. Before the furnace is lifted, make sure no one is in the working area. Wear safety footwear and a hard hat.

Safety Instructions

- Forklifts must be operated only by authorized personnel. The operator bears sole responsibility for safe operation and the load

- When the furnace is being lifted, make sure that the ends of the forks or the load do not catch on neighboring goods. Use a crane to move tall parts, such as control cabinets.
- Use only lifting equipment with sufficient load-bearing capacity
- Lifting gear must be attached only to positions that have been designated for this purpose
- Attachments, piping, or cable conduits must never be used to affix lifting gear
- Unpackaged parts should only be lifted with ropes or straps
- Attach transportation equipment only to positions intended for this purpose.
- Lifting and securing equipment must conform to the provisions contained in accident prevention regulations
- Consider the weight of the furnace when choosing lifting and securing equipment. (see Specifications)
- Stainless steel parts (including mounting elements) must always be kept separate from unalloyed steel parts
- Do not remove corrosion protection until immediately prior to assembly

Risks during Normal Operation!

Suspended loads are dangerous. Working beneath a suspended load is prohibited. There is a risk of fatal injury.

Note

Safety and accident prevention guidelines applicable for forklift trucks must be followed.

Transportation with a Pallet Truck

Observe the maximum permitted capacity of the pallet truck.

1. Our furnaces are delivered ex works on wooden frames to facilitate unloading. Transport the furnace in its original packaging and with suitable equipment to prevent any damage. Remove the packaging only when the furnace is in its final location. When transporting the furnace, make sure it is secured against sliding, toppling over, and damage. The furnace should be transported and installed by at least two persons. **Do not store the furnace in damp rooms or outdoors.**
2. Push the pallet truck underneath the transportation frame. Make sure that the pallet truck is **completely** beneath the frame. Pay attention to neighboring goods.

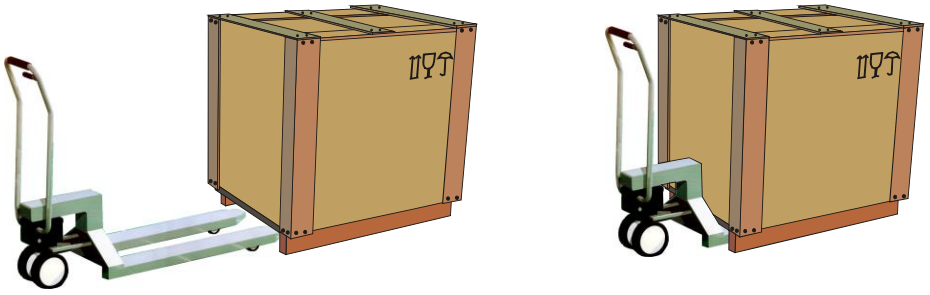


Fig. 11: Pallet truck is pushed **completely** beneath the transportation frame

3. Lift the furnace carefully and pay attention to its center of gravity. When the furnace is being lifted, make sure that the ends of the forks or the load do not catch on neighboring goods.
4. Make sure that the furnace is balanced safely; if not, attach securing equipment. Push the furnace carefully, slowly and with the pallet truck at its lowest position. Do not transport the furnace on inclines.

5. Carefully lower the furnace at its final position. Pay attention to neighboring goods. Try not to set it down too abruptly.

Note

In Germany, the general accident protection guidelines must be observed. The accident prevention regulations applicable in the country where the furnace is installed must be observed.

⚠ CAUTION

- **Device may slip or topple over.**
- **Damage to the device.**
- Risk of injury from lifting heavy loads.
- Transport device only in original packaging.
- Several people must carry the device.

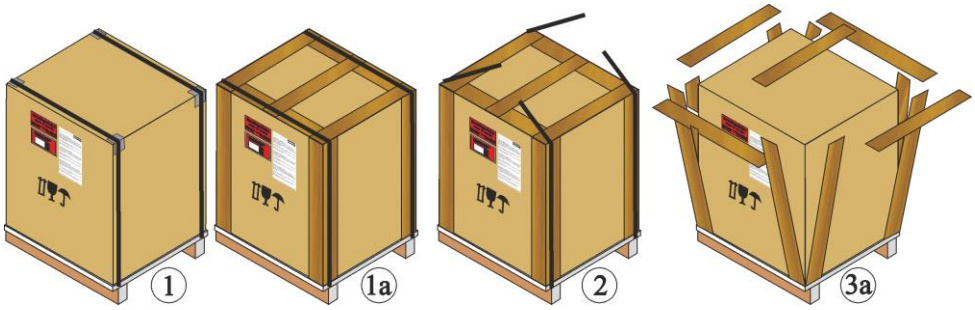
Symbols:

The symbols for handling packaging are defined in ISO R/780 (International Organization for Standardization) and in DIN 55402 (German Institute for Standardization).

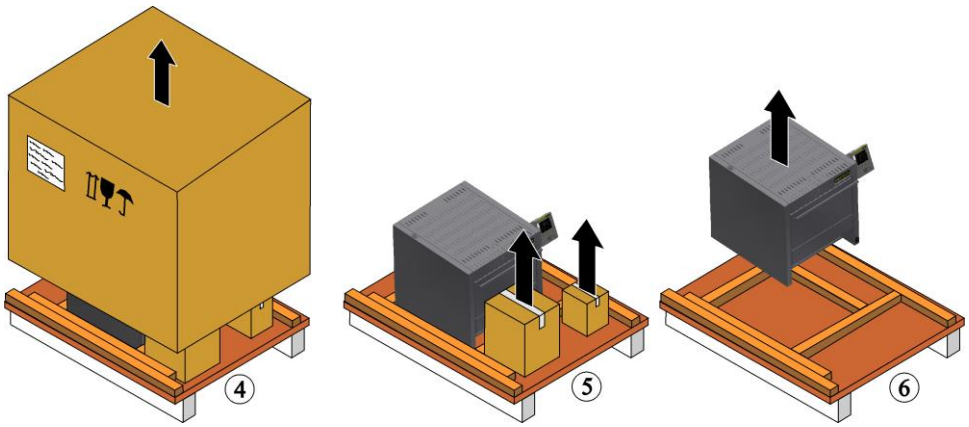
Description	Symbol	Explanation
Fragile		This symbol is to be attached to fragile goods. Goods marked like this are to be handled carefully and must not be thrown or tied up.
This side up		The freight must be transported, transshipped, and stored in such a way that the arrows point upward. The freight must not be rolled, folded, or stored on edge. However, the package does not have to be packed on top of other freight.
Keep dry		Products with this symbol must be protected against high air moisture, hence, they must be stored under cover. If particularly heavy or bulky packages cannot be stored in halls or sheds, they must be covered carefully with a tarpaulin or similar.
Sling here		The symbol shows only where the sling should be attached, not the method of slinging. If the symbols are at an equal distance from the middle or center of gravity of the package, the package hangs straight if the slings are the same length. If this is not the case, the sling on one side has to be shortened.

5.2 Unpacking (N 7/H - N 17/HR)

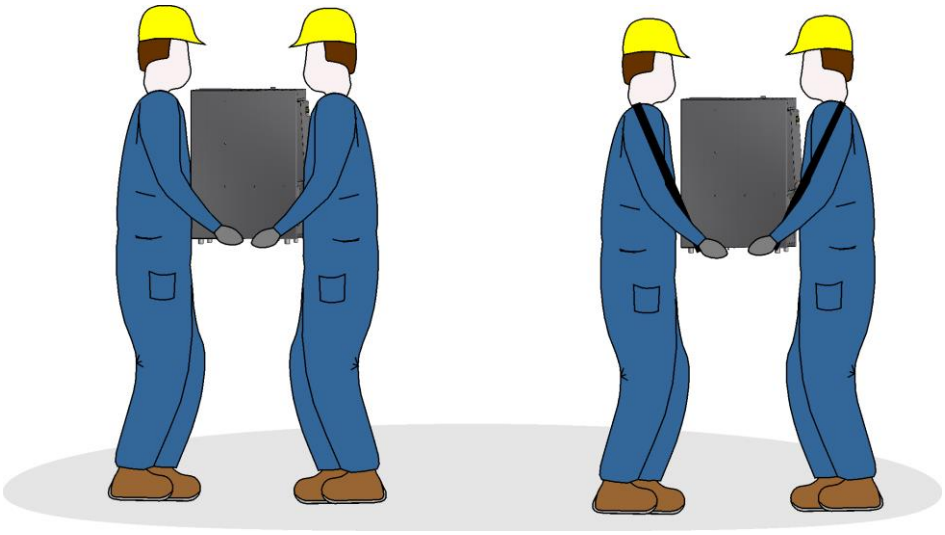
Wear protective gloves



1. Check the transportation packaging for possible damage.
2. Remove tensioning straps from the transportation packaging.
3. Slacken screws and remove wooden casing from the covering box (if available 3a).



4. Carefully lift the cardboard box and remove it from the pallet.
5. Remove the foil and packaging material. Compare the delivered items with the delivery note and the order documents, see "Delivery".
6. With two people, carefully lift the furnace out of the lower packaging unit, using the **lifting straps** on the furnace. We recommend that you attach the lifting straps around the sides (across) beforehand so that you can lift the furnace out of the packaging unit.



7. To carry, grip furnace from below at the sides and make sure you have a firm grip.
8. For furnaces weighing more than 25 kg, transport work must be carried out by at least 2 people. If transport straps are used, they must be attached crosswise only. Ensure that they are secure.

Note

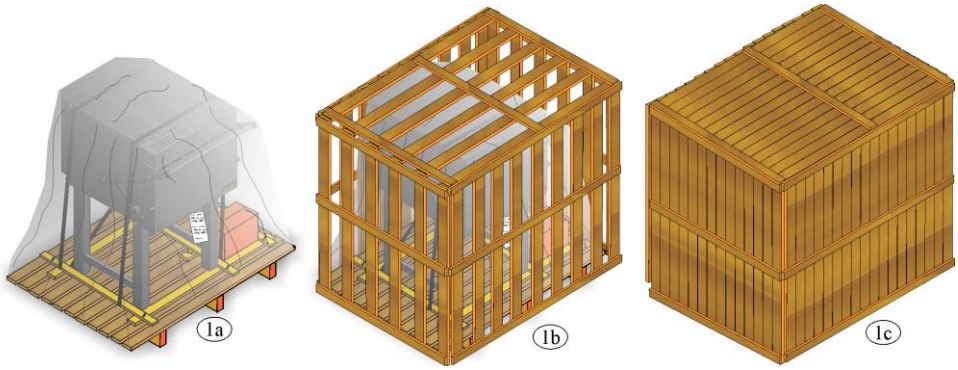
In Germany, the general accident protection guidelines of VBG or BGZ must be observed. The national accident prevention regulations of the country of operation apply.

Note

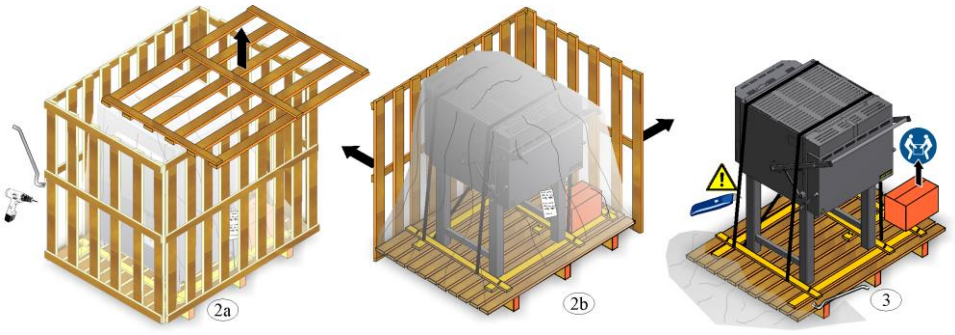
Save the packaging for possible shipping or for storing the furnace.

5.3 Unpacking (N 31/H - N 87/H)

Wear protective gloves

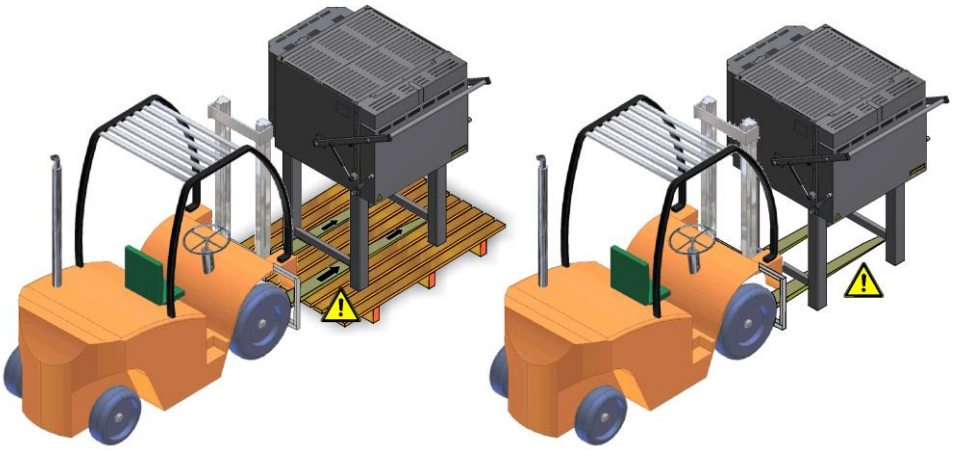


1. Check the transport packaging for any signs of damage. The packaging differs depending on size, weight or installation site and, based on this, is provided in one of the following ways. On a pallet, in a wooden cage or in a wooden box.



2. Remove screws/staples and then carefully remove the wooden siding from around the base. Remove any plastic transportation sheeting.
3. Remove any transportation sheets, straps and packaging materials.

Transportation with suitable forklift truck



4. The furnace frame is made of thick steel sections. Drive the forklift forks under the furnace watching out for fragile parts such as attachments and cables. Remove as necessary. Make sure that the forks of the forklift are **completely** under the frame. Mind the nearby transported goods.

   Carefully lift the furnace from below minding the center of gravity. When lifting make sure that the fork tips or the load itself do not get caught on nearby stacked goods. Drive carefully, slowly and **in the lowest** position. Do not drive over any steep surfaces. When the installation site is reached, lower the base carefully on the wheels. Avoid any sudden drops.

Caution

We recommend that the system be moved to the installation site over longer distances or over bumpy surfaces using a forklift or a pallet lift.

Note

In Germany, the general accident protection guidelines must be observed. The accident prevention regulations applicable in the country where the furnace is installed must be observed.

