Nabertherm
MORE THAN HEAT 30-3000 °C

Operating Instructions

Universal High-Temperature Tube Furnace

RHTC

M01.1031 ENGLISCH

Original instructions

Made
in
Germany

www.nabertherm.com

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Nabertherm GmbH
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28865 Lilienthal
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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 Key to the Symbols and Warning Terminology Used in Warning Messages

Note

The following operating instructions set forth specific warnings to highlight the residual risks that cannot be avoided when operating the equipment. These residual risks include hazards to personnel/product/equipment and the environment.

The symbols used in the operating instructions are primarily intended to draw attention to the safety instructions!

The respective symbols cannot replace the text contained in the safety instructions. The text must therefore always be read in full!

Graphic symbols correspond to **ISO 3864**. According to the **A**merican **N**ational **S**tandards **I**nstitute (ANSI) **Z535.6** standard, the following warning messages and terminology are used in this document:



The general hazard symbol, in conjunction with the warning words **CAUTION**, **WARNING** and **DANGER**, warns of the risk of serious injury.

The textual explanations associated with the general hazard symbol, particularly if this appears on the device, must always be observed in order to obtain instructions on how to avoid hazards and prevent injury or death.

NOTICE	Indicates a hazardous situation leading to damage to or destruction of the equipment.
CAUTION	Indicates a hazardous situation that could result in minor or moderate injury.
WARNING	Indicates a hazardous situation that could result in death or serious or irreversible injury.
DANGER	Indicates a hazardous situation that will result in immediate death or serious injury.

Warning Message Structure:
All warning messages are structured as follows


4

⚠[1] WARNING[2]

- **Type and source of hazard[3]**
- **Consequences of non-observance[3]**
- Action to avert hazard[3]

or

 4	[1] DANGER[2] • **Type and source of hazard**[3] • **Consequences of non-observance**[3] • Action to avert hazard[3]	 5

Item	Name	Explanation
1	Safety alert symbol	Indicates risk of injury
2	Signal word	Classifies the hazard
3	Safety messages	• Type and source of hazard • Potential consequences if not observed • Measures/prohibitions
4	Graphical symbols (optional) according to ISO 3864:	Consequences, measures or prohibitions
5	Graphical symbols (optional) according to ISO 3864:	Rules 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 – 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.



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 – 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

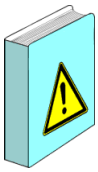
You may not always realize that surfaces, such as furnace components, furnace walls, doors and materials, and even liquids are hot. Do not touch the surface.



Warning – Electrical voltage!

Warning of dangerous electric voltage.

1.2 Product Description



These high-temperature tube 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.

Universal high-temperature tube furnaces, RHTC models

These compact tube furnaces with SiC rod heating and integrated switchgear with controller can be used for many different processes. An easy-to-replace working tube and the accessories that are available allow them to be used flexibly for a wide range of applications. The high-quality fiber insulation enables short heating and cooling times, while the SiC heating rods arranged parallel to the working tube guarantee excellent temperature uniformity. Universal high-temperature tube furnaces in the RHTC series reach a maximum temperature of 1600 °C (2912 °F).

Other features of this product are:

- Housing made from sheets of textured stainless steel
- High-quality fiber insulation
- Active housing cooling for low surface temperatures
- Thermocouple type S
- Solid-state relay ensures low-noise heater operation
- Prepared for installation of working tubes with water-cooled flanges
- Ceramic tube, C 799 grade
- Only insulation materials that are not classified according to Regulation (EC) No. 1272/2008 (CLP) are used. This means that no aluminum-silicate wool, also known as RCF fiber, is used, which is classified and may be carcinogenic.

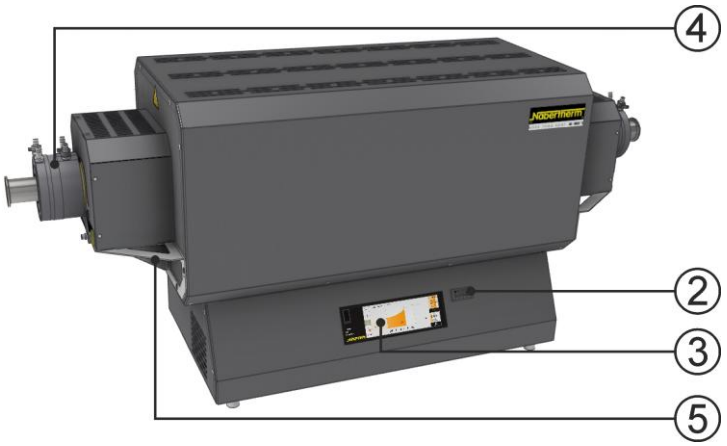
Additional equipment

- Over-temperature limiter with manual reset
  according to DIN EN IEC 60519-1
- Charge control with temperature measurement in the working tube and in the furnace chamber outside the tube
- Fiber plug
- Check valve in gas outlet stops false air entering
- Working tube for operation with water-cooled flanges
- Display of temperature in the working tube with additional thermocouple
- Alternative gas supply system packages for protective gas and vacuum operation
- Alternative working tube and accessories, see “Accessories”

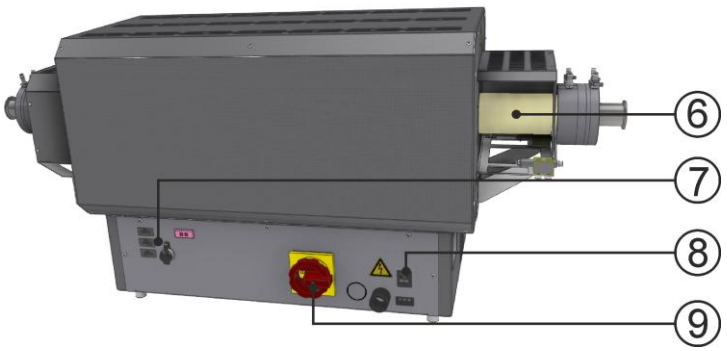
1.3 Overview of the Complete System



Example 1: RHTC, standard model



Example 2: RHTC with vacuum flanges as additional equipment



Example 2: RHTC with vacuum flanges as additional equipment (rear view)

Fig. 1: Complete view: Example: Universal high-temperature tube furnace

Item	Name
1	Fiber plug
2	Over-temperature limiter (additional equipment)

Item	Name
3	Controller
4	Vacuum flange (additional equipment)
5	Flange holder (additional equipment in combination with vacuum flange)
6	Vacuum tube (additional equipment)
7	Snap-in coupling (power supply)
8	Power switch (ON/OFF)
9	EMERGENCY STOP

1.4 Key to the Model Names

Example	Explanation
RHTC 80-230/16	**RHTC** = Universal high-temperature tube furnaces with SiC rod heating
RHTC **80**-230/16	**80** = Max. possible outer diameter of tube in mm
RHTC 80-**230**/16	**230** = Heated tube length in mm
RHTC 80-230/**16**	**16** = Tmax 1600 °C

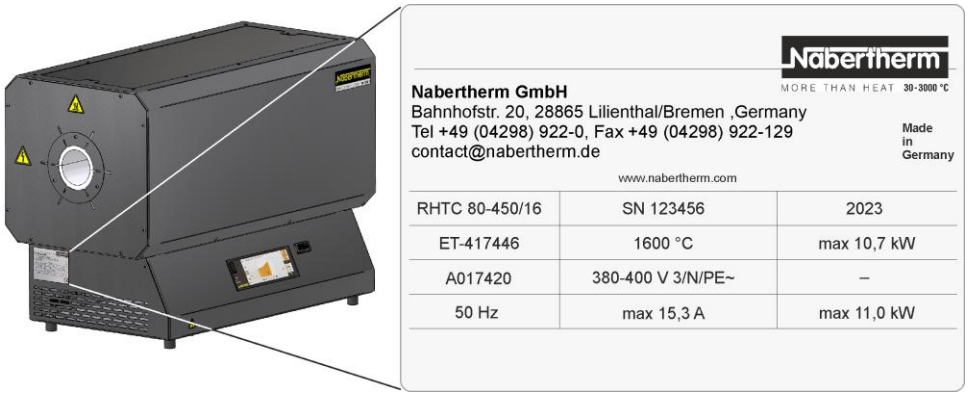
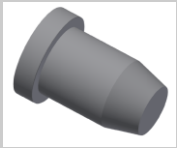


Fig. 2: Example of model name (type plate)

1.5 Scope of Delivery

The scope of delivery includes:

	System components	Quantity	Comment
	Universal high-temperature tube furnace model RHTC …-…/..	1 x	- - -
	Allen key	1 x	- - -
	Standard working tube Vacuum working tube *)	1 x	- - -
	Fiber plug *)	2 x	Fiber plugs are required only in combination with the standard working tube
	Gas supply system *)	1 x	- - -
	Flanges/flange holder *)	2 x	- - -
	Other components, depending on model	- - -	See shipping documents

	Document type	Quantity	Comment
	Operating instructions for universal high-temperature tube furnace	1 x	Nabertherm GmbH
	Operating manual for controller	1 x	Nabertherm GmbH
	Circuit diagram *)	1 x	Nabertherm GmbH
	Installation instructions for vacuum flange *)	1 x	- - -
	Other documents, depending on model	1 x	Refer to documentation folder

*) = included in the delivery depending on model

Note

Keep all documents for future reference. All functions of this furnace system were tested during manufacture 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 °C[3]	Outer dimensions in mm W	D	H	Tube Ø outer/ mm	Heated length/ mm	Length constant temperature ΔT 10 K in mm	Tube length mm	Connected load/kW	Electrical connection	Weight in kg
RHTC 80-230/16	1600[4]	600	430	580	80	230	120	600	7.5	3-phase[2]	50
RHTC 80-450/16	1600	820	430	580	80	450	210	830	11.3	3-phase[1]	70
RHTC 80-710/16	1600	1070	430	580	80	710	345	1080	13.8	3-phase[1]	90

[1] Heating only between two phases
[2] Heating only with one phase
[3] Tmax outside the tube. Actual achievable working temperature in tube approx. 50 °C lower.
[4] Standard design (short tube with fiber plug) for use with vacuum tubes and water-cooled flanges Tmax 1500 °C

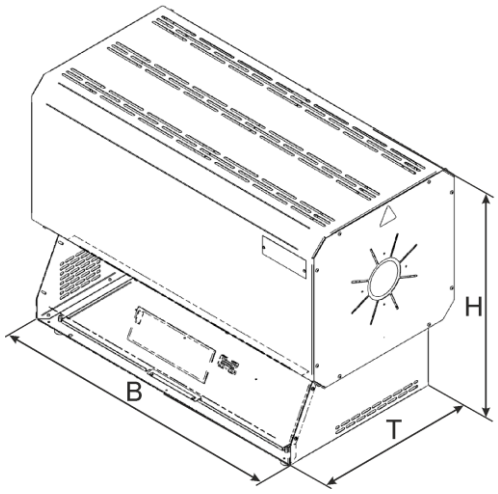


Fig. 3: Dimensions of universal high-temperature tube furnaces, model RHTC

Electrical connection	**Voltage (V)**	**3-phase:**	
Furnace model		See type plate on furnace	
	Voltage:	220 V	380 V – 415 V
	Frequency:	50 or 60 Hz	
Thermal protection class	Furnaces:	**DIN EN IEC 60519-1**	
Protection type	Furnaces	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**	**< 70 dB(A)**

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



This Nabertherm furnace system was designed and built to comply with various carefully chosen harmonized standards and technical specifications. Hence, it corresponds to the state of the art and assures the greatest level of safety.

This furnace is designed for commercial use in the laboratory sector.