5.4 Transport Securing Device/Packaging

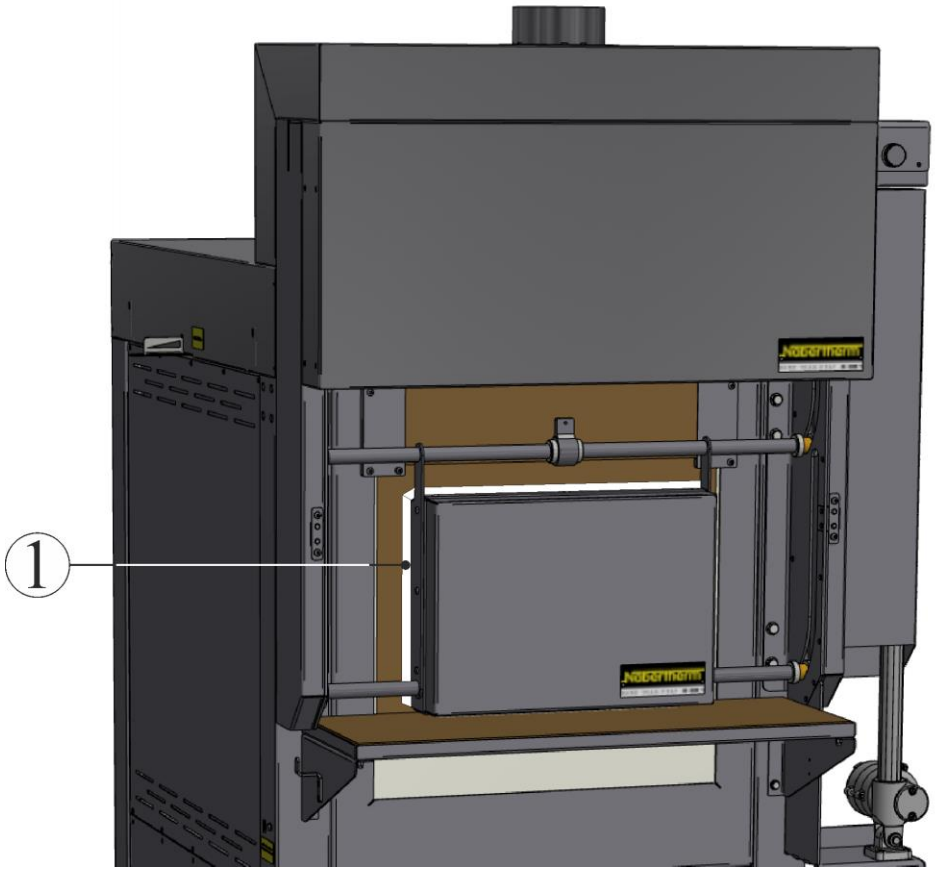
Note

No special transportation securing equipment is available for this furnace

The furnace packaging prevents damage during transportation. Make sure that you remove all packaging material (also inside the Furnace Chamber). All packaging material can be recycled. The packaging was designed so that no special description is necessary.

Safety Information

Do not allow children to play with packaging parts. They are at risk of suffocation from folding boxes and plastic film.



1 Remove the transport foil used to protect the all-round insulation

Fig. 12: Removing transport protection

Note

Please keep the packaging for possible shipping or storing of the furnace.

5.5 Constructional and Connection Requirements

5.5.1 Installation (Furnace Location)

When setting up the furnace, these safety instructions must be followed:

- The furnace must be installed in a dry room in accordance with the safety instructions.
- The table/supporting surface must be flat to enable the furnace to be installed straight. Place the furnace on a **non-flammable** surface (fire safety class A DIN 4102 – Example: concrete, tiles, glass, aluminum or steel) so that any hot material falling from the furnace cannot ignite the surface.
- The carrying capacity of the table must be designed to bear the weight of the furnace incl. accessories.
- The floor covering must be made of non-flammable material so that hot material falling out of the furnace will not cause the floor covering to ignite.

Installation Location

- The operator is responsible for adequate ventilation by installing the appropriate systems to supply fresh air and to vent exhaust air. If a batch emits gases or vapors, adequate ventilation of the installation site must be provided as well as a suitable exhaust air venting system. A suitable vent for combustion exhaust must be supplied by the customer
- Make sure that the heat radiated by the furnace is vented (consult a ventilation expert, if necessary)
- Although the furnace is well-insulated, the exterior surfaces of the furnace radiate heat. If necessary, this heat must be dissipated (**a ventilation technician may need to be consulted**). In addition, a minimum clearance (**S**) of 0.5 m on all sides and 1 m above the furnace must be maintained to flammable materials. In individual cases, more space must be chosen in order to match the local conditions. For **nonflammable materials**, the minimum **side** clearance can be reduced to 0.2 m.
- The furnace must be protected against weather and caustic atmospheres. Nabertherm accepts no liability or warranty claim for any corrosion damage as a result of installation in damp surroundings or for similar reasons.
- The furnace and switchgear are not designed to be operated outdoors.

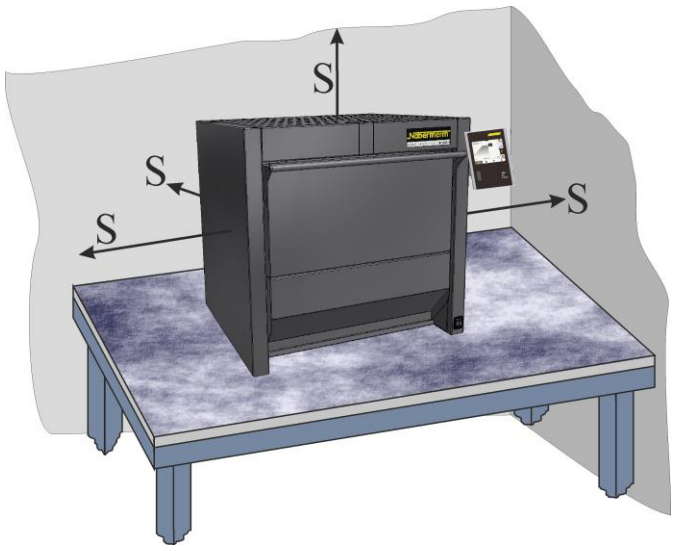


Fig. 13: Minimum safety gap to flammable materials (similar to picture)

	**DANGER** **• Risk of fire, danger to health** **• Risk of fatal injury** • Adequate ventilation must be ensured at the installation location to remove exhaust heat and exhaust gases

	**DANGER** **• Danger associated with the use of an automatic extinguishing system** **• Danger to life from electrocution through wetness, suffocation caused by extinguishing gas, etc.** • If automatic extinguishing systems are in place to fight fires and protect the building, e.g. sprinkler systems, care must be taken during their planning and installation that no additional hazards are created, for example by extinguishing a pilot light, mixing hardening oil and extinguishing water, shutdown of electrical equipment, etc.

5.6 Assembly, Installation, and Connection

5.6.1 Venting Exhaust Fumes

When the furnace is heating, hazardous gases and vapors may be released. Therefore, "exhaust gases" emitted from the exhaust air opening must be directed outdoors in a suitable manner (example: ventilate the working area). If adequate ventilation cannot be ensured at the working area, the "exhaust gases" must be removed via a suitable pipe. We recommend that you install a suitable extraction flue above the furnace or, if this is already installed on the furnace, connect suitable extraction pipes and remove the exhaust gases.

A suitable metal exhaust gas pipe can be used. Use only metal pipes (example: stainless steel). It must be attached facing upwards and be fixed to the wall or ceiling.

A maximum exhaust gas temperature of approx. 200 °C can be assumed for the exhaust system. There is a risk of burning at the bypass connection and the piping. The wall duct (1) must be made from heatproof material.

The size and design of the exhaust system must be defined by a ventilation engineer.

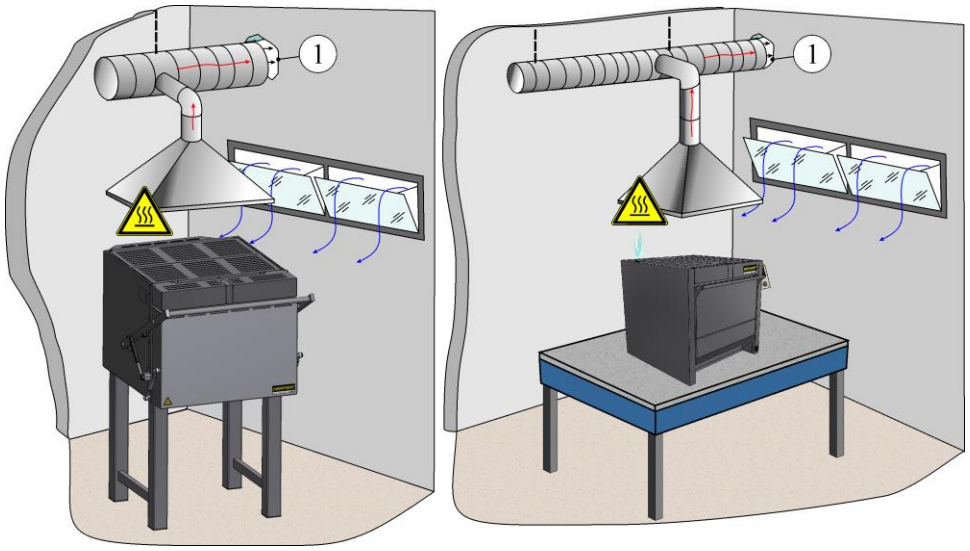


Fig. 14: Example: Installation of exhaust air piping (similar to picture)

Caution

Steps must be taken to ensure that the flow of hot air emitted from the furnace's exhaust outlet flap is not hazardous to people, property or the building.

Note

Exhaust gases can be vented only if the room is ventilated with a corresponding fresh air inlet.

Note

Roof work and/or masonry by the customer is required for the exhaust gas extraction. The size and design of the exhaust gas system must be defined by a ventilation engineer. The accident prevention regulations applicable in the country where the furnace is installed must be observed.

5.6.2 Insertion of the Base Plate

Compare the delivered items with the delivery note and the purchase order documents. **Immediately** notify the carrier and Nabertherm GmbH of any missing or damaged parts, as complaints received at a later date cannot be acknowledged.

Carefully place the insert plate(s)* (number of insert plates depends on the furnace model), distributed across the floor of the furnace, starting from the middle. When placing the insert plate(s) make sure that neither the door collar nor the heating elements are damaged. Absolutely avoid touching the heating elements when inserting the heating plate(s). Contacting the heating elements can result in their immediate destruction.

The furnace floor is made of high-quality refractory material but this material is highly sensitive to impact or pressure.

Some models are supplied with one insert plate as a standard in order to prevent the soft furnace floor from being damaged. Nabertherm accepts no liability for damage (e.g. depressions) in the furnace floor resulting from not using these insert plates*. Damaged insert plate(s) must be immediately replaced with new ones (see the section "Spare Parts/Wearing Parts").

The charge must be positioned in the furnace chamber, on the floor, as centered as possible. This ensures uniform heating.

After charging, the furnace door must be closed carefully.

*in scope of delivery depending on the design/furnace model

Note

It must be ensured that the load on the furnace base does not exceed 2 kg/dm^2.

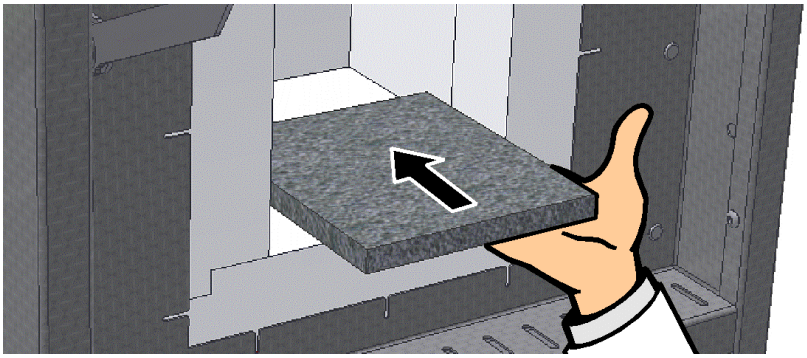


Fig. 15: Inserting the ceramic insert plate (in scope of delivery depends on design/furnace model) (similar to picture)

Note

Since SiC plates expand continuously, they should be replaced after about 3-5 years. Otherwise there is a risk that the collar bricks will be pushed outwards. In this case, we will not accept warranty claims.

5.6.3 Assembling the Controller (Depending on the Model)

Attach the supplied controller with holder (model-related) to the furnace.

At the controller position there are screws to attach the holder; these must be unscrewed beforehand.

Place the controller holder (2) with the screws loosened on to the correct position on the furnace and fasten it with suitable tools (3).

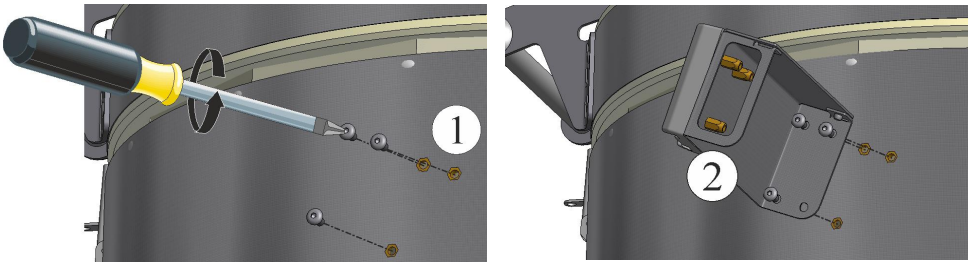


Fig. 16: Install the holder on the furnace housing (similar to picture)

Tighten the screws (3) of the holder and check that is sits properly (4).

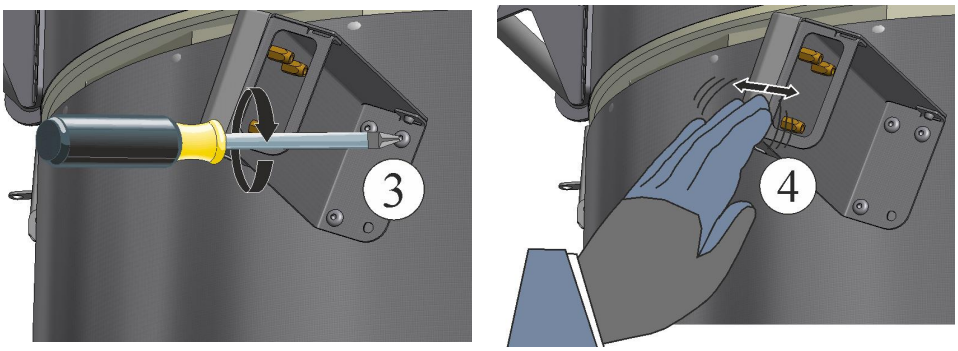


Fig. 17: Tighten the screws on the holder (similar to picture)

Place the controller in the holder on the furnace.

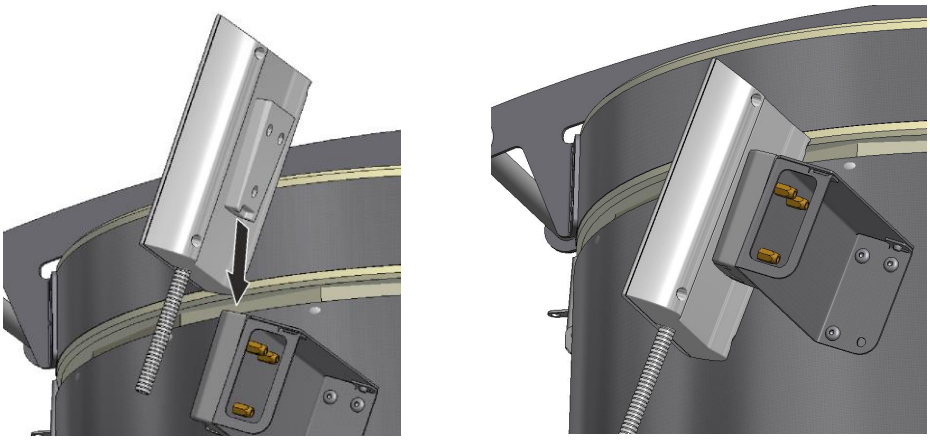


Fig. 18: Place the controller in the holder (similar to picture)

Make sure that the controller is placed correctly in the holder. If this is ignored, the controller may be damaged or destroyed. Nabertherm accepts no liability if the controller is not handled properly.

Fig. 19: Place the controller in the holder on the furnace (similar to the picture)

5.6.4 Connecting the Furnace to the Power Supply

On the building side, the required services must be provided, i.e. the carrying capacity of the installation surface, provision of power (electricity), etc.

- The furnace must be installed in accordance with its intended use. The power connection values must correspond to the values on the furnace type plate.

- The power socket must be located close to the furnace and must be easily accessible. The safety requirements are not met if the furnace is not connected to a socket with grounding contact.
- On use of an extension cable or a multipoint socket, the maximum electrical rating must not be exceeded. Do not use the furnace with an extension cable if you are uncertain whether grounding is guaranteed.
- The power cable must not be damaged. Do not place any objects on the power cable. Route the cable so that nobody can tread on or stumble over it.
- A damaged power cable must be replaced immediately.
- Ensure that the furnace's connection cable is routed so that it is protected.

Note

Before connecting the power, make sure that the power switch is set to "**Off**" or "**0**".

Power Connection with Plug-In Power Line:

When you plug the power plug into an appropriate socket check the type plate for specifications related to mains voltage, mains type and max. power requirement. The distance between the furnace and the socket should be as short as possible. Extensions must be avoided.

The power plug (furnace with feeder) enables the furnace and control box to be connected and disconnected from the power grid.

The power plug must be easy to reach while the furnace is in operation to be able to pull it quickly in case of emergency (see section entitled "What to do in an emergency").

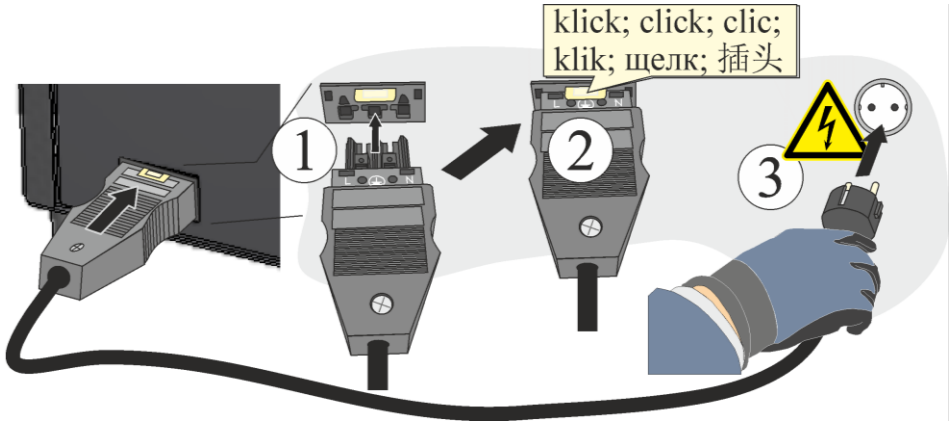


Fig. 20: Furnace up to 3600 kW (the power cable is supplied) (similar to picture)

1. Plug the supplied connection cable with snap-in coupling into the rear wall of the furnace.
2. Then connect the power cable to the power supply. Use only a grounded socket.

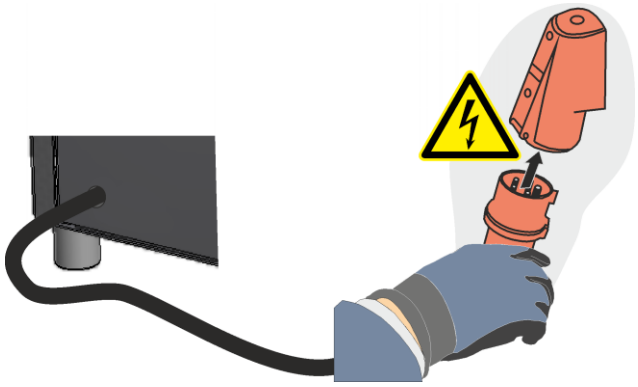


Fig. 21: Furnace from 3.600 W (CEE plug) (similar to picture)

1. Connect the power cable to the power supply. Use only a grounded socket.

   Check the ground resistance (acc. to VDE 0100); see also accident prevention regulations.

   Electrical systems and equipment according to DGUV V3.

Power Connection without Plug-In Power Line:

The power line must have a fixed connection in the switchgear cabinet, either at the available terminals or, in models without a separate switchgear, to the main switch. When carrying out this work pay attention to the specs on the type plate: network voltage and type, and maximum power consumption.

The fuse protection and the cross-section of the required power connection depend on the surrounding conditions, the length of the line and how it is installed. For this reason, the type of protection and how it should be installed must be decided by a qualified electrician.

- The power cable must not be damaged. Do not place any objects on the power cable. Lay the cable so that nobody can step on it or trip over it.
- The power line may only be replaced by an approved, equivalent line
- Ensure that the connection line of the furnace is protected

This protection must be compliant with locally applicable standards and regulations.

Ensure that the protective conductor terminal is correct.

When several phases are involved, they must be connected with a clockwise rotating field in the sequence L1, L2, L3.

Before you switch on the furnace for the first time make sure that **a clockwise rotating field is in place**. This is a prerequisite for the smooth functioning of the furnace.

Warning – Danger of Electric Shock!

Work on the electrical equipment may be done only by qualified, authorized electricians.

The customer must ensure that the floor has adequate load-bearing capacity and that the necessary energy (electricity) is provided.

- Make sure that the power cables are adequately dimensioned and fused according to the furnace characteristics.
- Ensure that the connection cable between the furnace and switchgear is protected.
- **Under certain operating conditions, contact voltages may occur, which could exceed the release current of an RCD with personal protection. For electrical safety, the requirements of EN IEC 60519-1 “Safety in electroheat installations Part 2” must be complied with.**
- Testing of ground resistance (compliant with VDE 0100); also refer to the accident prevention regulations.
- Electrical systems and operating equipment compliant with DGUV V3.

Note

The national regulations of the respective country of operation apply.

CAUTION

- **Danger from incorrect voltage**
- **Damage to the device**
- Check voltage before connecting and starting the furnace
- Compare the voltage with the details on the type plate

DANGER

- **Risk of fire, danger to health**
- **Risk of fatal injury**
- Adequate ventilation must be ensured at the installation location to remove exhaust heat and exhaust gases

5.6.5 Connection to Compressed Air Supply

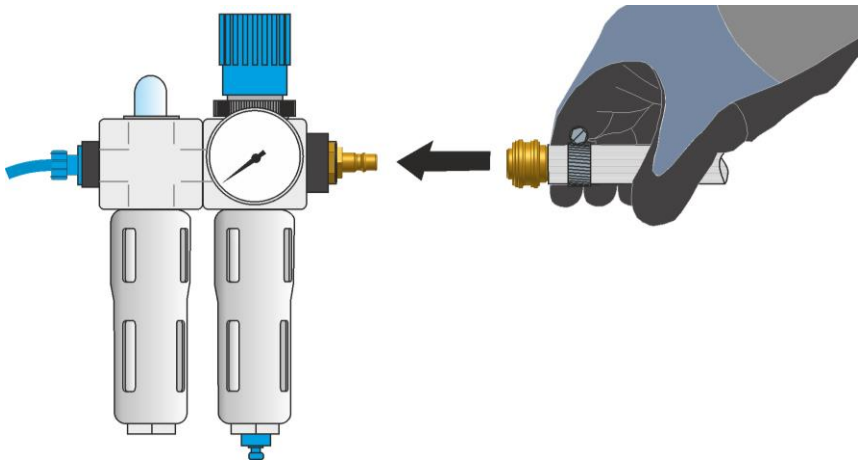


Fig. 22: Connection for the compressed air supply (similar to picture)

Connect the Coupling Socket to the Quick Coupling

Connect the coupling socket (1) (not included with delivery) with a suitable hose (2) and a hose clamp. Tighten the hose clamp with a suitable tool (3). Make sure that the connection between the coupling socket and the hose is tight.

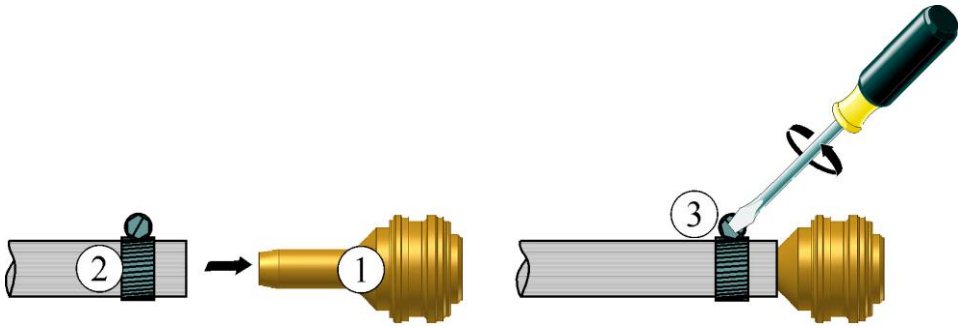


Fig. 23: Connection between coupling socket and hose (similar to picture)

Place the hose with the connected coupling socket on to the quick-action coupling (4).

Fig. 24: Connection between coupling socket and quick-action coupling (similar to picture)

When you hear a "click" you know that the coupling socket and the quick-action coupling are connected properly.

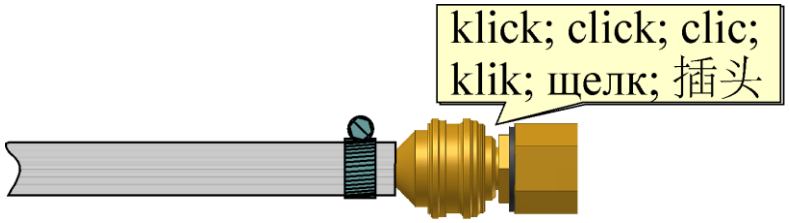


Fig. 25: Connection between coupling socket and quick-action coupling (similar to picture)

Disconnect the Connection at the Coupling Socket and the Quick Coupling

Close the valve of the compressed air supply or the gas supply system and pull out the coupling socket (1) on the line.

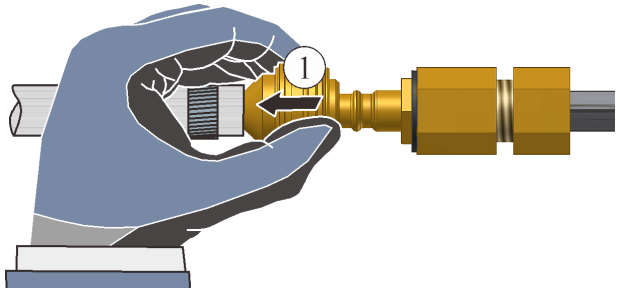


Fig. 26: Disconnect the coupling socket from the quick coupling (similar to picture)

Medium:	**Air**
Primary Pressure:	max. 8 bar (at 40 °C ambient temperature)
Oil content:	- - -
Solid content:	- - -
Water content:	- - -
Connection:	Quick coupling with 3/8" hose fitting

5.6.6 Setting the Traveling Distance for the Pneumatic Door Opener

After connecting the compressed air supply (1) the door can be opened or closed by pressing the foot pedal (see section "Operating the Pneumatic Door Opener with the Foot Pedal"). **Maximum operating pressure** (2) approx. **8 bar** (dependent on ambient temperature) for filtered (40 µm) compressed air (and oiled as well).

The **optimum operating pressure** was set at the factory on the maintenance unit (3) at approx. **6 bar** and should not be changed. During operation there must be permanent pressure on the maintenance unit. However, any potentially necessary correction may only be made if these instructions are followed:

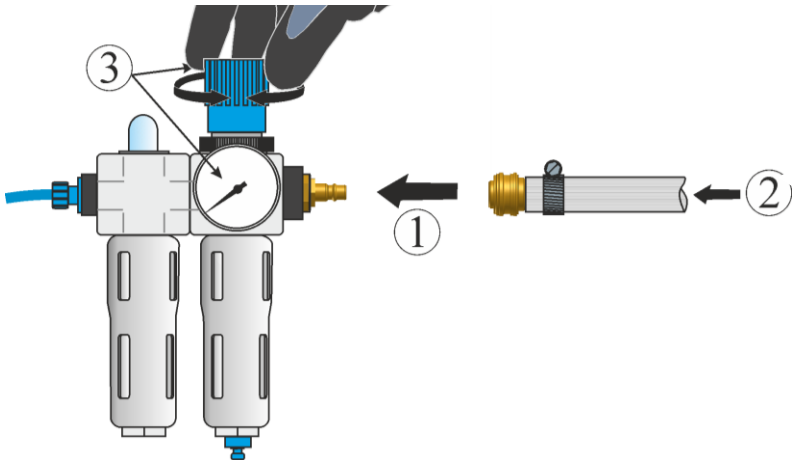


Fig. 27: Operating pressure (similar to picture)

The **closing and opening speed of the door** can be changed with the help of the pneumatic schematic (the pneumatic schematic for this system is in the appended Annex) by adjusting the setting screw at the throttle (at the top and bottom) of the pneumatic cylinder.

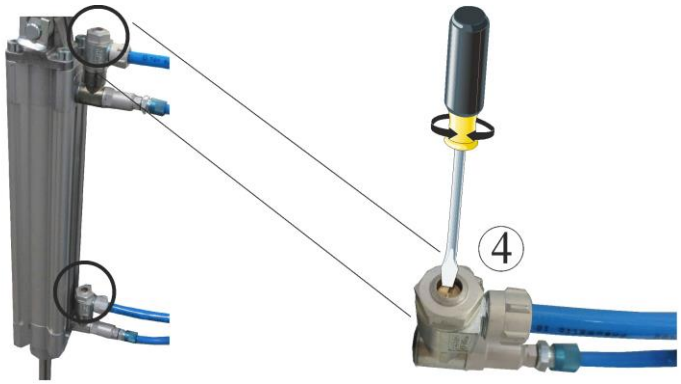


Fig. 28: Closing and opening speed of the door (similar to picture)

The **cushioned stop position** can be changed using a setting screw on the pneumatic cylinder (top and bottom).