Intended thermal processes are processes carried out:

- under atmospheric conditions
- with non-flammable protective and reaction gases (according to DIN EN 746-3) at a slight overpressure up to 90mbar rel. nitrogen (N2) or argon (Ar), for example, are permitted as non-flammable protective and reaction gases in the furnace
- in vacuum

Improper furnace operation:

- Use of flammable protective and reaction gases (according to DIN EN 746-3) and flammable gassing from the charge with overpressure and underpressure without the respective safety package
- Use of substances that are also flammable or explosive with the exclusion of oxygen or that generate other flammable or explosive atmospheres or substances
- Thermal processes in which uncontrolled chemical or thermodynamic reactions take place, also in combination with the protective and reaction gases that are used
- Use or generation of corrosive gases or gases with corrosive components
- Use or generation of hazardous materials that require additional protective measures
- Heating food for consumption

The operator is liable for any resulting damages

- Only materials whose characteristics and melting temperatures are known may be used. Observe the safety date sheets for the respective materials.
- Depending on the tube material, the maximum heating rates and maximum working temperatures specified in “Maximum Permitted Heating Rates and Working Temperatures” must not be exceeded.
- If, as a result of excessive heat, a batch is likely to be damaged by the pre-set response temperature of the over-temperature limiter or if the batch itself becomes a source of danger for the furnace or its surroundings, the temperature setting on the over-temperature limiter must be **reduced to the maximum permissible value**.
- Fiber plugs, flanges, and protective covers must not be removed when the furnace is hot (> 100 °C). This would cause a thermal shock that would destroy the working tube and, under certain circumstances, also the heating elements.
- Changes to the furnace require the written approval of Nabertherm. Protective components (if applicable) must not be removed, overridden, or deactivated. If any modifications are made without first consulting with us, the EC conformity declaration will lose its validity.
- The set-up instructions and safety instructions must be observed, otherwise the furnace will be considered improperly used, effectively canceling any claims against Nabertherm GmbH.



Warning – General hazards! – Working tubes and their fiber plugs

Tube furnaces must not be operated without working tubes, fiber plugs or flanges. There is risk of burns and electric shock. Nabertherm is not liable for any damage incurred.

Note

Depending on use, wearing parts, such as heating elements and insulation material, can be subject to increased wear. High temperatures on the stainless steel (especially if the furnace is opened when hot) can cause discoloration; however; this in no way affects the function of the furnace.



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.).



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.

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



Everywhere in the vicinity of the furnace, pouring pans, and similar components, wear protective clothing which is resistant to spatters of molten metal.



Protect your hands by wearing heat-proof gloves.



Wear a respirator (P2 or higher) to protect your respiratory tract e.g. when working on the fiber insulation.

4.5 Basic Measures During Normal Operation



Dangers During Normal Operation!

Before switching off the furnace check and ensure that only authorized persons are in the working area of the furnace and that nobody can be injured by the operation of the furnace.

Before the beginning of production check and ensure that all safety devices are in perfect working condition.

Check the furnace for visible damage and ensure that it is only operated in perfect operating condition each time, before you start production. Any shortcomings must be reported to your supervisor immediately!

Remove an material/objects from the working area of the furnace that is not necessary for production each time, before you start production.

At least once a day (see also Service and Maintenance) the following control activities must be carried out:

- Check the furnace for visible damages
- Check the functionality of all the safety devices (e.g. if included, the EMERGENCY-OFF device)

4.6 Basic Measures in Case of Emergency

4.6.1 What to Do in an Emergency



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.



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.



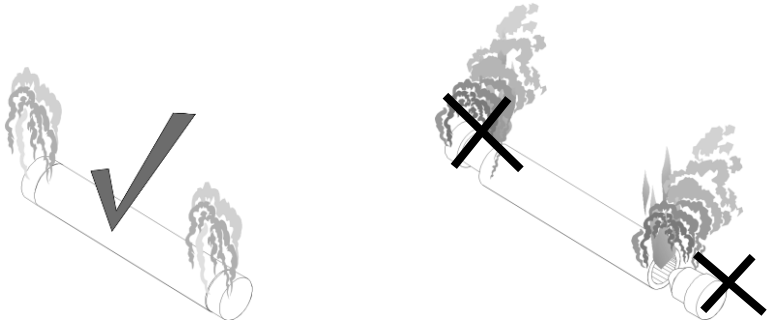
Warning – Danger of Electric Shock!

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



Warning! General Hazards!

In case of unexpected events in the furnace (e.g. severe smoking or annoying odor), fiber plugs at the working tube must **not** be opened or removed. Doing so creates a fire or explosion hazard. Wait until the furnace has naturally cooled down to room temperature.





Warning - General hazards!

If unusual processes are occurring in the furnace (e.g., emission of heavy smoke or strong odors), do **not** open or remove the flange at the working tube. Doing so creates a fire or explosion hazard. Wait until the furnace has naturally cooled down to room temperature.



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



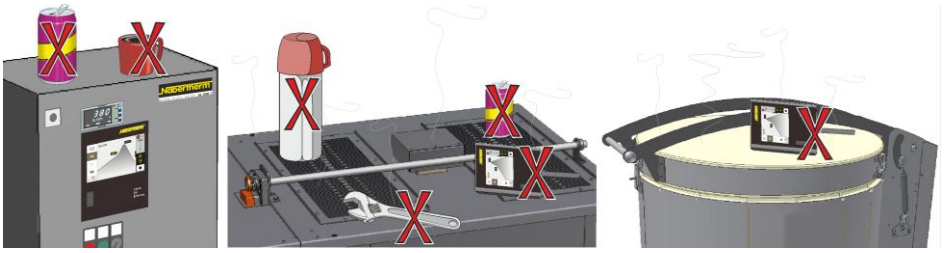
Warning – General Hazards!

- Risk of burning on the furnace housing and on the tube
- The door handle/grip can become very hot during operation; wear gloves.
- Risk of crushing on moving parts (door hinge, rotary tube drive, lifting table, etc.)
- The switchgear cabinet (if present) and the terminal boxes on the system contain dangerous electrical voltages.
- Do not insert any objects into the openings on the furnace housing, exhaust air holes, or cooling slots on the switchgear or furnace (if present). This poses a risk of electric shock.



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.





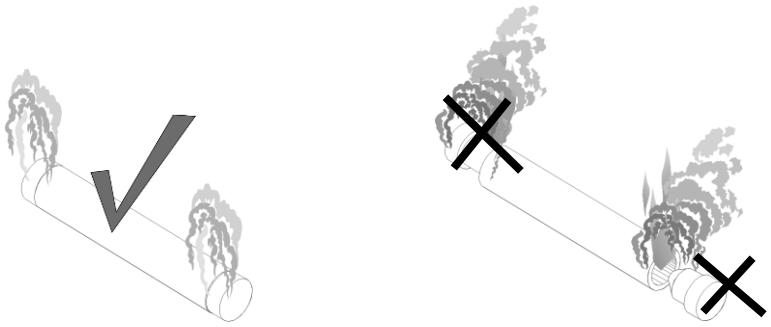
DANGER

- **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.



Warning! General Hazards!

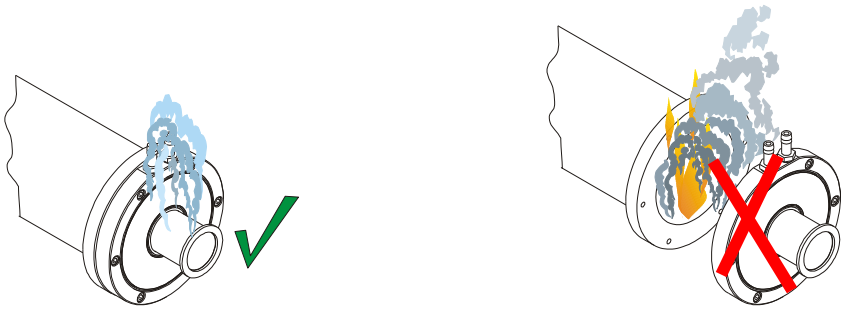
In case of unexpected events in the furnace (e.g. severe smoking or annoying odor), fiber plugs at the working tube must **not** be opened or removed. Doing so creates a fire or explosion hazard. Wait until the furnace has naturally cooled down to room temperature.





Warning - General hazards!

If unusual processes are occurring in the furnace (e.g., emission of heavy smoke or strong odors), do **not** open or remove the flange at the working tube. Doing so creates a fire or explosion hazard. Wait until the furnace has naturally cooled down to room temperature.



4.10 Safeguarding against Dangers from Excess Temperatures

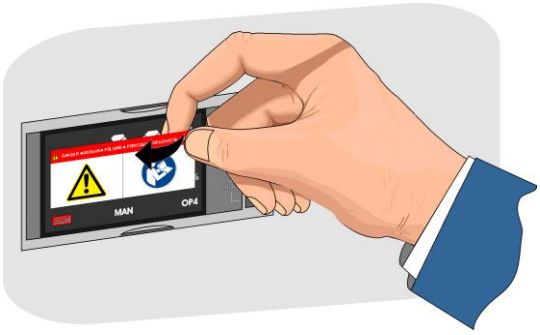
Over-temperature limiters and over-temperature limiters with automatic reset to protect against over-temperature in the furnace are available for Nabertherm GmbH furnaces either as a standard feature (depending on the model series) or as additional equipment (customized design).

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. 4: 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.

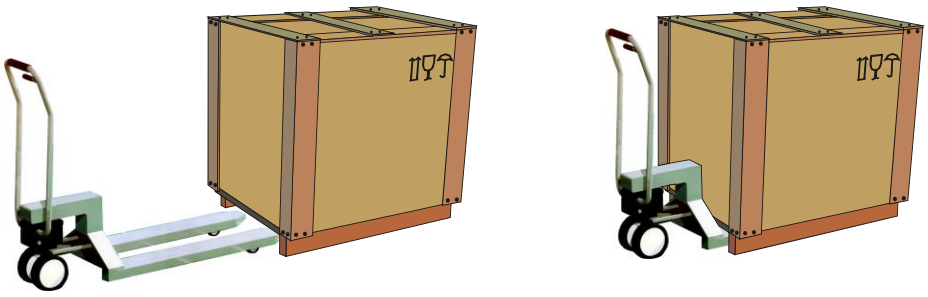


Fig. 5: Pallet truck is pushed **completely** beneath the transportation frame

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.



⚠ 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:

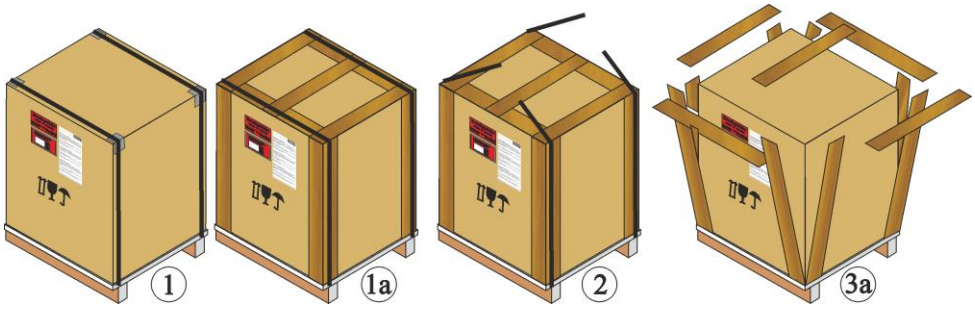
The symbols for handling packaging are defined in ISO R/780 (International Organization for Standardization) and in DIN 55402 (German Institute for Standardization).

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.