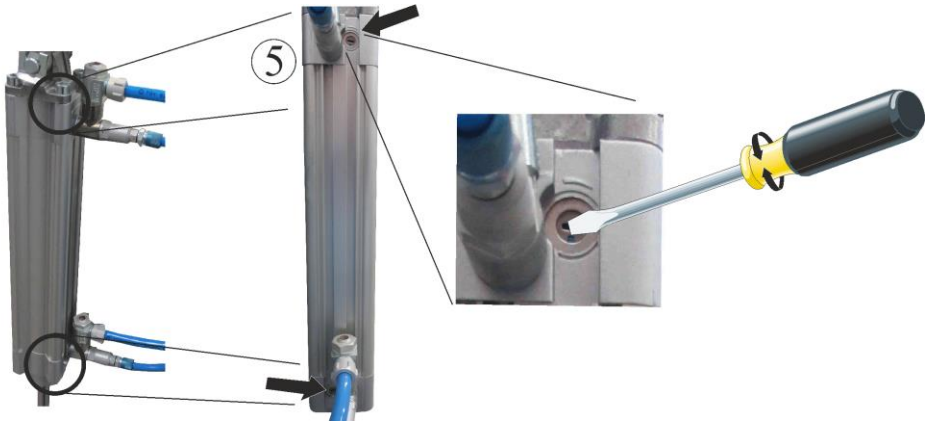


Fig. 29: Set the cushioned stop position (similar to picture)

5.6.7 Positioning the Foot Switch to Raise and Lower the Lift Door of the Furnace

Position the foot switch to raise and lower the lift door of the furnace on the floor at a **minimum distance** of **1.5 m** to the furnace. The operator must be able to see the entire area in which the door lifts. The foot switch must not be positioned other than as shown below.

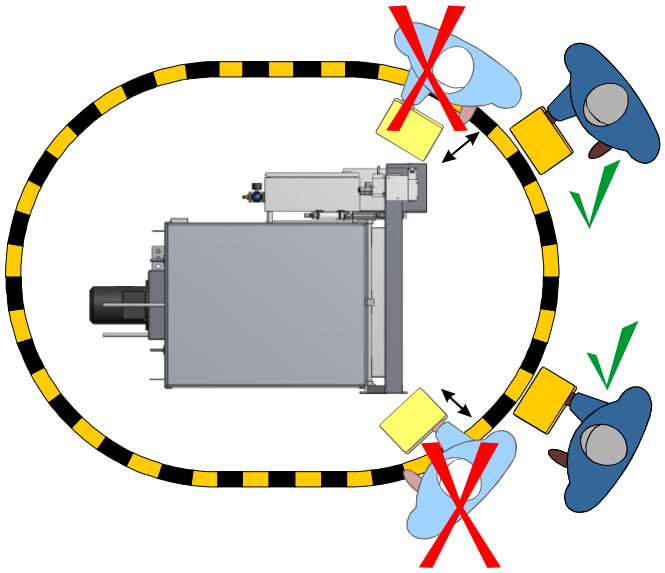


Fig. 30: Positioning the foot pedal

5.7 Initial Start-Up

The furnace may be put into operation only by qualified persons and in compliance with the safety instructions.

Read the section on "Safety". When the furnace is put into operation, the following safety information must also be observed to prevent serious injury, damage to the furnace, and damage to other property.

Make sure that the instructions and information in the controller instructions are observed and followed.

The furnace may be used only for its intended purpose.

Ensure that only authorized persons remain in the working area of the furnace and that no other persons are put at risk when the furnace is put into operation.

Before starting the furnace for the first time, make sure that all tools, foreign parts, and transportation securing equipment have been removed.

Activate all safety equipment (power switch, emergency stop button if applicable) before putting the furnace into operation.

Incorrectly wired connections may destroy electric/electronic components.

Observe the special protective measures (e.g. grounding, …) for components that are at risk.

Faulty connections can cause the furnace to start unexpectedly.

Before you switch on the furnace, make sure that you know what to do in case of faults or emergencies.

Before starting the furnace for the first time, check the electrical connections and control displays.

Before placing materials in the furnace, check whether they could harm or destroy the insulation or the heating elements. Materials that could damage the insulation include: alkalis, alkaline earths, metal vapors, metal oxides, chlorine compounds, phosphorous compounds, and halogens.

Caution

Before you switch on the furnace for the first time, make sure that the **motor achieves a clockwise rotating field**. This is a prerequisite for the smooth functioning of the furnace.

Note

Before starting the furnace for the first time, allow it to acclimatize at its installation location for 24 hours.

Note

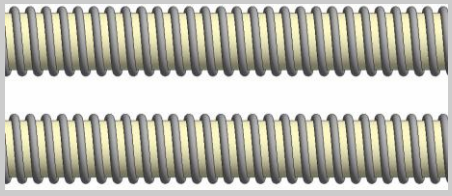
If the protective gas boxes are used, a working temperature to 1100 °C (2012 °F) is recommended; with working temperatures to 1150 °C (2102 °F) the boxes will suffer increased wear.

The formation of a layer of oxide is necessary for the correct function of the heating element.

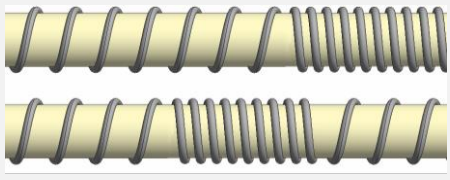
This procedure is for the first start-up and must be repeated after **every replacement** of heating elements.

The duration of the oxidation firing can be found in the section entitled "Recommendation for Heating the Furnace for the First Time".

Nest formation is a natural process and requires no correction. Considerable nest formation, however, can influence temperature distribution.



Before



After (nest formation)

5.8 Loading/Charging

Only materials whose characteristics are known may be heated. Consult any available safety data sheets for the materials.

Loading a very large quantity of material into the furnace chamber can substantially lengthen the heating-up time.

If it can be at all avoided, do **not** open the furnace when it is hot. When it is necessary to open the furnace at a high temperature, the time should be kept to an absolute minimum. Personnel must wear the appropriate protective clothing, and the workspace must be adequately ventilated as stated in the section entitled “Safety”.

Stainless steel sheet can discolor (especially if the furnace is opened while hot), but this does not impair the functionality of the furnace.

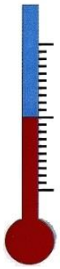
Additional Precautionary Measures

Please make sure that objects such as teapots and bottles are kept away from the furnace.

Warning - Danger of Electric Shock!

For the protection of the operator and the furnace, the heating program must be stopped before the furnace is loaded. Ignoring this warning can result in electric shock.

5.9 Recommendations for Heating Up the Furnace for the First Time



To generate an protective oxide coating on the heating elements the **furnace must be heated up over approx. 6 hours from a temperature of 100 °C (212 °F) to under the maximum temperature** (example: The furnace is designed for a maximum temperature of approx. 1280 °C (2336 °F), that means that a temperature of approx. 1180 °C (2156 °F) must be entered at the the controller). **But this temperature must be reached over the full period of 6 hours**. **The entered temperature** (example: 1180 °C) **must be held for approx. 1 hour**.

This procedure must be conducted when starting up for the first time, after heating elements have been replaced, or to regenerate the oxide coating. During heating up noxious odors may be emitted, this is due to the binding agent in the insulation material. We recommend that the furnace location be well ventilated during the first warm-up phase. Let the furnace cool down naturally to room temperature.

- To achieve an adequate oxide coating on the MoSi elements, please observe the information in “Molybdenum Disilicide (MoSi2) Heating Elements”.
- Operate without the cooling fan
- Heat the furnace with no charge
- Close the door
- Switch on the furnace/controller (see “Operation”)
- When the furnace is being heated for the first time, there may be a smell caused by binder being released from the insulation material. We recommend that you ventilate the room in which the furnace is located well during the first heating phase. Allow the furnace to cool naturally to room temperature.

Cracks in the Insulation

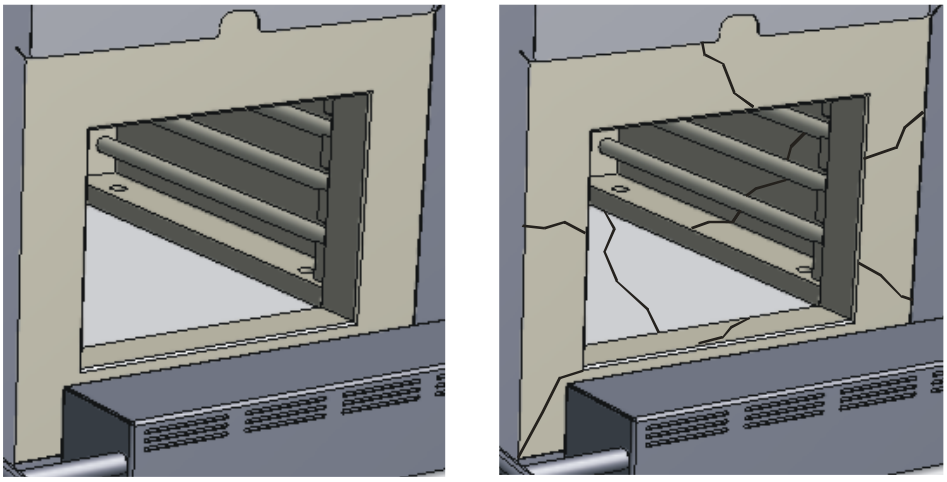
The insulation of the furnace consists of a very high-quality refractory material. Heat expansion may cause cracks in the insulation even after a few heating cycles. However, these have no effect on the functioning or quality of the furnace. This is no reason for a complaint.

Hinweis

Wear parts such as muffles, insert boxes, roller conveyors, charging plates or sheet metal linings are subject to increased wear depending on the respective use. In addition to the process and the type of application, the service life also depends on the frequency of use. There may be distortion of these components. A slight deformation is normal and requires no further measures. However, if larger distortions occur, rework or replacement of the component is recommended. A regular check of the functionality by the customer is recommended.

Note

If the protective gas boxes are used, a working temperature to 1100 °C (2012 °F) is recommended; with working temperatures to 1150 °C (2102 °F) the boxes will suffer increased wear.



before after

Fig. 31: Example: Cracks in the insulation after a few warm-up cycles.

6 Operation

6.1 Controller

B500/C540/P570

Fig. 32: Control field B500/C540/P570 (similar to picture)

No.	Description
1	Display
2	USB interface for a USB stick

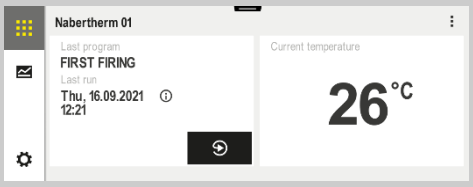
Note

See the separate operating instructions for a description of how to enter temperatures and times and to “start” the furnace.

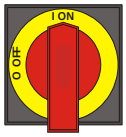
7 Operation, Display and Switch Elements (depending on design)

7.1 Turning on the Controller/Furnace

Furnaces with Power Plug

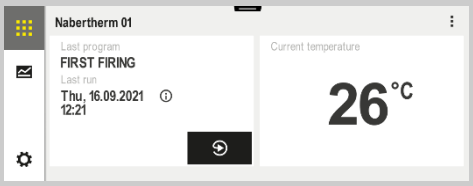
Turning on the controller		
Procedure	**Display**	**Comments**
Turn on the power switch		Set power switch to "**I**". (Power switch type varies according to design/furnace model)
The furnace status is displayed. After a few seconds, the temperature is displayed.		When the temperature is shown on the controller, the controller is ready for operation.

Furnaces with Main Switch



Turn on main switch **[1]** → **I/ON**

The furnace and switching system are connected to the power supply using the main power switch.

Turning on the controller		
Procedure	**Display**	**Comments**
Turn on the power switch		Set power switch to "**I**". (Power switch type varies according to design/furnace model)
The furnace status is displayed. After a few seconds, the temperature is displayed.		When the temperature is shown on the controller, the controller is ready for operation.

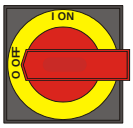
7.2 Turning off the Controller/Furnace

Furnaces with Power Plug

Turn off the controller		
Steps	**Display**	**Comments**
Turn off the power switch	 /	Turn off the power switch by setting it to "**O**" (power switch type differs depending on features/furnace model)

Furnaces with Main Switch

Turn off the controller		
Steps	**Display**	**Comments**
Turn off the power switch		Turn off the power switch by setting it to "**O**" (power switch type differs depending on features/furnace model)



Turn off main switch **[1]** → **O/OFF**

The furnace and switching system are disconnected from the power supply and de-energized using the main power switch .

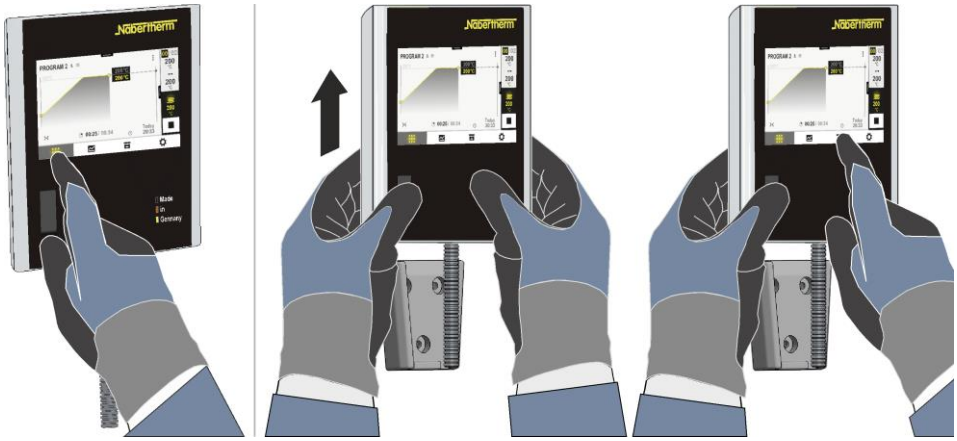
All the necessary settings for perfect functions have already been made at the factory.

Note

See the separate operating instructions for a description of how to enter temperatures and times and to “start” the furnace.

7.2.1 Handling the Controller

The controller can simply be removed from the holder for especially ergonomic handling and more comfortable operation.



Simple operation directly on the controller

Easy and ergonomic handling by removing the controller from its holder

Fig. 33: Handling the controller (similar to picture)

7.3 Opening and Closing the Door

Opening the Swinging Door

The swinging door can be easily opened by pressing down the rod located across the front of the door. Always open and close the door completely to avoid the paint being burnt by the furnace's radiant heat (this will not hamper the furnace's function in any way).