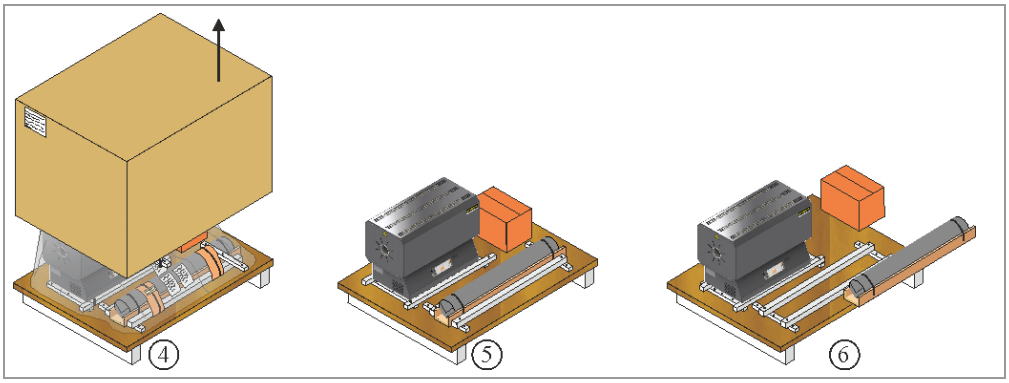
5.2 Unpacking



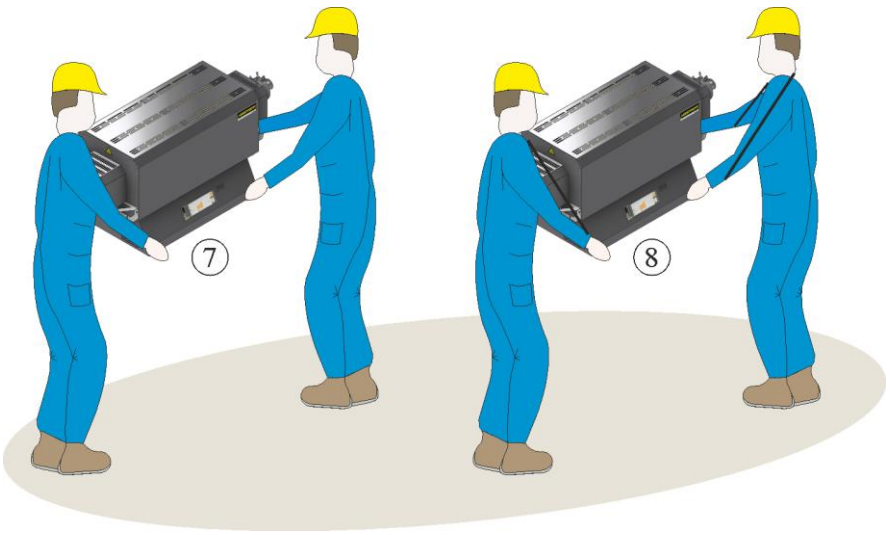
Wear protective gloves



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. You will find a flat box on the rear wall of the furnace, containing the accessories for your furnace (ceramic tile, heating element pliers; optionally, a cable). Compare the delivered items with the delivery note and the order documents, see “Delivery”. Remove screws or nails from the battens.
6. Remove the battens from the pallet.



7. To carry the furnace, place your hands at the sides beneath it and make sure that you have a firm grip.
8. Transport furnaces heavier than 25 kg with at least two people. If carrying straps are used, place them only on the sides (across). Make sure that you have a firm grip.

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

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

5.3 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.



Caution - Damage to Components!

Ceramic tubes are extremely heat-resistant, but easily breakable – therefore handle with care.



Caution – when using a ceramic tube!

The ceramic tube is very fragile and, in addition to mechanical effects, a large temperature gradient can also damage the working tube. Make sure that during operation and also if the tube has not been used for some time that there is no moisture in the working tube or near the flange. Even small amounts water generate a large temperature gradient via the wall of the tube when the tube is heated up (caused by enthalpy of evaporation). Cracks can form due to the thermal shock and in the worst-case scenario the tube will be damaged.

5.4 Constructional and Connection Requirements

5.4.1 Installation (Furnace Location)

When installing the furnace, observe the following safety precautions:

- The furnace must be installed in a dry room in accordance with the safety precautions.
- The bench/surface where the furnace is to be installed must be level so it stands upright. Place the furnace on a **non-flammable** surface (brick, metal, etc.).
- The load-bearing capacity of the bench must be suitable to take the weight of the furnace plus accessories.
- The floor covering must be made of non-flammable material so that it does not ignite if hot material falls out of the furnace.

In spite of its good insulation, the furnace radiates heat from its outer surfaces. If necessary, this heat must be dissipated (**a ventilation technician may have to be consulted**). A minimum safety distance (S) to flammable materials of 0.5 m on all sides and 1 m above the furnace must be ensured. In some cases, the distance must be greater in order to correspond with local conditions. The minimum distance between the furnace and **non-flammable materials** may be reduced to 0.2 m **at the sides**.

If the charge emits gases or vapors, ensure adequate ventilation at the installation site and/or a suitable exhaust gas venting system.

The customer must provide a suitable extractor for combustion exhaust gases.

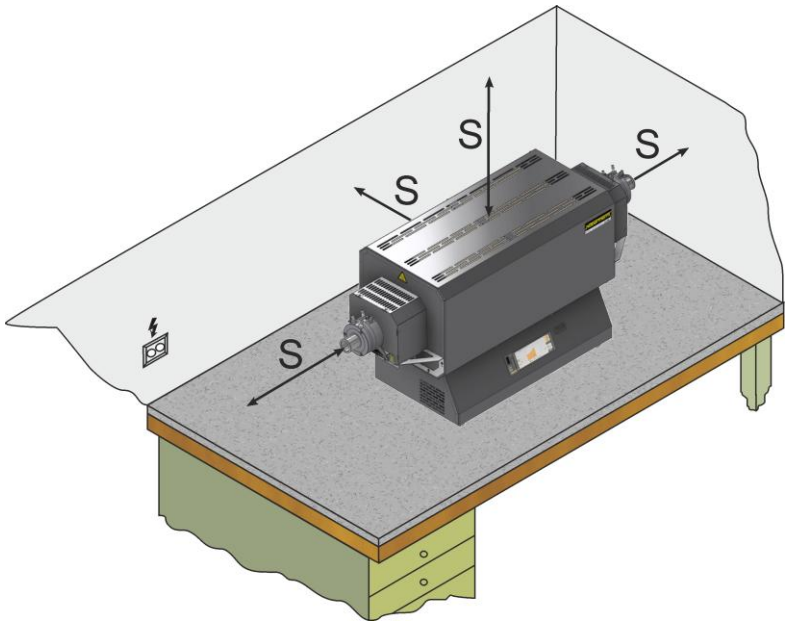


Fig. 6: Installing a tube furnace (on a non-flammable surface)

Note

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

Note

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



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.

5.5 Assembly, Installation, and Connection

5.5.1 Venting Exhaust Fumes

We recommend placing the furnace system underneath a suction system in order to discharge the exhaust gases accordingly.

A commercially avaiIable metal exhaust gas pipe may be used as the discharge pipe. It must be laid so that it always slopes upwards and must be fastened to the wall or ceiling.

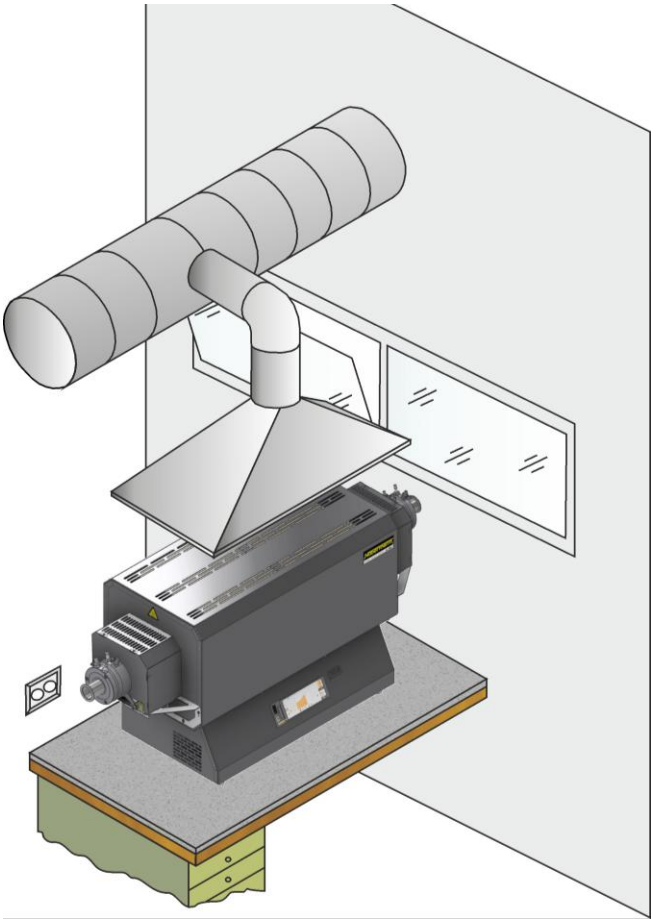


Fig. 7: Example: Installing an extraction system

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.

5.5.2 Connecting the Furnace to the Power Supply

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

- The furnace must be installed according to its intended use. The power connection must correspond to the values on the furnace type plate.
- The power socket must be close to the furnace and be easily accessible. The safety requirements are not met if the furnace is not connected to a socket with a protective ground contact.
- If an extension cable is used, its 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.
- The power cable must not be damaged. Do not place any objects on the power cable. Lay the cable in such a way that no one can stand on it or trip over it.
- Power cables may be replaced only with similar approved cables.
- Ensure that the connection cable of the furnace is protected.

Note

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

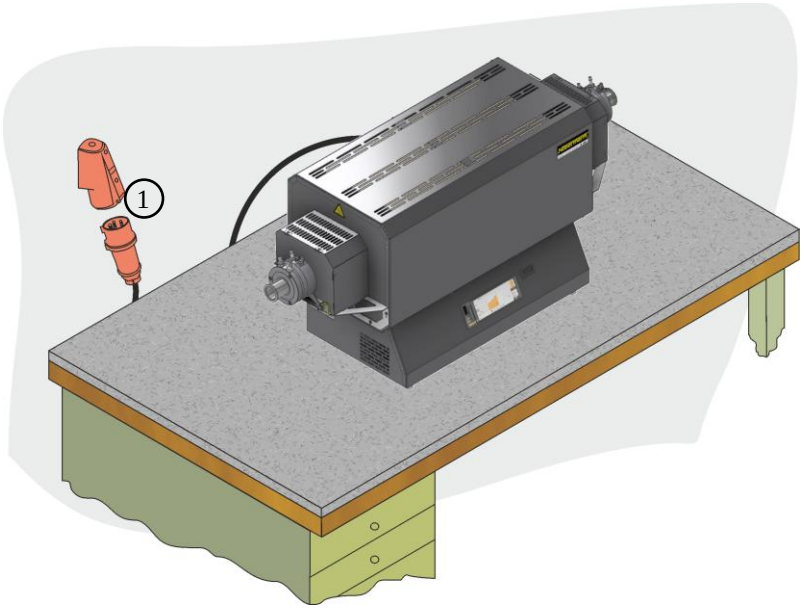


Fig. 8: Furnace 4.4 kW to 6.5 kW

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

Grounding the furnace and the switchgear (acc. to VDE 0100, Part 410) is a requirement for the heating unit's residual current operated device.

Testing of ground resistance (compliant with VDE 0100); also refer to the accident prevention regulations.

Electrical systems and operating equipment compliant with DGUV V3.