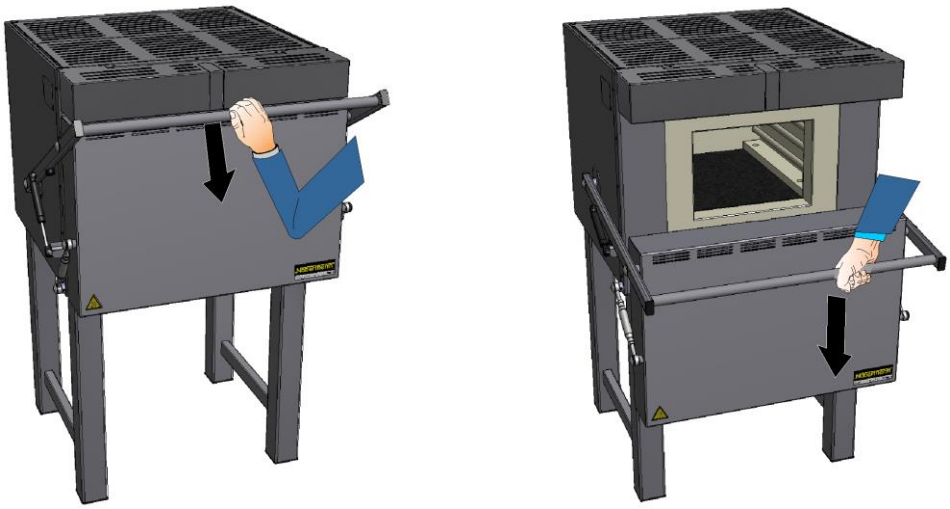


Fig. 34: Opening the swinging door (similar to picture)

Closing the Door

Close the swinging door carefully (do not slam). "Slamming" the door can damage the insulation around the door's edge.

After the swinging door is closed make sure that it is uniformly closed all around the door's edge (visual check).

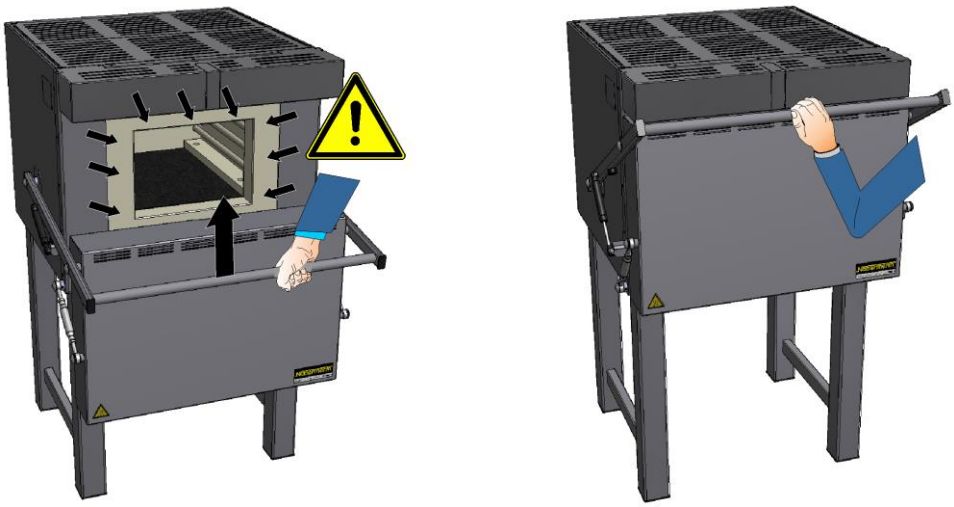


Fig. 35: Closing the swinging door (similar to picture)

7.4 Opening the Door Pneumatically with the Foot Pedal

Depress the **left foot pedal** to **open the door**. Release the foot pedal to interrupt the door's movement.

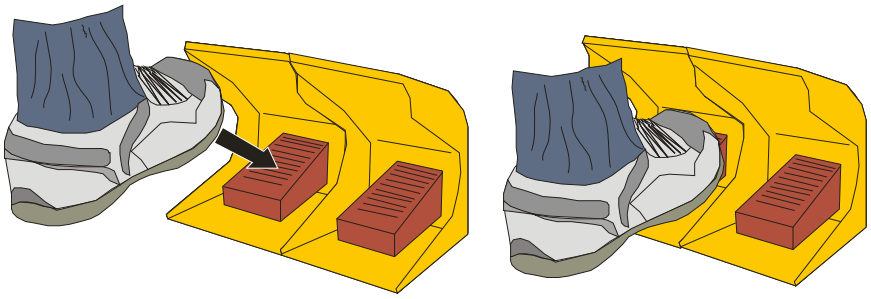


Fig. 36: Opening the door (similar to picture)

Depress the **right foot pedal** to **close the door**. Release the foot pedal to interrupt the door's movement.

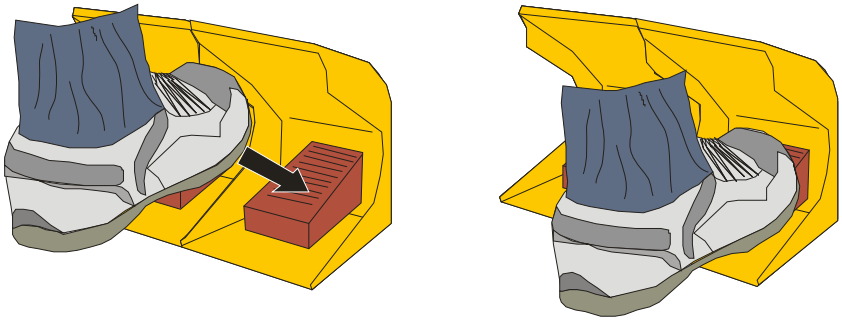


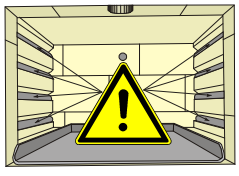
Fig. 37: Closing the door (similar to picture)

Warning - Dangers During Normal Operation!

When opening and closing the furnace door you must make sure that it can safely and freely move and can be observed at all times. You must ensure that there is nobody in the vicinity of the door to exclude the possibility of personal injury near the furnace door.

7.4.1 Charging Plate

The charging plate must be clean and dry before it is used. Wait until the furnace chamber has cooled to room temperature before placing the charging plate on the base of the furnace.

	NOTICE	
	• **Damage to the heating elements when inserting the charging plate** • **Damage to the heating elements** • Carefully place the charging plate in the middle of the furnace base	

Open the furnace door and carefully place the charging plate in the middle of the furnace base and slide it in until it touches the back wall. The furnace base must be level and clean, vacuum the base if necessary. When you are inserting the charging plate, make sure that you do not touch the heating elements. If you do not follow this advice, you may damage the heating elements.

To protect the bottom furnace collar (e.g. when charging an annealing box), make sure that part of the charging plate lies on the bottom furnace collar (A).

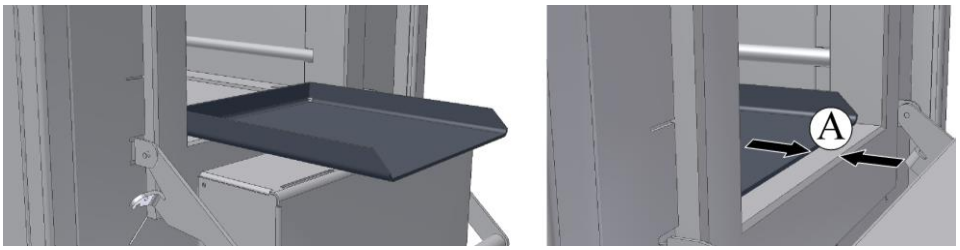


Fig. 38: Example: Placing the charging plate (similar to picture)

Note

The use of a charging plate to protect the furnace floor is strongly recommended.

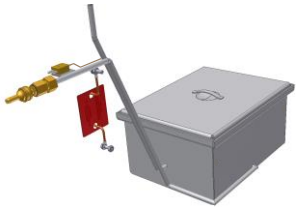
7.5 Operation with Heat Treatment Accessories

For heat treatments in protective gas Nabertherm offers protective-gas boxes and an extensive range of accessories for use in the furnaces. The advantage of protective-gas boxes is that they achieve a better protective gas atmosphere than furnaces that feed gas directly into the furnace chamber. In furnace models whose door opens downwards the penetration for the gas line is located in the upper part of the door collar, in larger furnaces whose door opens upwards, the gas line is located in the lower door collar. The protective-gas box is supplied through the protective gas inlet coupling with protective gas that, then, is released through the protective gas outlet.

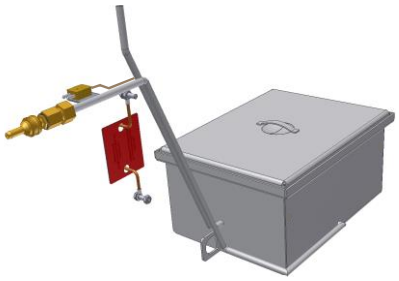
The box is connected to a gassing unit and can be heated while filled with protective gas. After the heat treatment is completed, the protective-gas box is pulled out and the workpieces can then be quenched in a fluid medium or in air or be left in the furnace with the lid closed until they have cooled.

Note

Connections, operation and safety recommendations for **protective gas and carburizing systems** see separate operating manual **M04.0001**



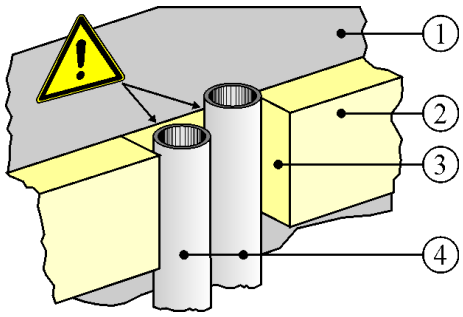
For furnace models to N 17/HR



For furnace models to N 87/HR

Fig. 39: Example: Protective-gas box for small and large furnace models

When charging the annealing box pay attention to the recess of the furnace collar and the protective gas pipes.



1 Furnace housing

2 Furnace collar (insulation brick)

3 Recess in the furnace collar

4 Protective gas pipes

Fig. 40: Pay attention to the furnace collar and the protective gas pipes (similar to picture)

Note

If the protective gas boxes are used, a working temperature to 1100 °C (2012 °F) is recommended; with working temperatures to 1150 °C (2102 °F) the boxes will suffer increased wear.

Warning – Danger of Suffocation

There is a danger of suffocation when process/purge or exhaust gases escape, e.g. as a result of leaks (e.g. at doors, pipes, valves, etc.).

Due to their specific weight gases can displace oxygen. This poses a danger of suffocation.

Measures: Switch on the extraction system.

Note

When working with protective gases always make sure that the room is adequately ventilated. Country-specific safety regulations must also be observed.

8 Servicing, Cleaning, and Maintenance

Warning - General Hazards!

Cleaning, lubrication, and maintenance tasks may only be performed by authorized experts following the maintenance instructions and accident protection guidelines. We recommend that maintenance and repair be performed by Nabertherm GmbH Service. Failure to comply runs the risk of bodily injury, death, or significant property damage!

Warning - Danger due to Electrical Current!

Work on the electrical equipment may only be performed by qualified, authorized electricians!

During maintenance work, the voltage supply to the furnace and/or switching system must be switched off to prevent unintentional commissioning. Disconnect the mains power connector due to reasons of safety.

Operators may only correct malfunctions which are obviously due to operational error!

Wait until the furnace chamber and attaching parts have cooled to room temperature.

The furnace must be visually inspected at regular intervals for damage. The interior of the furnace must also be cleaned as required (e.g. vacuuming out) **Attention:** Do not bang against the heating elements to avoid breaking them.

While work is being performed on the furnace, the furnace and work room must additionally be ventilated with fresh air.

Safety systems removed during maintenance tasks must be replaced after the work.

Warning of swinging loads in the workshop (e.g. crane systems). Work under a lifted load (e.g. a lifted furnace or switching system) is not permitted.

Safety switches and any limit switches present must be checked for function periodically (DGUV V3) or according to the national guidelines of the country of operation.

To ensure proper temperature regulation of the furnace, the thermocouple must be checked for damage before every process.

If necessary, retighten the element holders (see chapter "Replacing the Heating Element"). Before carrying out this work, the voltage supply to the furnace and/or switching system must be switched off (disconnect mains power connector). The regulations (DGUV V3) or corresponding national regulations in the relevant country of operation must be observed.

There are one or more contactors in the control system. The contacts of these circuit breakers are wearing parts and must therefore be serviced and/or replaced regularly (DGUV V3) or according to the national guidelines of the country of operation.

The switching system cabinet (if available) contains vent grilles with integrated filter mats. These must be cleaned and/or replaced at regular intervals in order to ensure sufficient intake and outflow of air from the switching system. During melting operation, the switching cabinet door must always be firmly closed.

8.1 Furnace Insulation

Repairs to the insulation or the replacement of components in the heating chamber may only be performed by persons who are trained about possible hazards and protective measures and can apply this knowledge without supervision.

During the work on the insulation or the replacement of components in the furnace chamber, the following points must be observed:

When repairs are made or demolition work is performed, silicon dust may be released. Depending heat-treated materials contained in the furnace, further contaminants may be contained in the insulation. To exclude possible health risks, dust concentrations must be kept to a minimum during any work performed at or near the insulation. In many countries there are specific occupational safety limits. You can acquire more relevant information by investigating the relevant legal specifications in your country.

Dust concentrations should be kept as low as possible. Dust must be removed using a suction device or a vacuum cleaner with a high-performance filter (HEPA – category H). Strong air currents such as drafts, for example, must be prevented. Pressurized air or brush must not be used for cleaning. Piles of dust must be sprinkled.

During work on the insulation a respirator mask with an FFP2 filter or an FFP3 filter must be used. The work clothing must be loose and cover the body completely. Gloves and goggles must be worn. Soiled clothing should be cleaned before it is removed with a vacuum cleaner equipped with a HEPA filter.

Contact with skin and eyes should be avoided. The impact of fibers on skin or eyes can lead to mechanical irritation which, in turn, causes reddening and itchiness. After completing the work, or after direct contact, the skin must be washed with soap and water. If there is contact with the eyes, they must be washed out carefully for several minutes. If necessary, an eye doctor should be consulted.

Smoking, eating and drinking at the workplace is prohibited.

When working on insulation, the Technical Regulations for Hazardous Materials must be applied in Germany. http://www.baua.de (German).

Additional information regarding how to handle fibrous materials can be found at http://www.ecfia.eu (English).

When the materials are discarded, national and regional guidelines must be observed. The possible presence of hazardous contaminants generated by the furnace process must be taken into account.

Note
Data sheets and safety data sheets can be requested from Nabertherm GmbH as required.

8.2 Shutting Down the Furnace for Servicing, Cleaning, and Maintenance

Wait until the furnace chamber and attached parts have cooled to room temperature.

- The furnace must be completely emptied
- Inform operating personnel and name supervisors
- Switch off main switch and/or disconnect the power cord.
- Lock the main switch (if available) and secure against restoration of power using a padlock.
- Attach a warning sign on the main switch
- Clean up the maintenance area as far as possible.
- Check for disconnection of power.
- Ground and short-circuit the working area.
- Cover any nearby parts still under power.

Warning - Dangers During Normal Operation!