Power supply without power cable:

The power connection must be a fixed connection in the control box, using the prepared terminals. When carrying out this work, pay attention to the information on the type plate as regards voltage, supply type and max. power consumption.

The fuse protection and the cross-section of the required power connection depend on local conditions, the length of the cable 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 in such a way that no one can stand on it or trip over it.
- Power cables may be replaced only with similar approved cables.
- Ensure that the connection cable of the furnace is protected.

It must be compliant with locally applicable standards and regulations.

Ensure that the ground wire is connected properly.

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

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



Warning – Danger of electric shock!

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



Notice

Observe the national regulations of the country in which the furnace will be used.

Note

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



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



5.5.3 Inserting/Introducing the Working Tube



Warning! Electrical Hazard!

Before inserting or introducing the working tube, ensure that the power switch is set to the "**Off**" or "**0**" position.



Warning! Electrical Hazard!

The furnace must not be put into operation without the working tube/protective caps. Otherwise there is a risk of electric shock.



Caution - Damage to Components!

Ceramic tubes are extremely heat-resistant, but easily breakable – therefore handle with care.

Note

The following work may be carried out only when the switchgear is switched off.

Note

If the furnace is supplied without the working tube at the customer's request, the openings must be secured by protective caps at the factory. Removal of these protective devices and operating the furnace without working tube voids the conformity.

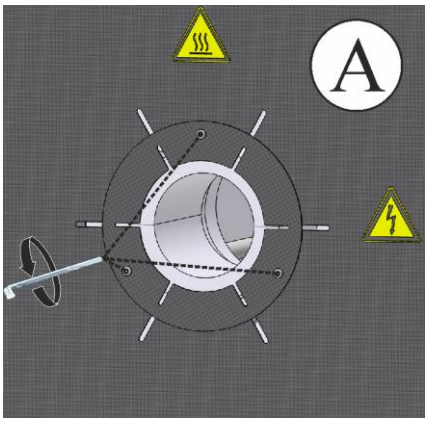


Fig. 9: Dismantling the clamping ring (similar to picture)

Undo the screws around the clamping ring (A) with a suitable tool.

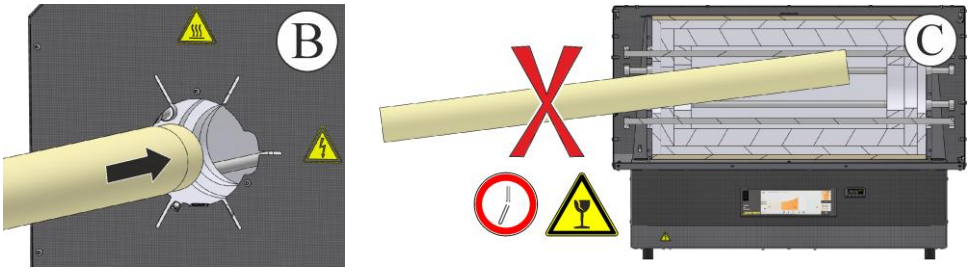


Fig. 10: Inserting the working tube (similar to picture)

After completely unpacking the working tube, slide it carefully into the intended opening (B). Make sure that there is no packaging material in the working tube. Slowly slide the working tube horizontally through the furnace opening. It is very important that you do not touch the heating elements (C) as this could destroy them. We recommend that you have a second person help you, who can direct the insertion of the working tube at the opposite opening (D).

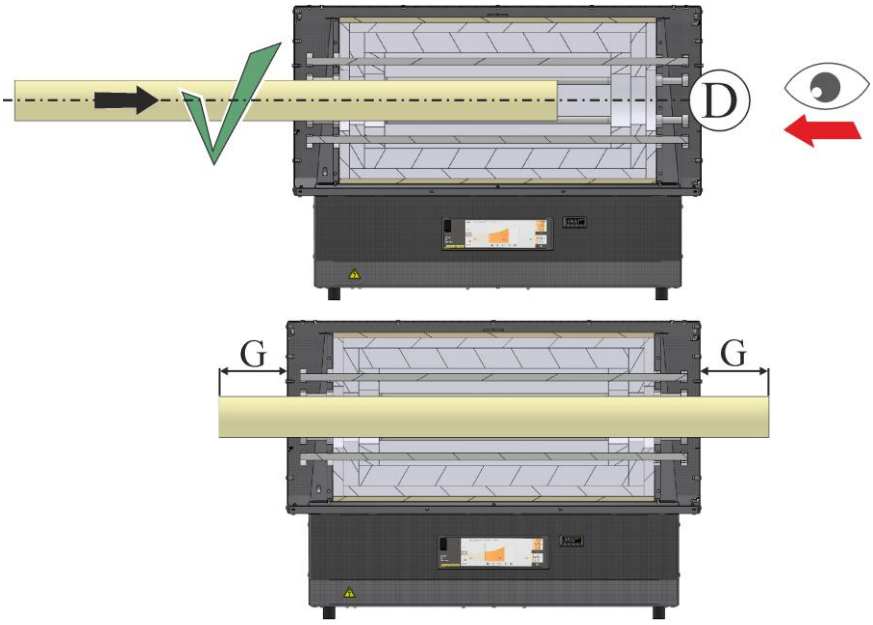


Fig. 11: Centering the working tube (similar to picture)

To facilitate assembly of the flange and the holding plates (fastening between the flange holder and the flange), it is important that the working tube is aligned in the middle (gap G).

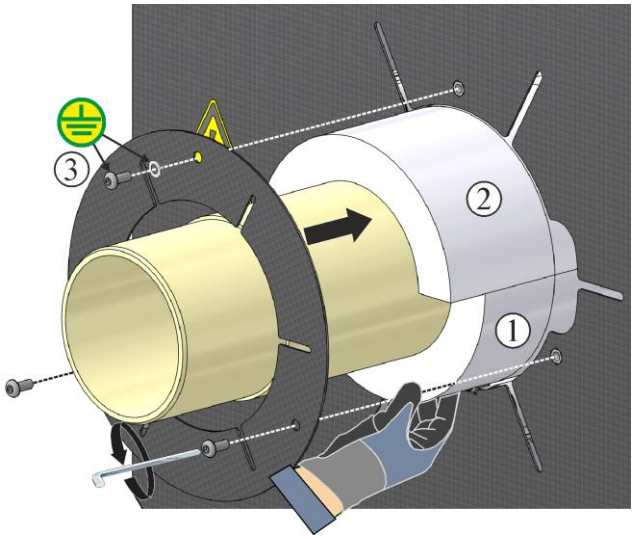


Fig. 12: Inserting the working tube (similar to picture)

First, carefully and slowly insert the bottom insulation half shells (1) and then the top insulation half shells into the housing. Only insert the top insulation half shells when the bottom insulation half shells have been completely inserted on both sides. Then, fix the clamping ring, using the screws that you previously unscrewed. Make sure that you place a tooth lock washer between the screw and the top. This position is marked by a ground sticker (3) on the clamping ring. Dismantle in reverse order. Remember to remove the top insulation half shells (2) first.

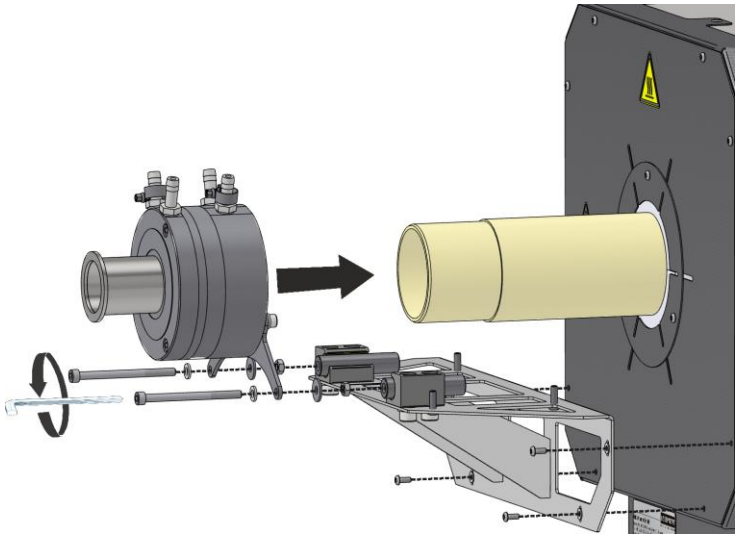


Fig. 13: Installing the flange (similar to picture)

See the separate flange instructions for how to install/dismantle the flange, flange holder, holding plates and connection to the cooling water supply.

5.6 Initial Start-Up

Commissioning of the system may only be performed by qualified personnel observing the safety instructions.

Read the section "Safety" as well. When commissioning the system, the following safety instructions must absolutely be followed - this will avoid life-threatening injury to personnel, system damage, and other property damage.

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

The system may only be used according to its intended purpose.

Make sure that only authorized personnel are located in the working area of the machine and that no other person is at risk due to the startup of the system.

Before the first start, check whether all tools, external parts, and transportation locks have been removed from the system.

Activate all safety systems (power switch, EMERGENCY STOP button if available) before commissioning.

Incorrectly wired connections can destroy electrical/electronic components.

Follow the special safety measures (e.g. grounding, etc.) for the components at risk.

Incorrect connections can cause unexpected startup of the system.

Inform yourself before starting the system about the proper behavior in case of malfunction and in case of emergency.

Before the first startup, check the electrical connections and control displays.

Note

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

Note

The furnace must not be put into operation without the working tube/protective caps. Otherwise there is a risk of electric shock.

5.7 Installing the Gas Supply System, Vacuum Packages, Charge Thermocouple, etc.

By using different equipment packages, certain tube furnace series can be equipped to operate with non-flammable or flammable gases or with vacuum.

Gas supply system 1 for non-flammable protective or reaction gases
Not gas-tight, cannot be used for vacuum operation

For many applications, this package is an adequate basic version for operation with non-flammable protective or reaction gases. The standard working tube supplied with the furnace can be used.

- Standard working tube can be used
- 2 plugs made from porous, non-classified ceramic fiber with protective gas connections
- The customer must provide an inlet gas pressure of 300 mbar.

Gas supply system for non-flammable protective gas (Ar, N2, forming gas*, others on request) with stopcock and flow meter with control valve, tubing attached ready for connection.

Gas supply system 2 for non-flammable protective or reaction gases/vacuum operation

We recommend this gas supply system where there are higher demands regarding the purity of the working tube atmosphere. This package can also be upgraded for vacuum operation.

- 2 vacuum-tight, water-cooled stainless steel flange with KF flange on the outlet side (customer must provide cooling water with NW9 hose connection)
- Holder device for the flange on the furnace
- The customer must provide an inlet gas pressure of 300 mbar.

Gas supply system for non-flammable protective gas (Ar, N2, forming gas*) with stopcock and flow meter.

*Country-specific guidelines with respect to the possible gas mixing ration have to be considered.

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.

The scope of delivery depends on how the respective furnace model will be used in the laboratory.

The modules included in the delivery must be connected with each other as marked.

5.7.1 Inserting the Fiber Plug

Close the open ends of the working tube with the fiber plugs that are supplied.

Note
Take care when handling the fiber plugs as they are very sensitive and brittle.