Do not touch any object without first having checked its temperature.

Warning – Danger of Electric Shock

Work on the electrical equipment may be done only by qualified, authorized electricians. During work it must be ensured that the furnace and the switching equipment cannot be activated by mistake (pull out the power plug) and that all moving parts in the furnace are secured. Observe DGUV V3 or the corresponding national regulations in the country where the furnace is installed. Wait until the furnace and the connected parts have cooled to room temperature.

8.3 Regular Maintenance Tasks for the Complete System

Warranty and liability claims for personal injury and material damage shall be excluded if regular maintenance work is not observed.

Component/ item/ function and action	**Comment**	**A**	**B**	**C**
Drives and third-party units Maintenance according to manufacturer's instructions				X2
Safety test in accordance with DGUV V3 or corresponding national regulations According to regulation				X2
EMERGENCY STOP equipment (if present) Activate the “EMERGENCY STOP”, power switch, or main switch			Q	X1
Key: see “Maintenance Table Key”				

Notice

Maintenance work must be performed only by authorized persons, observing the maintenance instructions and the accident prevention regulations. We recommend that maintenance and repair work be carried out by the service team of Nabertherm GmbH.

8.4 Regular Maintenance of the Furnace

Component/ item/ function and action	**Comment**	**A**	**B**	**C**
Heating elements Visual inspection: Formation of an oxide coating, cracks		-	W	X2
Supporting parts: Chains, ropes, etc. (if present) Visual inspection: For damage, functional check		-	W	X2
Moving parts, possibly from additional equipment (if present) Visual inspection: For damage, functional check		-	W	X2
Safety switch: Door lock (if present) Function check		-	M	X2

Component/ item/ function and action	Comment	A	B	C
Drives and third-party units Check according to manufacturer's maintenance instructions		-		X1
Safety and warning lamp (if present) Function test		-	D	X1
Insulation Visual inspection:		-	D	X1
Furnace chamber Clean (vacuum)		-	W	X1
Seals and sealing surfaces (if present) Visual inspection: Check for damage; replace if necessary		-	W	X2
Key: see "Maintenance Table Key"				
SiC/mullite tile cover Check correct position and for deformation		2	Q	X1

Note

Since SiC plates expand continuously, they should be replaced after about 3-5 years. Otherwise there is a risk that the collar bricks will be pushed outwards. In this case, we will not accept warranty claims.

8.5 Regular Maintenance Tasks – Switchgear

Component/ item/ function and action	Comment	A	B	C
Thermocouple Visual inspection of the display on the controller		-	D	X1
Check settings (if present) Inspection according to work schedule		-	D	X1
Contactors (if present) Maintain / replace contactors/contacts		-	Q	X2
Over-temperature setting on safety controller (if present) With each change to the heat treatment program		-	D	X1
Check for uniform power consumption of the heating system Function check		-	Q	X2
Display instruments (text and illuminated displays, if present) Function check		-	D	X1
Air intake filter (if present) Replace or clean filter mat	If this is ignored, electronic devices may break down. No liability for production losses	-	Q	X2

Component/ item/ function and action	Comment	A	B	C
EMERGENCY STOP device (if present) Function check: Activate the EMERGENCY STOP button, power switch		-	D	X1

Key: see “Maintenance Table Key”

Warning – Danger of Electric Shock!

Work on the electrical equipment may be done only by qualified, authorized electricians.

Notice

Maintenance work must be performed only by authorized persons, observing the maintenance instructions and the accident prevention regulations. We recommend that maintenance and repair work be carried out by the service team of Nabertherm GmbH.

Note

If used, over-temperature limiters with automatic reset and over-temperature limiters (see “Overview of the Complete Furnace”) must be checked regularly to ensure that they function as intended. To check whether the over-temperature limiters with automatic reset and over-temperature limiters respond, start the furnace and set the required setpoint on the temperature control unit below the setpoint of the controller. For more information, see the operating instructions for over-temperature limiters with automatic reset and over-temperature limiters.

Note

The switchgear must be serviced at regular intervals by an electrician. **Contactors are wearing parts and must be checked regularly, depending on ambient conditions and frequency of use, and be replaced after no more than a year**.

Note

When operating furnaces with heating transformers and speed control components, the EMC filter circuit can cause an upstream residual current device to trigger. Because of this, residual current devices should not be used as protective circuits.

Note

The filters for the control cabinet ventilation must be cleaned at regular intervals in order to ensure good air circulation. Depending on the type and design of the ventilation system there may be 2 or 3 filters, also at other locations on the control cabinet. The door of the switchgear must be kept closed and locked (otherwise the lifetime of the electronic devices will be shortened by contamination).

Note

If the furnace has an interruptible power supply (UPS), you must be sure that the rechargeable battery has an operating life of roughly 2 years when operating in an ambient temperature up to +40 °C. Higher ambient temperatures or long downtimes (furnace is shut down) shorten the life of the battery. The rechargeable battery is a wearing part and, depending on the ambient conditions, must be replaced every 1 to 2 years.

8.6 Regular Maintenance Tasks – Electrical Testing

Component/ item/ function and action	Comment	A	B	C
Insulation resistance test		-	Y	X2
High-voltage test If possible		-	Y	X2
Ground wire Correct position of ground wire on the connection between the system parts and the covers		-	Y	X2
Function check All electrical components		-	Y	X2
Key: see “Maintenance Table Key”				

OTL as over-temperature protection (if present) Function check		-	Y	-
Contactors Check contacts (wear in the switchgear)		-	Y	-
Key: see “Maintenance Table Key”				

Note

The switchgear must be serviced at regular intervals by an electrician. **Contactors are wearing parts and must be checked regularly, depending on ambient conditions and frequency of use, and be replaced after no more than a year**.

8.7 Regular Maintenance Tasks – Documentation

Component/ item/ function and action	Comment	A	B	C
Type plate Legible		-	Y	X1
Operating instructions Ensure they are kept near the furnace		3	Y	X1
Component instructions Ensure they are kept near the furnace		3	Y	X1
Key: see “Maintenance Table Key”				

8.8 Maintenance Table Key

Symbols:	
A = Spare Part Stocks	**1** = Stocks urgently recommended **2** = Stocks recommended / **3** = As required, not relevant
B = Maintenance Interval **Notice:** If ambient conditions are severe, the maintenance intervals must be shorter.	**D** = Daily, each time before the furnace is started **W** = Weekly **M** = Monthly / **Q** = Quarterly **Y** = Yearly /
C = Performed by	**X1** = Operating personnel **X2** = Specialist personnel

8.9 Cleaning Products

Observe the procedure for shutting down the furnace (see “Operation”). Then remove the power plug from the socket. Allow the furnace to cool naturally.

Use commercial cleaning products that are either water-based or non-flammable and free of any solvents to clean the housing of any deposits; use a vacuum cleaner for the interior.

Pay attention to the labeling and information on the cleaning product packaging.

Wipe the surface with a damp, lint-free cloth. You may also use the following cleaning products:

This List must be Completed by the Operator.	
Component and Position	**Cleaning Product**
Outer surfaces (frames)*	Use commercial cleaning products that are either water-based or non-flammable and free of any solvent*
Outer surface (stainless steel)	Stainless steel cleaner
Inside	Carefully clean with a vacuum cleaner (avoid the heating elements)
Insulation materials	Carefully clean with a vacuum cleaner (avoid the heating elements)
Door seal (if applicable)	Use commercial cleaning products that are either water-based or non-flammable and free of any solvent
Instrument panel	Wipe the surface with a damp, lint-free cloth. (e.g. glass cleaner)
*You must be sure that the cleaner does not damage the water-soluble, environmentally safe paint (test the product on an interior, hidden area).	

Fig. 41: Cleaning products

Clean quickly to protect the surfaces.

Remove the cleaning product completely from the surfaces by wiping them with a damp, lint-free cloth.

After cleaning, check all supply lines and connections for leaks, loose connections, abrasion and damage; report any defects immediately!

See “Environmental Protection Regulations”.

Note

The furnace, the furnace chamber and attached components must **NOT** be cleaned with a high-pressure cleaner.

DANGER

- **Danger of electric shock.**
- **Risk of fatal injury**
- Before cleaning, pull out the power plug.
- Do NOT pour water or cleaning products over the inside or outside surfaces
- Allow furnace to dry completely before operating it again

9 Malfunctions

Work on the electrical system may be done only by qualified, authorized electricians. Operators may only rectify malfunctions that are obviously due to operating errors.

Call your local electrician for malfunctions that you cannot localize.

If you have any questions, problems, or requirements, contact Nabertherm GmbH. By mail, phone, or e-mail -> See "Nabertherm Service".

Phone advice is free and non-binding for our customers – all you pay is the phone costs.

In case of mechanical damage, send an email containing the above information and a digital photo of the damaged part and a photo of the complete furnace to the following address:
-> see "Nabertherm Service".

If a malfunction cannot be rectified with the described solutions, contact our service hotline directly.

Have the following information at hand when you phone. This makes it easier for our customer service to answer your questions.

9.1 Error Messages of the Controller

ID+ Sub-ID	Text	Logic	Remedy
Communication error			
01-01	Bus zone	Communication connection to a control module disrupted	Check that the control module is firmly attached LEDs on the control modules red? Check the cable between the control unit and the control module Plug of the connection cable not plugged correctly into the control unit
01-02	Bus communications module	Communication connection to the communications module (Ethernet/USB) disrupted	Check that the communications module is firmly attached Check the cable between the control unit and the communications module

ID+ Sub-ID	Text	Logic	Remedy
Sensor error			
02-01	TC open		Check thermocouple, thermocouple terminals and cable Check contacts of the thermocouple cable in plug X1 on the control module (contacts 1+2)
02-02	TC Connection		Check the set thermocouple type Check poles of thermocouple connection
02-03	Compare point error		Control module defective
02-04	Compare point too hot		Temperature in the switchgear too high (approx. 70 °C) Control module defective
02-05	Compare point too cold		Temperature in the switchgear too low (approx. -10 °C)
02-06	Encoder separated	Error at the 4-20 mA input of the controller (<2 mA)	Check 4-20 mA sensor Check the connection cable to the sensor
02-07	Sensor element defective	PT100 or PT1000 sensor defective	Check PT sensor Check connection cable to the sensor (cable break/short circuit)
System error			
03-01	System memory		Error after firmware updates[1)] Defective control unit[1)]
03-02	ADC error	Communication between AD converter and controller disrupted	Replace control module[1)]
03-03	File system defective	Communication between display and memory chip disrupted	Replace control unit
03-04	System monitoring	Program execution on the control unit defective (Watchdog)	Replace control unit USB flash drive removed too soon or defective Switch controller off and on again
03-05	Zone system monitoring	Program execution on a control module defective (Watchdog)	Replace control module[1)] Switch controller off and on again[1)]
03-06	Self-test error		Contact Nabertherm Service[1)]

ID+ Sub-ID	Text	Logic	Remedy
Monitoring			
04-01	No heater power	No temperature increase in the ramps when heating output <> 100 % for 12 minutes and when the temperature setpoint is higher than the current furnace temperature	Acknowledge the error (if necessary, disconnect from the power supply) and check safety contactor, door switch, heating controls and controller. Check heating elements and heating element connections. Lower D value of the control parameters.
04-02	Excess temperature	The temperature of the control zone exceeds the max. program setpoint or the maximum furnace temperature by 50 Kelvin (from 200 °C) The equation for the switch off threshold is: Maximum program setpoint + zone offset of the master zone + charge control offset [Max] (if charge control active) + excess temperature switch-off threshold (P0268, e.g., 50 K)	Check solid state relay Check thermocouple Check controller (from V1.51 with 3 minute delay)
		A program was started at a furnace temperature higher than the maximum setpoint in the program	Do not start the program until the furnace temperature is lower. If this is not possible, insert a hold time as a start segment and then a ramp with the desired temperature (STEP=0 minutes duration for both segments) Example: 700 °C -> 700 °C, Time: 00:00 700 °C -> 300 °C, Time: 00:00 The normal program begins here From Version 1.14, the actual temperature is also considered at the start. (from V1.51 with 3 minute delay)
04-03	Power failure	The set limit for restarting the furnace was exceeded	If possible, use an uninterruptible power supply
		The furnace was switched off at the main switch during the program	Stop the program on the controller before you switch off the main switch
04-04	Alarm	A configured alarm was triggered	
04-05	Auto-tune failed	The determined values are implausible	Do not carry out auto-tune at the lower temperature range of the furnace working range
	Battery weak	Time is not shown correctly. A power failure may no longer be handled properly.	Export all parameters to a USB flash drive Replace the battery (see “Specifications”)

ID+ Sub-ID	Text	Logic	Remedy
Other malfunctions			
05-00	General malfunction	Malfunction in the control module or Ethernet module	Contact Nabertherm Service Provide the service export

Error messages can be reset by acknowledging the message. Contact Nabertherm service if an error message appears again. Recirculation motors (if included) also remain switched on in case of an error until the temperature falls below the set cut-off temperature.

9.2 Warnings of the Controller

Warnings are not displayed in the error archive. They are only displayed on the display and in the file of the parameter export. Warning do not generally lead to a program crash.