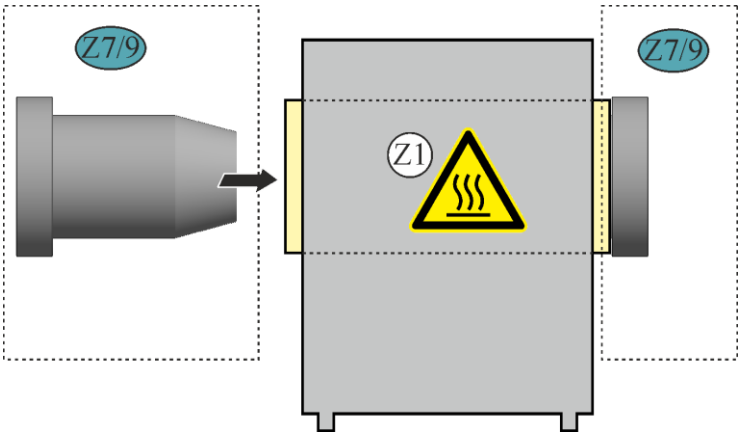


Fig. 14: Tube furnace – installing the fiber plug (similar to picture)

5.7.2 Gas Supply System 1, Including Fiber Plug

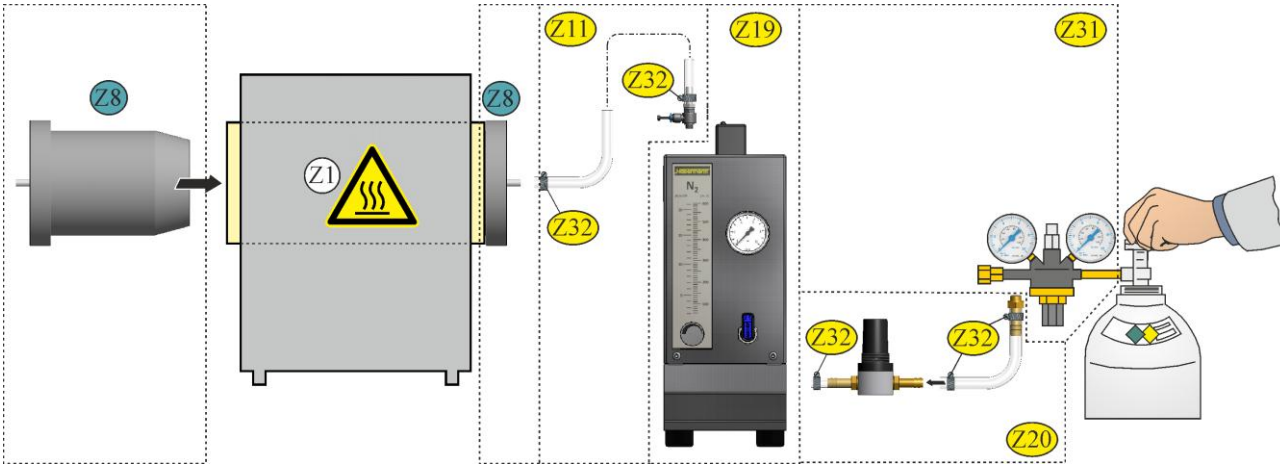


Fig. 15: Tube furnace – gas supply system 1 including fiber plugs (similar to picture)

5.7.3 Gas Supply System 2, Optionally with Connection Kit for Vacuum Operation

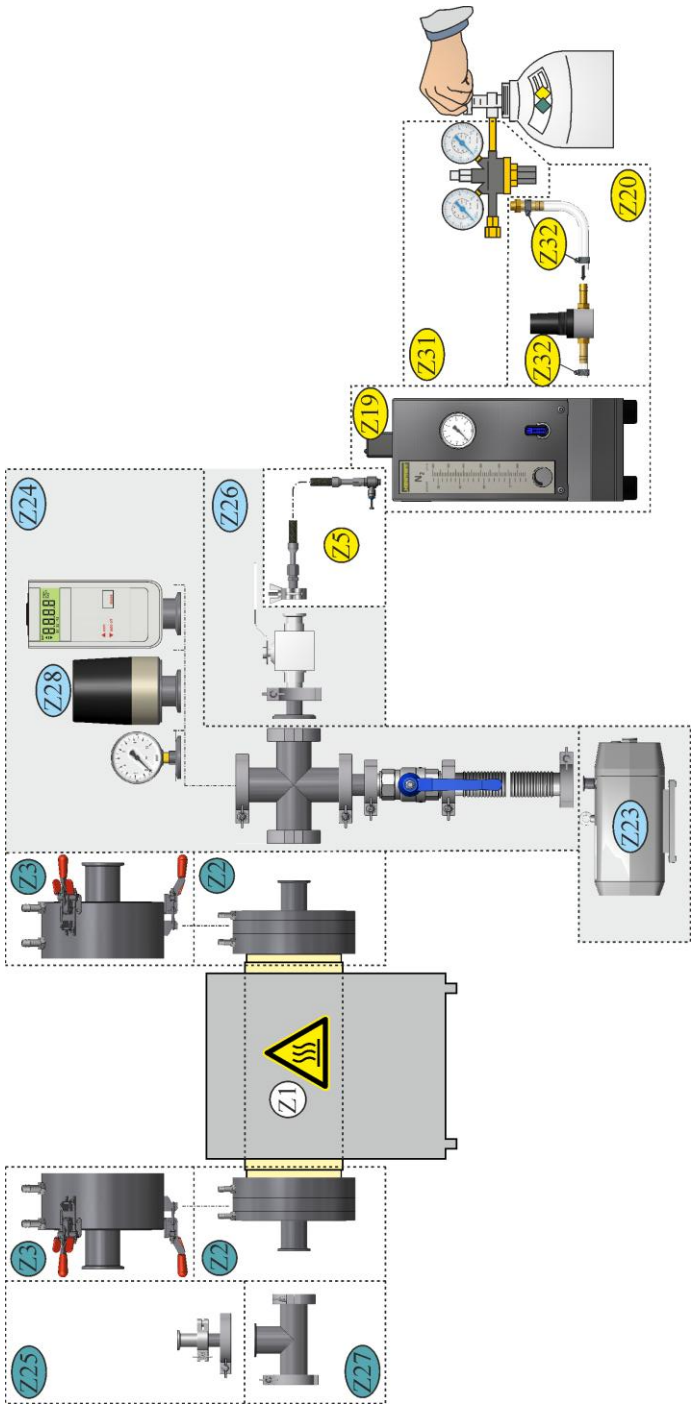


Fig. 16: Tube furnace with gas supply system 2, optionally with connection kit for vacuum operation (similar to picture)

5.7.4 Gas Supply System 2, Including Charge Thermocouple, Optionally with Connection Kit for Vacuum Operation

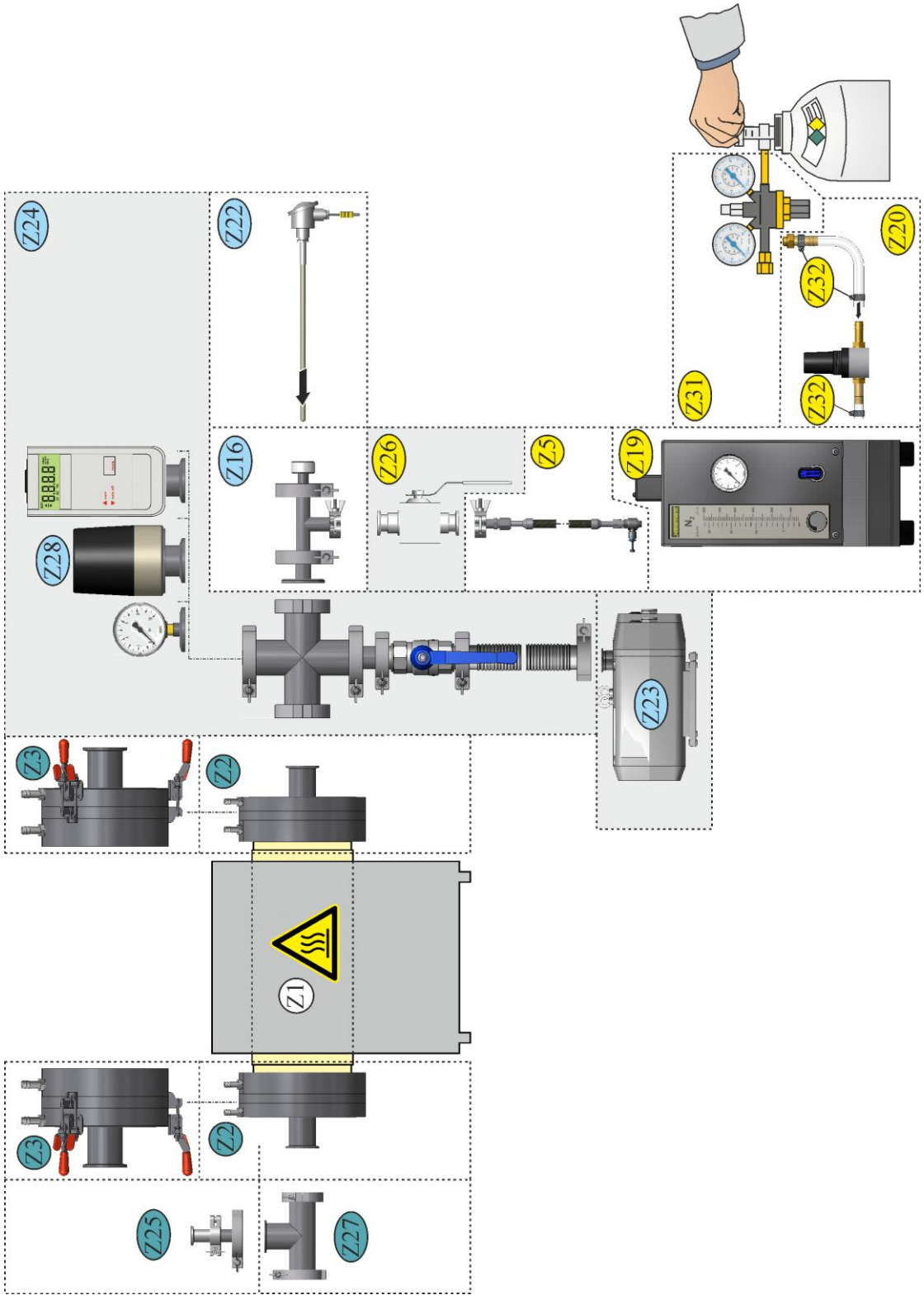


Fig. 17: Tube furnace with gas supply system 2 including charge thermocouple, optionally with connection kit for vacuum operation (similar to picture)

5.8 Installing a Flange Holder

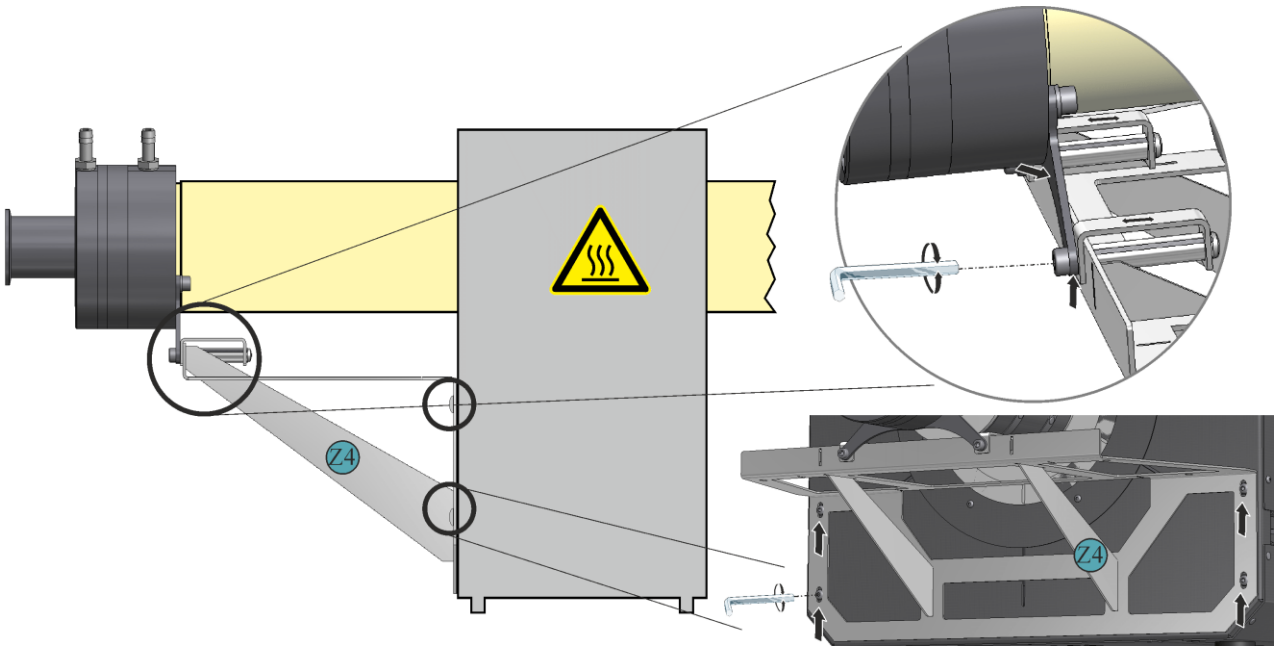


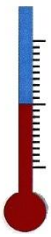
Fig. 18: Installing a flange holder (similar to picture)

Note
Assembly/disassembly: see separate instructions

No.	Name	Comment
Z1	Working tube	
Z2	Vacuum flange	
Z3	Vacuum flange with quick-release clamp	
Z4	Flange holder	Design depends on furnace model
Z5	Gassing hose set	with plug-in connection, corrugated hose and clamping ring
Z7	Fiber plug	Design depends on furnace model suitable for furnace models to Tmax. 1400 °C
Z8	Fiber plug with gas connection	Design depends on furnace model suitable for furnace models to Tmax. 1400 °C
Z9	Fiber plug	Design depends on furnace model suitable for furnace models to Tmax. 1800 °C
Z10	Fiber plug with gas connection	Design depends on furnace model suitable for furnace models to Tmax. 1800 °C
Z11	Hose kit	for fiber plug with plug-in connection and PVC hose
Z14	Vertical tube bracket	
Z16	Inlet kit for charge thermocouple	

No.	Name	Comment
Z19	Gas supply system (depending on design, either manual or automatic)	for non-flammable protective or reaction gases
Z20	Pressure reduction kit	included in delivery depending on model
Z22	Charge thermocouple	
Z23	Vacuum pump	Vacuum operation option included in delivery depending on model
Z24	Connection kit for vacuum operation	Vacuum operation option see Z28
Z25	Overpressure valve	for furnaces with gas supply system or vacuum operation
Z26	Stopcock	Vacuum operation option for furnaces with gas supply system or vacuum operation
Z27	Sight glass	included in delivery depending on model
Z28	Vacuum measurement device – pressure gauge Vacuum measurement device – transmitter pressure measurement device Vacuum measurement device – vacuum manual measurement device	Vacuum operation option included in delivery depending on model
Z31	Cylinder pressure regulator	included in delivery depending on model
Z32	Suitable hose clamp	included with delivery

5.9 Recommendations for Heating Up the Furnace for the First Time



Before using the furnace for the first time, heat it to 1400 °C (2552 °F) within 5 hours and keep it at this temperature for 2 hours and then let it cool naturally.

When the furnace is being heated for the first time, there may be a smell caused by binder being emitted from the insulation material. It is advisable to ventilate the room in which the furnace is located well during the first heating phase.

Note

The furnace can be operated to a maximum temperature of 1600 °C. Operation above 1500 °C will increase wear and tear of the heating elements.

Warning – General hazards!

Depending on the working tube, when heating up the furnace, comply with the following heating-up rates and maximum working temperatures, unless specified otherwise.

If these are not complied with, the working tube will be destroyed and, under certain circumstances, also the heating elements.

Maximum permissible warming-up rates:

Depending on the application and temperature various working tubes are available. The technical specifications of the different working tubes can be found in the following table:

Material	Tube Outer Ø mm	Max. Warm-Up Rate K/h	Tmax Atmosphere °C	Tmax in Vacuum °C	Gas-Tight
C 530 (Sillimantin)	< 120	unlimited	1300	not possible	no
	from 120	200			
C 610 (Pytagoras)	< 120	300	1400	1200	yes
	from 120	200			
C 799 (99.7 % Al_2O_3)	< 120	300	1800	1400	yes
	from 120	200			
Quartz	all	unlimited	1100	950	yes
CrFeAl alloy (APM)	all	unlimited	1300	1100	yes

6 Operation

B510/C550/P580

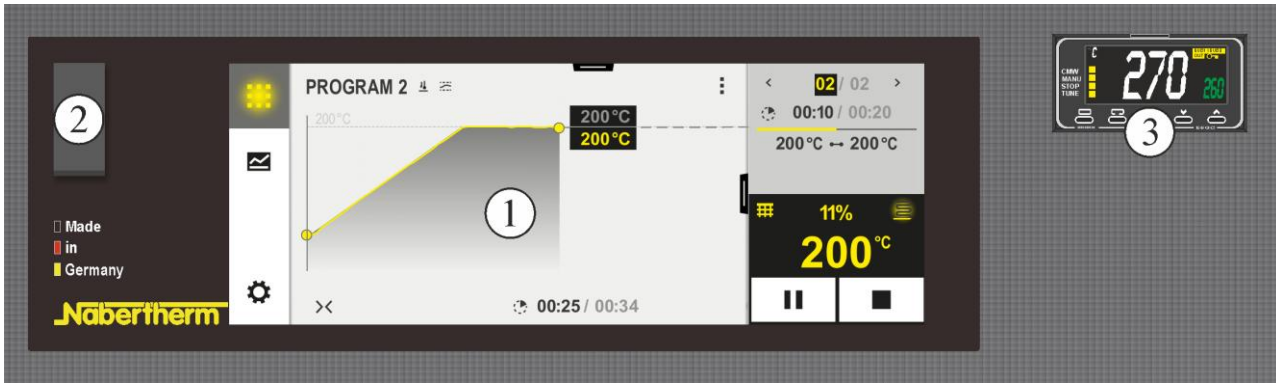


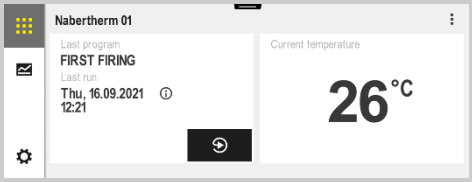
Fig. 19: Control field B510/C550/P580 (similar to picture)

No.	Description
1	Display
2	USB interface for a USB stick
3	Over-temperature limiter with manual reset (optional)

Note

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

6.1 Turning on the Controller/Furnace

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.

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

If required, heating programs can also be imported by loading a program file onto a USB flash drive.

6.2 Turning off the Controller/Furnace

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)

Note

Stop running heating programs before turning the furnace off at the main switch, since the controller will otherwise generate a fault message when it is turned back on.
See Faults/fault messages

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

Note

Continuous operation at maximum temperature can lead to increased wear of heating elements, insulation materials and metallic components. We recommend working at approx. **50 °C below maximum temperature**.

	**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.

6.3 Over-Temperature Limiter with Manual Reset

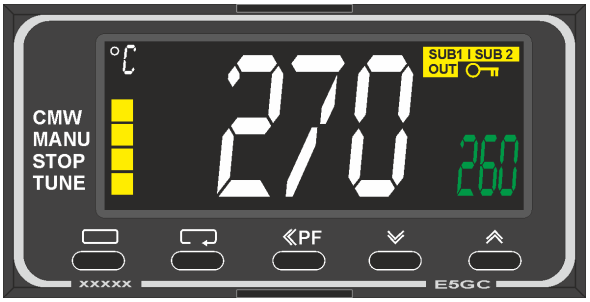
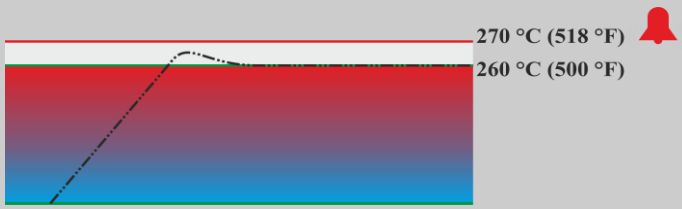


Fig. 20: Over-temperature limiter with manual reset (similar to picture)

Button	Description	Display
	The over-temperature limiter (2z) monitors the temperature in the furnace. The display shows the trigger temperature that was last set. If the furnace temperature rises above the set trigger temperature, the heating is switched off to protect the furnace and the charge. "**ALM**" alarm flashes on the over-temperature limiter.	**260 °C** **ALM**
	If the thermocouple sensor breaks, the over-temperature limiter switches the heating off to protect the furnace and the charge. "**S.ERR**" is displayed on the over-temperature limiter.	**S.ERR**
	If the temperature in the furnace falls **below the value set on the over-temperature limiter**, press the following buttons to enable the heating so that the furnace can continue to operate:	
	Enable heating:	
PF	Press PF for one second. The alarm message of the over-temperature limiter is reset and the heating is enabled.	

	Setting the trigger temperature:	
	Use the buttons to set the required trigger temperature (example 270 °C) Increase the value with (260 … 269, 270) Decrease the value with (270 … 261, 260) To change the value quickly: press and hold .	**270** **260**
	 Wait 1 second until the set trigger temperature is applied automatically. **Note:** Premature triggering of the over-temperature limiter can be avoided if the difference between the adjustable furnace temperature and the trigger temperature is not less than 10 °C.	
	The display jumps back to the start screen showing the trigger temperature. The current trigger temperature is displayed. Input finished.	**270 °C**
	For further information about operation, refer to the separate OMRON E5GC operating instructions.	

	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.

6.4 Loading/Charging

Charging the Furnace

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

The furnace must also be charged when cold.

When charging the furnace make sure that the working tube is not damaged.

The charging must be in as small quantities as possible positioned in the center of the charge space of the working tube. This ensures uniform heating.

When a very large quantity of ware is loaded into the working tube the warm-up times can be substantially longer.

The removal of the fiber plugs, flanges and protective lid is prohibited when hot (> 400 °C/752 °F). The resulting thermal shock leads to the destruction of the working tube and, possibly, of the heating elements.

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.



Caution - Damage to Components!

Ceramic tubes are extremely heat-resistant, but easily breakable – therefore handle with care.



Caution – when using a ceramic tube!

The ceramic tube is very fragile and, in addition to mechanical effects, a large temperature gradient can also damage the working tube. Make sure that during operation and also if the tube has not been used for some time that there is no moisture in the working tube or near the flange. Even small amounts water generate a large temperature gradient via the wall of the tube when the tube is heated up (caused by enthalpy of evaporation). Cracks can form due to the thermal shock and in the worst-case scenario the tube will be damaged.

7 Servicing, Cleaning, and Maintenance



Warning – General hazards!

Cleaning, lubrication, and maintenance tasks may be performed only by authorized professionals observing the maintenance instructions and accident protection regulations. We recommend that maintenance and repair work be carried out by the service team of Nabertherm GmbH. Disregard of this may cause injuries, death, or considerable damage to property.



Warning – Danger of electric shock!

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



During maintenance work, the furnace and/or switchgear must be disconnected from the power supply and safeguards must be taken to ensure that they cannot be switched on again inadvertently. For safety reasons, pull out the power plug.

Operators may only rectify malfunctions that are obviously due to operating errors.