No.	Text	Logic	Remedy
00	Gradient monitoring	The limit value of the configured gradient monitoring was exceeded	For troubleshooting, refer to “Gradient Monitoring” Gradient set too low
01	No control parameters	No “P” value was entered for the PID parameters	Enter at least one “P” value in the control parameters. It must not be “0”
02	Charge thermocouple defective	No charge thermocouple was determined with the current program and activated charge control	Plug in a charge thermocouple Disable charge control in the program Check the charge thermocouple and its cable for damage
03	Cooling thermocouple defective	The cooling thermocouple is not plugged in or is defective	Plug in a cooling thermocouple Check the cooling thermocouple and its cable for damage If there is a malfunction in the cooling thermocouple during active controlled cooling, the system switches over to the thermocouple of the master zone.
04	Documentation thermocouple defective	Either no documentation thermocouple or a defective one was determined.	Plug in a documentation thermocouple Check the documentation thermocouple and its cable for damage
05	Power failure	A power failure was determined. There was no program interrupt	None
06	Alarm 1 - Band	The configured band alarm 1 was triggered	Optimize the control parameters Alarm set too narrowly
07	Alarm 1 - Min	The configured min. alarm 1 was triggered	Optimize the control parameters Alarm set too narrowly
08	Alarm 1 - Max	The configured max. alarm 1 was triggered	Optimize the control parameters Alarm set too narrowly
09	Alarm 2 - Band	The configured band alarm 2 was triggered	Optimize the control parameters Alarm set too narrowly

No.	Text	Logic	Remedy
10	Alarm 2 - Min	The configured min. alarm 2 was triggered	Optimize the control parameters Alarm set too narrowly
11	Alarm 2 - Max	The configured max. alarm 2 was triggered	Optimize the control parameters Alarm set too narrowly
12	Alarm - External	The configured alarm 1 at input 1 was triggered	Check the source of the external alarm
13	Alarm - External	The configured alarm 1 at input 2 was triggered	Check the source of the external alarm
14	Alarm - External	The configured alarm 2 at input 1 was triggered	Check the source of the external alarm
15	Alarm - External	The configured alarm 2 at input 2 was triggered	Check the source of the external alarm
16	No USB flash drive inserted		When exporting data, insert a USB flash drive in the controller
17	Import/export of data via the USB flash drive unsuccessful	The file was edited with a PC (text editor) and saved in the wrong format or the USB flash drive was not detected. You want to import data that is not in the import folder on the USB flash drive	Do not edit XML files with a text editor, only in the controller. Format the USB flash drive (format: FAT32). No quick formatting Use a different USB flash drive (to 2 TB/FAT32) When importing, all data must be in the import folder on the USB flash drive. The maximum storage capacity for USB flash drives is 2 TB/FAT32). If you experience problems with your USB flash drive, use a different USB flash drive with maximum 32 GB
	Programs are rejected during the import of programs	Temperature, time or rate are outside the limit values	Import only programs that are suitable for the furnace. The controllers differ as regards the number of programs and segments and the maximum furnace temperature.
	While programs are being imported, “Error occurred” is displayed	The complete parameter set (at least the configuration files) was not stored in the “Import” folder on the USB flash drive	If you deliberately left out files during import, ignore the message. Otherwise, check the completeness of the import files.
18	“Heating blocked”	This message is displayed if a door switch is connected to the controller and the door is open	Close the door Check the door switch
19	Open door	The furnace door was opened while a program was running	Close the door while a program is running.
20	Alarm 3	General message for this alarm number	Check the cause of this alarm message
21	Alarm 4	General message for this alarm number	Check the cause of this alarm message

No.	Text	Logic	Remedy
22	Alarm 5	General message for this alarm number	Check the cause of this alarm message
23	Alarm 6	General message for this alarm number	Check the cause of this alarm message
24	Alarm 1	General message for this alarm number	Check the cause of this alarm message
25	Alarm 2	General message for this alarm number	Check the cause of this alarm message
26	Multi-zone holdback temperature exceeded	A thermocouple that was configured for multi-zone holdback has left the temperature band downward	Check whether the thermocouple is necessary for monitoring. Check the heating elements and their activation
27	Multi-zone holdback temperature undershot	A thermocouple that was configured for multi-zone holdback has left the temperature band upward	Check whether the thermocouple is necessary for monitoring. Check the heating elements and their activation
28	Modbus connection interrupted	The connection to the superordinate system was interrupted.	Check if the Ethernet cables are damaged. Check the configuration of the communication connection

9.3 Malfunctions of the Switchgear

Error	Cause	Remedy
Controller does not light up	Controller is switched off	Switch the power switch to “**I**”
	No power available	Is the power cord plugged into the socket? Check the building fuses. Check the fuse of the controller (if present) and replace it if necessary.
	Check the fuse of the controller (if present) and replace it if necessary.	Switch the power switch on. If the error occurs again, contact Nabertherm Service
Controller displays error	See the separate instructions of the controller	See the separate instructions of the controller
Furnace does not heat	Door / cover is open	Close the door / cover
	The door contact switch is faulty (if present)	Check the door contact switch
	"Delayed Start" is displayed	The program is waiting for the programmed start time. Deselect delayed start above the start button.
	Error in entering the program	Check the heating program (see the separate instructions of the controller)

Error	Cause	Remedy
	Heating element defective	Have this checked by Nabertherm Service or a qualified electrician.
Very slow heating of the heating space	The fuse(s) of the connection is/are defective.	Check the fuse(s) of the connection and replace if necessary. Notify Nabertherm service if the new fuse fails again immediately.
The program does not jump to the next segment	In one TIME segment in the program input, the wait time is set to INFINITE If charge control is activated, the temperature of the charge is higher than the zone temperatures.	Do not set the wait time to INFINITE
	If charge control is activated, the temperature of the charge is higher than the zone temperatures.	The parameter [LOWER BLOCK] must be set to [NO].
The controller module can not be registered on the operating unit	Addressing error of the controller module	Perform a bus reset and re-adress the controller module
The controller is not heating in the optimization	No optimization temperature has been set	The temperature to be optimized must be entered (see the separate instructions of the controller)

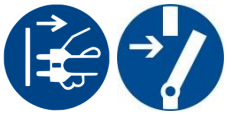
The temperature rises faster than the controller setting allows	The switch element of the heating unit (semiconductor relay, thyristor or switch contactor) is defective. Individual defective components inside a furnace cannot be completely ruled out in advance. That is why the controllers and the switchgear units must be equipped with safety facilities. For example, the furnace shuts down the heating unit in response to error message 04 - 02 via an independent contact element.	Have the switch element tested by a qualified electrician and replaced as necessary.
Glass Bubbles on the Surface of the Heating Element	At temperatures above 1550 °C (2822 °F) fine glass bubbles can settle on the surface of the heating elements due to residual silicon during the production process.	Before heating the furnace again remove the glass bubbles carefully (with a paintbrush or brush).

9.4 Safe Procedure for Eliminating Blockages

9.4.1 Swinging Door with Pneumatic Drive

Note

In Germany, the general accident protection guidelines must be observed. The accident prevention regulations applicable in the country where the furnace is installed must be observed.



Pull out the power plug and, if included, switch the control power switch/main switch to the off position ("O/OFF") → switchgear

The responsible employee/supervisor must be immediately informed of any faults or damages found in the furnace. Interrupt production of this system until the damage has been rectified. Any shortcomings discovered in the furnace must be corrected without delay.

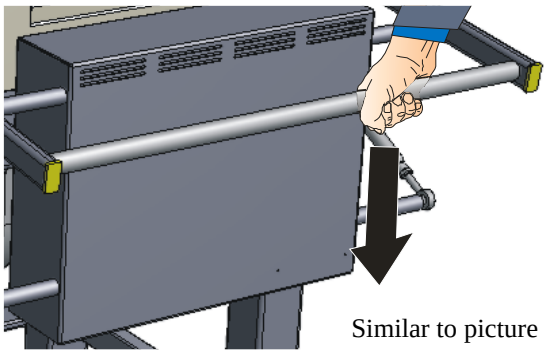
Close off a generously dimensioned workspace (perimeter chains, warning signs) before carrying out any work on the furnace.

All compressed air and protective gas connections must be closed and disconnected from the compressed air or protective gas system.

Wait until the furnace chamber and its attachments have cooled down to room temperature.

The system must be switched pressure-free before any work is performed on the pneumatic lowering device.

The hexagonal bolts on the compressed air connections must be loosened. Loosening these bolts will release the pressure in the pneumatic cylinder and the door can be controlled, pressed down, by hand.



Similar to picture

Contact Nabertherm Service at any time for maintenance and repair.

If you have any questions, problems, or requirements, contact Nabertherm GmbH. By mail, phone or e-mail.

Note

The pictures contained in the instruction manual may contain inaccuracies in terms of the function, design and furnace model.

10 Spare Parts/Wearing Parts

Ordering spare parts:

Our Nabertherm Service team is available worldwide. Due to our high vertical range of manufacture, we deliver most spare parts from stock overnight or can produce them with short delivery times. You can order Nabertherm spare parts directly from the factory quickly and easily. Orders can be made by mail, phone, or e-mail -> see “Nabertherm Service”.

Availability of spare parts and wearing parts:

Although Nabertherm has many spare parts and wearing parts in stock, we cannot guarantee the short-term availability of all of them. We recommend that certain parts be ordered in good time. If you need any assistance when selecting spare parts and wearing parts, the staff at Nabertherm will be glad to help you.

Note

Since SiC plates expand continuously, they should be replaced after about 3-5 years. Otherwise there is a risk that the collar bricks will be pushed outwards. In this case, we will not accept warranty claims.

Note

Original parts and Accessories are designed especially for Nabertherm furnaces. Replace parts only with original Nabertherm parts. Otherwise the warranty will be void. Nabertherm accepts absolutely no liability for damage caused by using parts that are not original Nabertherm parts.

Note

Contact our Nabertherm Service for dismantling and installing wearing/spare parts. See “Nabertherm Service”. Work on the electrical equipment may be done only by qualified, authorized electricians. This applies also to repairs that are not described here.

10.1 Replacing a Heating Element

Warning – Danger of Electric Shock

Work on the electrical equipment may be done only by qualified, authorized electricians. During work it must be ensured that the furnace and the switching equipment cannot be activated by mistake (pull out the power plug) and that all moving parts in the furnace are secured. Observe DGUV V3 or the corresponding national regulations in the country where the furnace is installed. Wait until the furnace and the connected parts have cooled to room temperature.

Note

In Germany, the general accident protection guidelines must be observed. The accident prevention regulations applicable in the country where the furnace is installed must be observed.

Note

See the enclosed circuit diagram for the wiring and electrical connections. The machine's electrical equipment is shown in the circuit diagram.

Tip: Because of the many different furnace models, we recommend that you take several photos of the initial condition, the installed heating elements and the switchgear. This will simplify subsequent installation and wiring of new heating elements.

Note

The pictures contained in the instruction manual may contain inaccuracies in terms of the function, design and furnace model.

Dismantling the cover(s)

We expressly do not accept any responsibility for direct or indirect damage caused by incorrect assembly. This also applies in all cases where general installation steps are not described. To replace the heating elements, the panel(s) (model-related) on the furnace (protective cladding) must be dismantled. Undo all the screws of the panel with a suitable tool and keep them in a safe place for future use. The number and position of the panels and screws may differ depending on the furnace model.

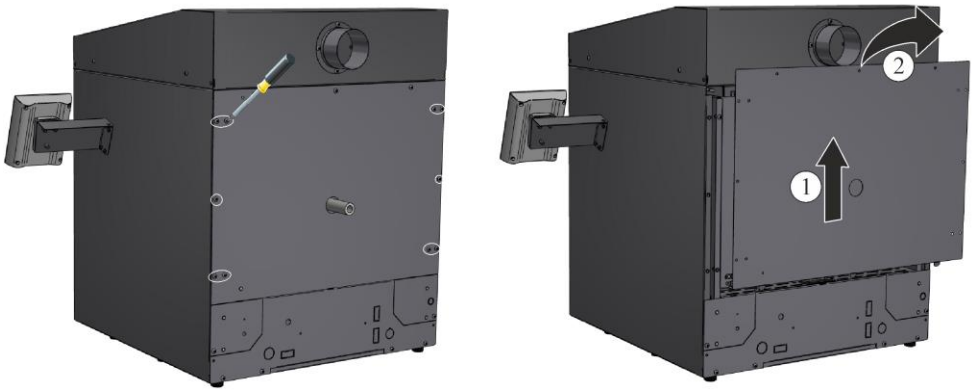
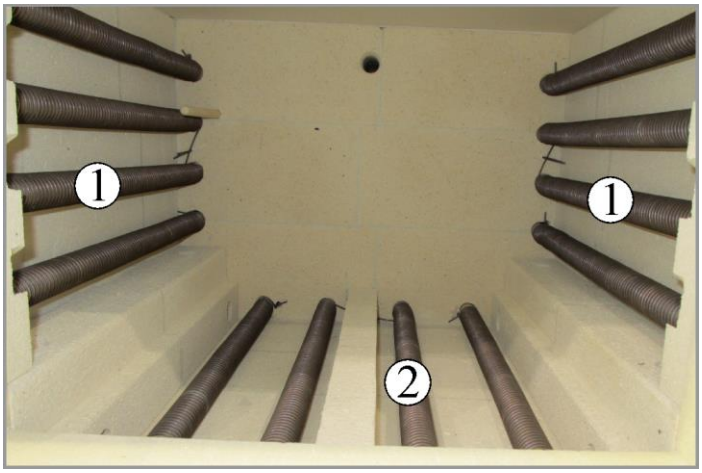


Fig. 42: Example: Removing cover(s) (similar to picture)

Arrangement of the heating elements (model-related)



1 Heating elements inside furnace
2 Heating elements (remove floor panels) model-related

Fig. 43: Example: Heating elements (model-related) (similar to picture)

Arrangement of the terminals (depending on the model)

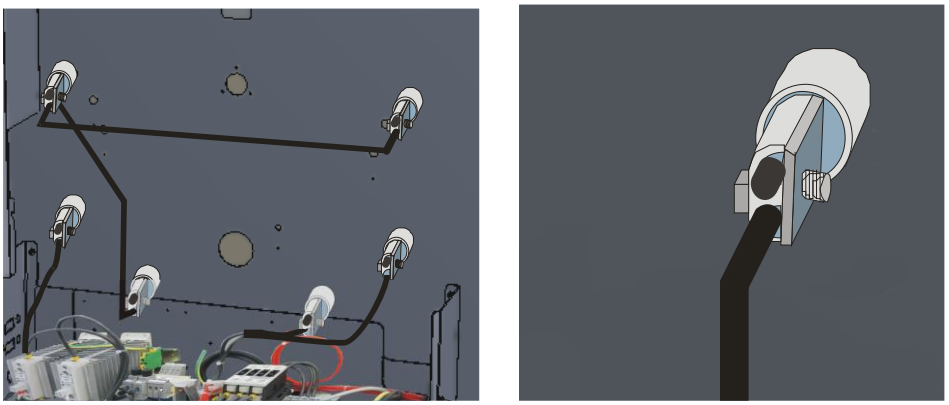
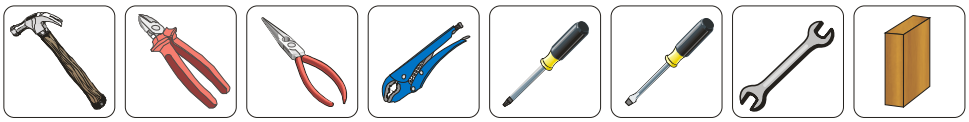


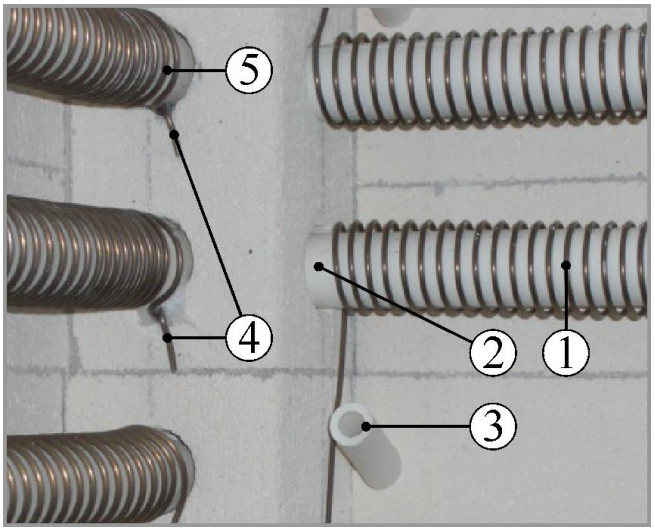
Fig. 44: Example: Connection terminals of the heating elements (similar to picture)

Tools needed for assembly

The following tools are needed to replace the heating elements. Hammer, side cutter, long-nose pliers, pipe wrench, screwdriver (crosstip or slot screwdriver depending on the age of the furnace), open-end wrench and a block of wood to knock in the ceramic tubes.

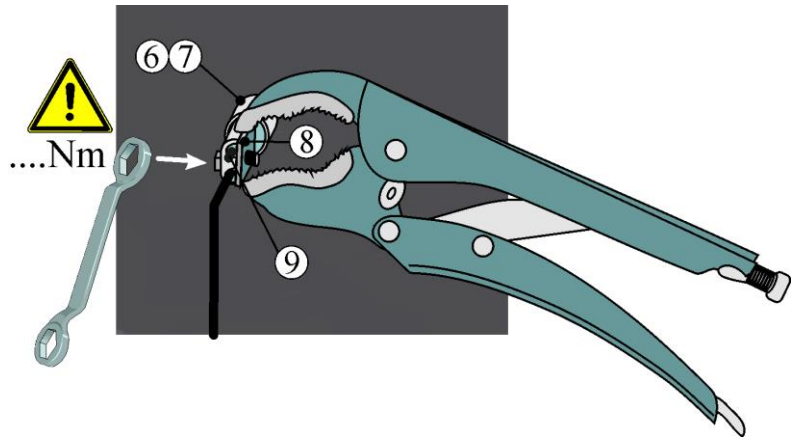


Replacing the heating elements (short description)



1 Heating element (heating coil)
2 Support tube
3 Holding tube (model-related)
4 Clamp(s)
5 Fiber wadding

Fig. 45: Names of the required attachment parts (similar to picture)



7 Ceramic duct, **6** Fiber wadding
8 Terminal
9 Heating element end (twisted)

Fig. 46: Example: Connection terminal(s) (similar to picture)

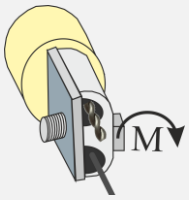
Removing the heating elements

- Remove the protective cladding from the electrical connections.
- Undo the terminals on the ends of the heating coil. Remove the ceramic ducts and replace if necessary.
- Remove the clamps and/or ceramic tubes holding the heating elements from the brickwork (old clamps are very brittle; if a clamp breaks, remove the remainder).
- Carefully remove the heating coils with the support tubes (caution: old heating elements are very brittle).

Installing the heating elements

- Clean the heating chamber, support tubes, support bricks, clamps and ceramic ducts to remove firing residues.
- **Note:** We recommend that you use new support tubes, clamps, and ceramic ducts (contaminated support tubes/ceramic ducts cause new heating elements to break down prematurely)
- With new heating elements, the ends (twisted) have a lug for protection. Pinch off the loops before installation. Install the heating coil with support tubes
- Insert the clamps into the wall brickwork. Note: Never use the old holes for new clamps. There could be problems with the RCD (if present). Depending on the furnace model, ceramic tubes may be installed as holders rather than clamps.
- Seal ceramic ducts from outside with a small amount of fiber wadding. Establish the electrical connections with the terminals: Hold the bottom part with pliers, tighten the screw.
- Recommendation: Tighten all screws on the connection terminals of the heating elements after one week of operation and then once each year. Avoid all stress or twisting of the heating wire. If this is not observed, the sensitive heating elements will be destroyed.
- If necessary, shorten projecting twists to slightly more than the width of the terminal (approx. 2-3 cm).
- Ensure that electrical connections and ground wire are connected properly.

11 Tightening Torque for Screw Connections on Heating Elements

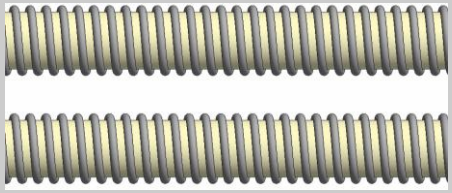
Screw tightening torque			
Tighten screws on the heating elements with a defined torque. If this advice is not followed, the heating elements may be damaged.			
Figure	Screw/type of fixing	Thread diameter of metric thread	Torque (M) in Nm
	Fastening power cable clamp	M5	6 Nm
		M6	8 Nm
		M7	8 Nm
		M8	14 Nm
		M10	20 Nm

The formation of a layer of oxide is necessary for the correct function of the heating element.

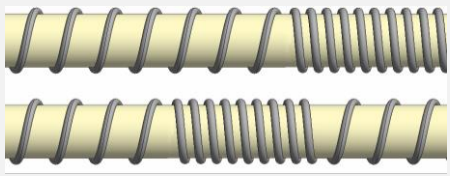
This procedure is for the first start-up and must be repeated after **every replacement** of heating elements.

The duration of the oxidation firing can be found in the section entitled "Recommendation for Heating the Furnace for the First Time".

Nest formation is a natural process and requires no correction. Considerable nest formation, however, can influence temperature distribution.



Before



After (nest formation)

Note

If the protective gas boxes are used, a working temperature to 1100 °C (2012 °F) is recommended; with working temperatures to 1150 °C (2102 °F) the boxes will suffer increased wear.

Note

Re-install in reverse sequence.

Note

Check all screw and plug-in connections. After tightening screws on heating element terminals, make sure that the cable is held firmly in the terminal. This can be done simply by pulling it.

11.1 Replacing a Thermocouple

Warning – Danger of Electric Shock

Work on the electrical equipment may be done only by qualified, authorized electricians. During work it must be ensured that the furnace and the switching equipment cannot be activated by mistake (pull out the power plug) and that all moving parts in the furnace are secured. Observe DGUV V3 or the corresponding national regulations in the country where the furnace is installed. Wait until the furnace and the connected parts have cooled to room temperature.

Warning – General Hazards!

If installed improperly, functioning and safety of the system can no longer be guaranteed. The connection must be properly installed and put into operation by qualified personnel.

Caution - damage to components!

Thermocouples are extremely sensitive to breakage. Any strain on or rotation of the thermocouples must be avoided. Failure to observe this rule will lead to the immediate destruction of the sensitive thermocouples.

Note

The pictures contained in the instruction manual may contain inaccuracies in terms of the function, design and furnace model.

Use an appropriate tool to remove the screws all around the cover and keep them in a secure place for later use. The cover must be lowered onto a soft material (such as foam rubber). The number and position of the screws may differ from one furnace model to the next. The furnace may look different than the picture depending on the furnace model and additional equipment.

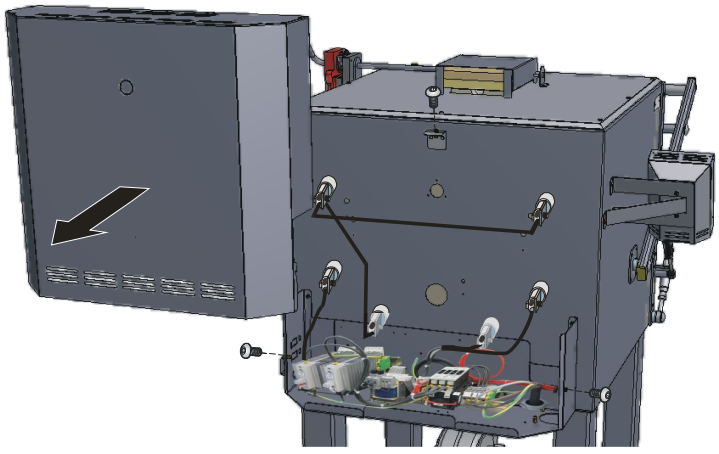


Fig. 47: Removing the back furnace wall (similar to picture)

You can find the position and labeling of built-in thermocouples in the schematic contained in the appendix.

First remove the two screws (A) from the thermocouple connection. Remove screw (B) and pull out the thermocouple (C).

Insert the new thermocouple carefully into the thermal channel (C), install and connect in reverse order. Make sure that the polarity of the electrical connections (D) is correct*).

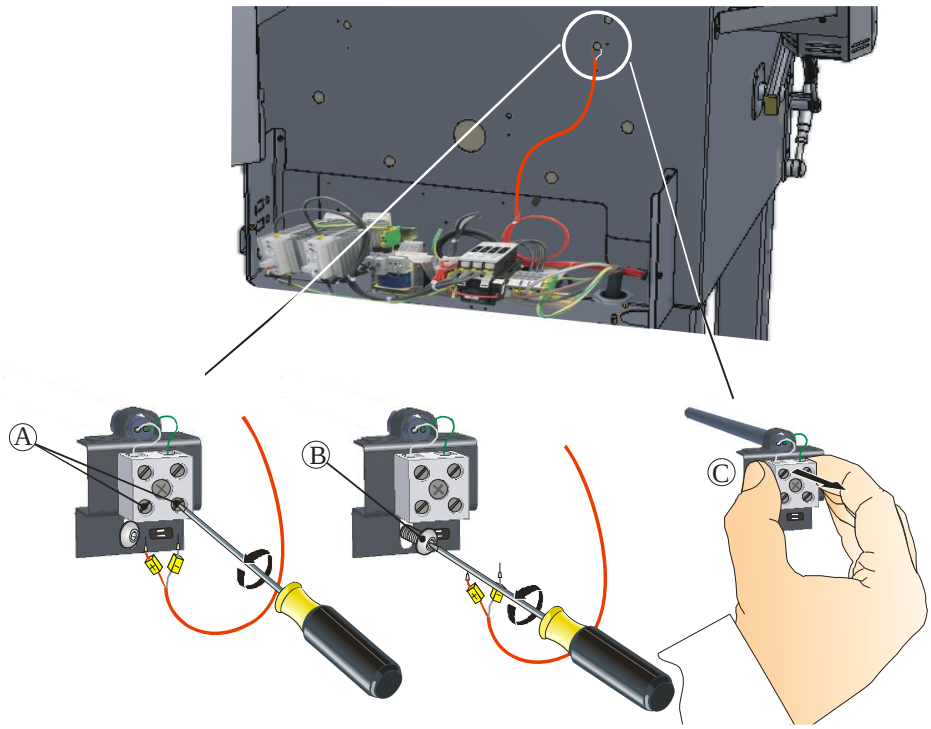


Fig. 48: Removing the thermocouple/s (similar to picture)

Note

*) The connections of the connecting lines from the thermocouple to the controller are labeled with ⊕ and ⊖. It is absolutely essential to observe the correct polarity.

⊕ to ⊕ ⊖ to ⊖

Note

Make sure that all screwed and plugged connections are in working order.

11.2 Electrical Schematics/Pneumatic Schematics

Note

The documents included do not always contain the electrical schematics and pneumatic diagrams.

If you need the respective diagrams, they can be ordered from Nabertherm Service.

12 Nabertherm Service

The Nabertherm Service team is available at all times for furnace maintenance and repair.

If you have any questions, problems, or requirements, contact Nabertherm GmbH. By mail, phone, or the Internet.

Mail	Phone or fax	Web or e-mail
Nabertherm GmbH Bahnhofstrasse 20 28865 Lilienthal Germany	Phone: +49 (4298) 922-333 Fax: +49 (4298) 922-129	www.nabertherm.com contact@nabertherm.de

When you contact us, please have the type plate details of the furnace or controller at hand.

Provide the following details from the type plate:

① Furnace model

② Serial number

③ Article number

④ Year of construction

Fig. 49: Example (type plate)

13 Shut-Down, Dismantling, and Storage

To be Completed by the Operator

When the furnace is shut down, the following safety information must be observed to prevent serious injury, damage to property, and damage to the environment.

The furnace may only be shut down by authorized, trained personnel.

▶ The following operating materials/parts are to be disposed of by:

_____

_____

_____

_____

Oils and other substances that are hazardous to water must be completely removed before the furnace is dismantled for recycling or scrap.
Ensure that operating materials, lubricants, and consumables are disposed of in an environmentally compliant manner. Regulations relating to proper waste recycling and disposal must be observed.
The furnace may be lifted only at the intended points.
Use only the specified lifting and securing equipment to lift the furnace/parts.

Consider a total weight of kg when choosing _____suitable lifting equipment.

For transportation, consider a permitted floor weight of at least _____kg/m².

▶ Before transporting the furnace, attach the following securing equipment:

_____

_____

_____

_____

▶

Note

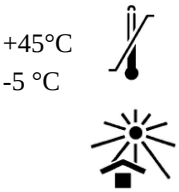
See “Safety” and “Transportation”.

13.1 Transportation/Return Transportation

If you still have the original packaging, this is the safest way to send a furnace.

Otherwise:

Choose suitable, adequately sturdy packaging. During transportation, packages are often stacked, bumped, or dropped; the packaging acts as external protection for your furnace.



- **Drain all piping and containers before transportation/return transportation (e.g. cooling water). Pump off operating materials and dispose of properly.**
- **Do not subject the furnace to extreme cold or hot temperatures (direct sunlight)**
- **Storage temperature -5 °C to 45 ° (23 °F to 113 °F)**
- **Humidity 5 % to 80 %, non-condensing**
- **Place the furnace on a level floor to prevent distortion**
- **Packaging and transportation may be carried out only by qualified and authorized persons**

If your furnace has transportation securing equipment (see "Transportation Securing"), use this.
Otherwise, in general:

“Fix” and “secure” (adhesive tape) all moving parts and cushion and protect any projecting parts against breakage.
Protect your electronic equipment against moisture and make sure that no loose packaging material can get inside it.

Fill gaps in your packaging with soft but adequately firm material (e.g. foam mats) and make sure that the equipment cannot slide around in the packaging.

If the goods are damaged during return transportation due to inadequate packaging or some other breach of duty, the costs will be borne by the customer.

As a rule:

The furnace is sent without accessories, unless the technician expressly requests them.

Enclose a detailed description of the malfunction along with the furnace – this saves the technician time and costs.

Don't forget to enclose the name and phone number of a contact in case there are any questions.

Note

Return transportation may only be carried out according to the information given on the packaging or in the transportation documents.

Note

Transportation and return transportation **not** covered by a warranty claim are paid for by the customer.

14 Declaration of Conformity

CE

EU Declaration of Conformity

Electrically Heated Chamber Furnaces

Model	N 7/H	N 11/H	N 11/HR	N 17/HR	N 31/H	N 41/H
	N 61/H	N 87/H				

Name and address of the manufacturer

Nabertherm GmbH
Bahnhofstr. 20
28865 Lilienthal, Germany

The above product fulfills the following harmonization regulations of the EU:

- 2006/42/EC (Machinery Directive)
- 2014/30/EU (EMC):
- 2011/65/EU (RoHS)

The following harmonized standards were applied:

- DIN EN 60335-1 (08.2020)
- DIN EN IEC 61000-6-1 (11.2019), DIN EN IEC 61000-6-3 (06.2022)

The manufacturer has sole responsibility for issuing this declaration of conformity. The signatories of the declaration are authorized to compile the relevant technical documents. The address corresponds to the specified address of the manufacturer.

Lilienthal, 13.09.2022

Dr. Henning Dahl
Vice President R & D

Gernot Fäthke
Department Manager R & D