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

Check the furnace regularly for obvious damage. Also, clean the inside of the furnace as required (e.g., with a vacuum cleaner). **Caution:** Do not touch the heating elements as they may break.

While work is being carried out on the furnace, the furnace and the room in which it is installed should be ventilated with fresh air.

Protective equipment that was removed during maintenance work must be replaced and checked once the work is finished.

Warning about suspended loads at the workplace (e.g., cranes). Working beneath a suspended load (e.g., lifted furnace or switchgear) is prohibited.

The functions of safety switches and end switches must be checked at regular intervals (according to DGUV Regulation 3 or corresponding national regulations of the country in which the system is used).

To ensure perfect temperature control of the furnace, the thermocouple must be checked for damage before each process.

Tighten the screws of the element holders (see “Replacing a Heating Element”) if necessary. Before carrying out this work, the furnace and/or the switchgear must be disconnected from the power supply (disconnect the power plug). Regulations (DGUV Regulation 3 or corresponding national regulations of the respective country of use) must be observed.

The switchgear contains one or more contactors. The contacts of these contactors are wearing parts and must therefore be maintained regularly and replaced as required (DGUV Regulation 3) or according to the corresponding national regulations of the country where the switchgear is installed.

The switchgear cabinet (if present) has ventilation grilles with integrated filter mats. These must be cleaned regularly and be replaced when necessary to ensure adequate ventilation of the switchgear. During melting operations, the control cabinet door must always be firmly closed.

7.1 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.

7.2 Shutting the System Down for Maintenance

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

- The furnace must be completely empty
- Inform the operating personnel and nominate supervisors
- Switch off the main switch and/or disconnect the power plug
- Lock the main switch (if available) and secure it with a padlock to prevent it from being switched on
- Attach a warning sign to the main switch
- Secure a large zone around the area where maintenance work is being carried out
- Make sure that the system is deenergized
- Ground and short-circuit the working area
- Cover neighboring live parts



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.



Caution – Danger of Falling

Ignoring this can lead to fatal injury. Danger of falling exists at a height less than 1.00 m above the ground or another sufficiently broad bearing surface (for example, on elevated operating positions and workplaces, working platforms, galleries, platforms, footbridges, flying bridges, ramps and stairways), openings and recesses through which people can fall (for example in floors, platforms, installation openings, hatchways and pits, non-bearing roofs).

7.3 Regular Maintenance of the Furnace

Component/ item/ function and action	**Comment**	**A**	**B**	**C**
Safety test in accordance with DGUV V3 or equivalent national regulations According to regulation	According to regulation	3	-	X2
EMERGENCY STOP device (if present) Press the button		3	D	X1
Safety and limit switch (if present) Function check		3	Y	X2
Furnace chamber, extraction holes and extraction tubes Clean and check for damage, vacuum out carefully		3	M	X1
Sealing surfaces: Door collar/furnace collar Visual inspection		3	D	X1
Seals (if present) Clean/replace		1	W	X1
Heating elements/working tube Visual inspection		1	D	X1
Check for uniform power consumption of the heating system Function check		1	Y	X2
Thermocouple Visual inspection (visible part of the thermocouple inside the furnace)		1	D	X1
Check setpoint value Check according to work schedules		3	D	X1
Settings on the over-temperature limiter Each time the heat treatment program is changed	With each change to the heat treatment program, check the trigger temperature (alarm value) on the over-temperature limiter	3	-	X1
Measurement and control accuracy Calibration		3	Y	X2
Key: see “Maintenance Table Key”				

Fig. 21: Maintenance table

7.4 Regular Maintenance Tasks – Electrical Testing

Component/ item/ function and action	**Comment**	**A**	**B**	**C**
Insulation resistance test		-	Y	X2

Component/ item/ function and action	Comment	A	B	C
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”				

7.5 Regular Maintenance Tasks – Documentation

Component/ item/ function and action	Comment	A	B	C
Type plate Legible condition		3	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”				

7.6 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



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.

7.7 Cleaning Products



Carry out the procedure to switch off 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. 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 (frame)*	Use commercial cleaning products that are either water-based or non-flammable and free of any solvent*
Outer surfaces (stainless steel)	Stainless steel cleaner
Interior	Carefully clean with a vacuum cleaner (pay attention to the heating elements)
Insulation materials	Carefully clean with a vacuum cleaner (pay attention to the heating elements)
Door seal (if present)	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 ensure that the cleaning product does not damage the water-soluble, environmentally safe paint (test the product on an interior, concealed area).

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; rectify any defects immediately.

Observe the “Environmental 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



8 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.

8.1 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 modules are 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 thermocouple type that has been set 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
03-07	Analog output / wrong voltage at output	Measured value of the output voltage does not correspond to the specified value	Have an electrician carry out the following steps: - De-energize the furnace - Disconnect loads at the analog output - Switch the furnace on again and start the program - Error does not re-occur Replace loads. - Error still present: Replace control module Contact Nabertherm Service[1)]
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 control 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 (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.
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”)
Other malfunctions			

ID+ Sub-ID	Text	Logic	Remedy
05-00	General malfunction	Malfunction in the control module or Ethernet module	Contact Nabertherm Service Provide the service export
05-01	Self-test for lower limit switch	Self-test unsuccessful.	Please turn the furnace off and on again to repeat the self-test. If the problem is not resolved, contact Nabertherm Service
05-02	Self-test for upper limit switch	Self-test unsuccessful.	Please turn the furnace off and on again to repeat the self-test. If the problem is not resolved, contact Nabertherm Service
05-03	Self-test for heating	Self-test unsuccessful.	Please turn the furnace off and on again to repeat the self-test. If the problem is not resolved, contact Nabertherm Service
05-04	Vacuum pump / pressure switch	Evacuation was not successful.	Check whether the vacuum pump is switched on. Check the connection between the furnace and the vacuum pump. Check the seal on the furnace table. Dirt and correct closure Check and, if necessary, replace faulty seals. If the problem is not resolved, contact Nabertherm Service

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.

8.2 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 control zone.

No.	Text	Logic	Remedy
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
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; edit them 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

No.	Text	Logic	Remedy
	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 active.
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
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

8.3 Malfunctions of the Switchgear

Error	Cause	Remedy
Controller does not light up	Controller is switched off	Switch the power switch to “**I**”

Error	Cause	Remedy
	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)
	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.

9 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

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.

9.1 Replacing a Heating Element

Before replacing the heating element, remove the clamping rings and the insulation half shells and the working tube from the furnace; see “Inserting the Working Tube”.

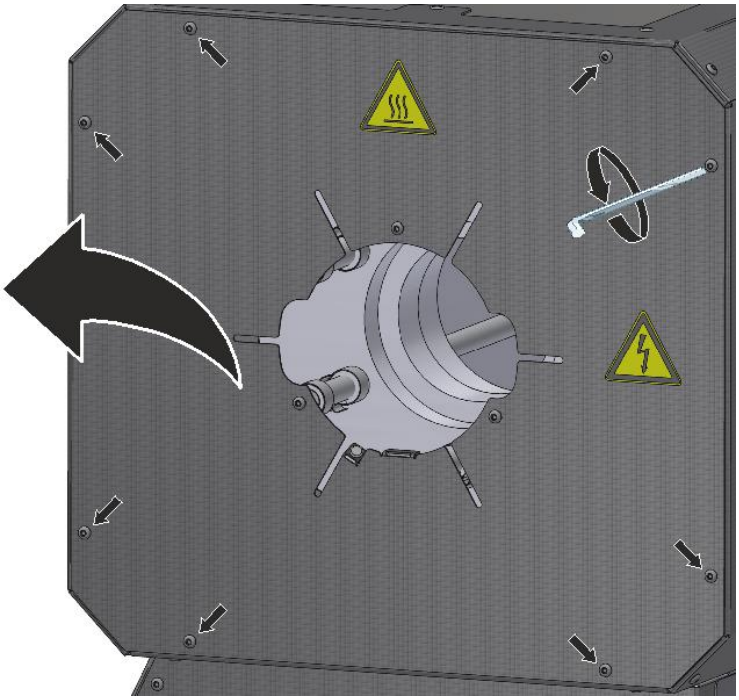
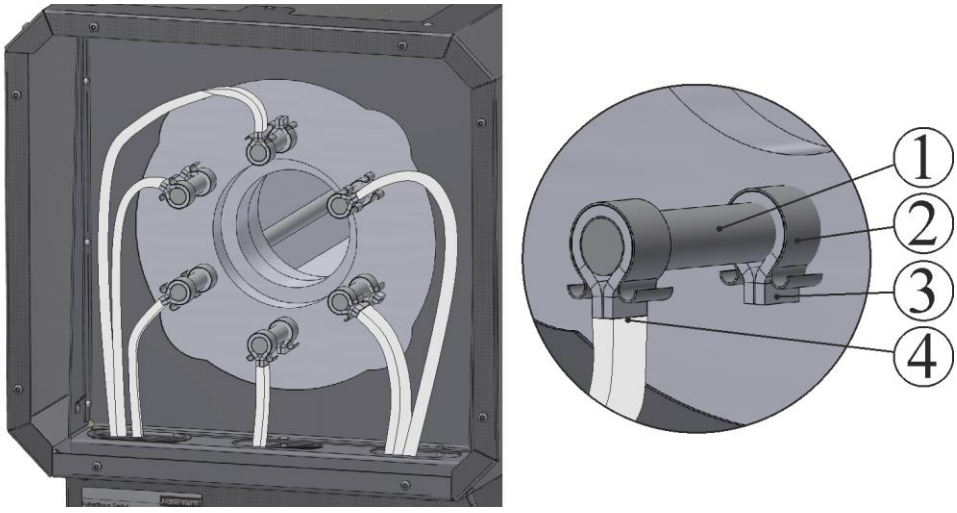


Fig. 22: Dismantling the side covers (similar to picture)

Use suitable tools to undo the screws on both side covers, carefully remove the covers and place them on a soft surface.



1) Heating element
2) Clip
3) Fiber paper strip
4) Fabric tape with connection clamp

Fig. 23: Connection terminals of the heating elements (similar to picture)

Remove the working tube from the furnace. See “Inserting the Working Tube”. Use suitable tools to remove the clips on the heating elements. Remove the fabric tape from the heating element and remove the fiber paper strips. Carefully feed the heating element through the furnace chamber.

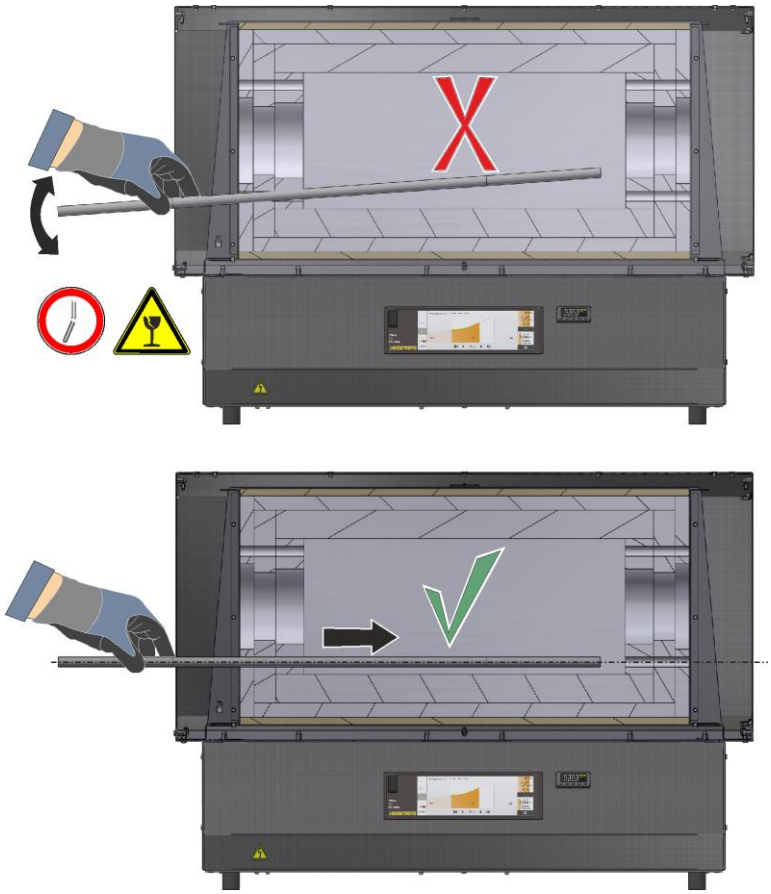


Fig. 24: Inserting the heating element (similar to picture)

Carefully insert a new heating element. Hold it straight and make sure that it does not catch on the insulation. If you do not observe this, there is a risk that the heating element will break or the insulation will be damaged. Carefully feed it through the hole on the other side.

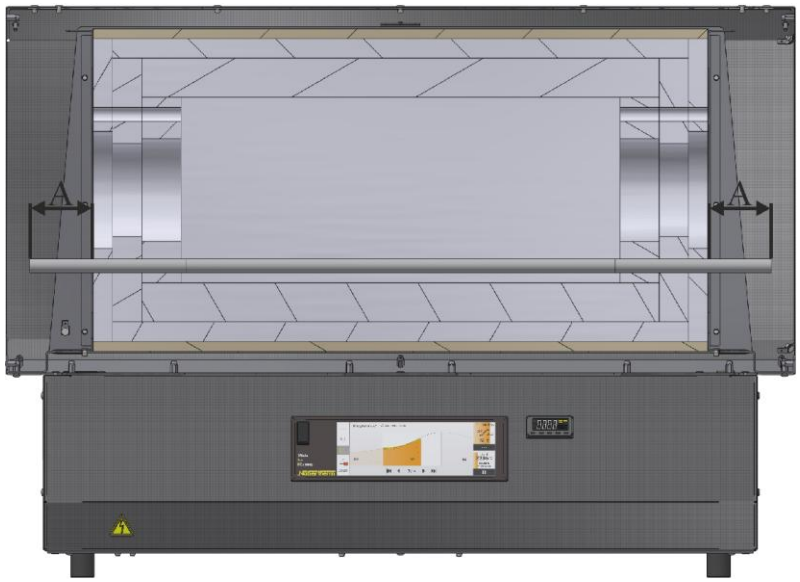


Fig. 25: Positioning the heating element (similar to picture)

Position the heating element symmetrically in the furnace so that gap A is equal on both sides.

Connecting the heating element

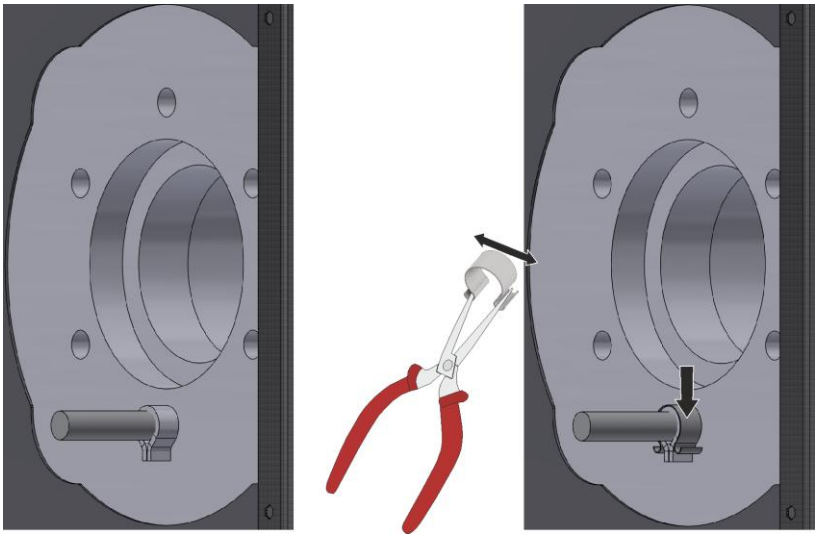


Fig. 26: Attaching the fiber paper strip and fixing it in place with a clip (similar to picture)

Attach the fiber paper strip around the heating element so that it is flush with the insulation panel.

Use a suitable tool (e.g., round-nose pliers) to attach the supplied clip in the middle of the fiber paper strip flush with the insulation panel.

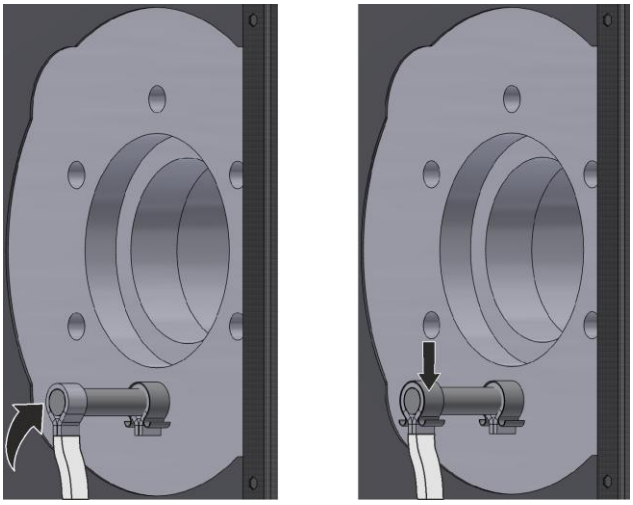


Fig. 27: Attaching the fabric tape and fixing in place with a clip (similar to picture)

Slide the loop of the fabric tape onto the heating element. Fix the tape in place with a clip.

Important: Make sure that you slide the whole width of the tape loop onto the element. Check that it is firmly in place.

Position the fabric tape so that the side covers do not become jammed when they are being screwed on. If necessary, slide the fabric tapes through the elongated holes below.

Then install the working tube, the insulation half shells, the side covers and the clamping ring. See “Inserting the Working Tube”.

9.2 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.



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.

Tools

To change the thermocouple, you will need the following tools:



1 Allen wrench (supplied with furnace), 2 Slotted screwdriver, 3 Phillips screwdriver

Fig. 28: Tools

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*).

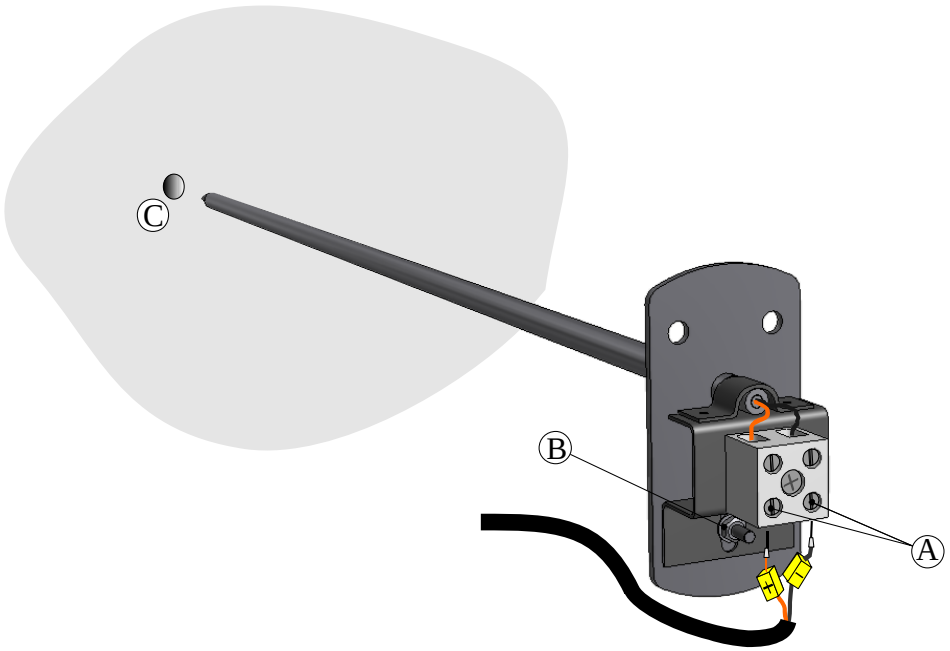


Fig. 29: Removing the thermocouple/s (Similar to this)

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.

9.3 Repairing the Insulation

The insulation of the furnace consists of a very high-quality refractory material. Heat expansion may cause tears in the insulation even after a few heating cycles. However, these have no affect on the function or quality of the furnace. However, if entire "sections" of the insulation come loose, Nabertherm Service must be notified.

10 Accessories (Options)

10.1 Laboratory Gas Supply Station

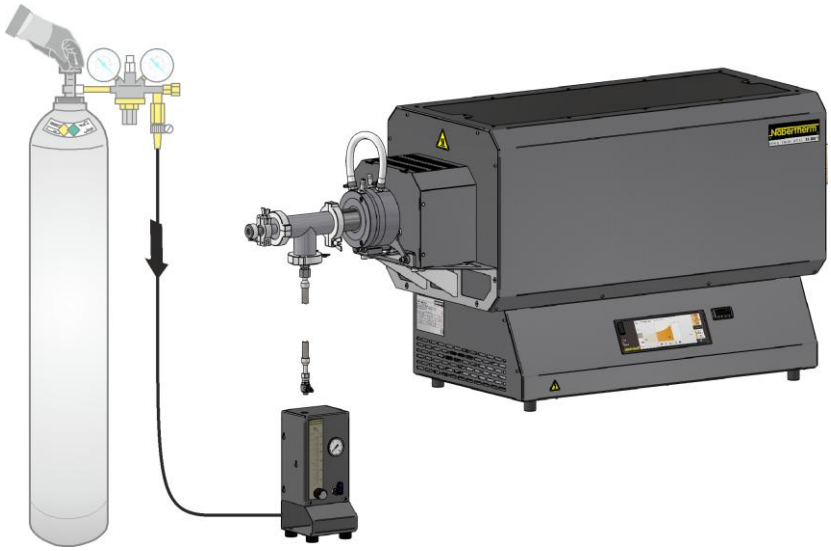


Fig. 30: Connection to the gas supply system (similar to picture)

Gas supply systems are designed for commercial use in laboratories. Nabertherm furnaces can be equipped with different packages for operation with **non-flammable gases**. The different packages can be delivered together with the furnace or separately at a later date. Gas feed panels are available for manual or automatic operation. Gas supply systems for non-flammable protective and reaction gases are available (argon Ar, nitrogen N_2) with shut-off valves, flowmeter, and control valve.

10.2 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.

11 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. 31: Example (type plate)

12 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”.

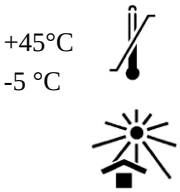
12.1 Transportation/Return Transportation



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.

13 Declaration of Conformity

CE

EU Declaration of Conformity

Electrically heated tube furnace

Model	RHTC 80-230/16	RHTC 80-450/16	RHTC 80-710/16

Name and address of the manufacturer

Nabertherm GmbH
Bahnhofstr. 20
28865 Lilienthal, Germany

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

- 2014/35/EU (Low Voltage Directive)
- 2014/30/EU (EMC)
- 2011/65/EU (RoHS)

The following harmonized standards were applied:

- DIN EN 61010-1 (03.2020)
- 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, 22.01.2025

Dr. Henning Dahl
Vice President R & D

Malte Pirngruber-Spanier
Department Manager R & D

14 For Your Notes

For Your Notes

For Your Notes

For Your Notes