

## Operating Instructions

### Hinged Tube Furnace

**RS 80/300/11 - RS 170/1000/13**

-> 06.2007

Original instructions

■ Made  
■ in  
■ Germany

[www.nabertherm.com](http://www.nabertherm.com)

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## 1 Introduction

### Dear Customer,

Thank you for choosing a quality product from Nabertherm GmbH.

You can be proud that you have chosen an oven which has been especially tailored to suit your manufacturing and production conditions.

This product is characterized by

- professional workmanship
- high performance due to its high efficiency
- high-quality insulation
- low power consumption
- low noise level
- simple installation
- easy to maintain
- high availability of spare parts

Your Nabertherm Team



#### Note

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)

#### Protective Rights

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



#### Note

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

## 1.1 Product Description



These tube furnaces are quality products providing many years of reliable operation if given good care and maintenance. A significant prerequisite is the proper use of the furnace.

In development and production, particular value has been placed on safety, functionality, and cost-effectiveness.

### Hinged tube furnaces of model series RS

Hinged tube furnaces of model series RS can be used both for **horizontal** and for **vertical** operation. The variegated accessories make these professionally tube furnaces ideally suited for your process. Upgrading with various gas supply packages allows operation under protective gas atmosphere, vacuum or even with flammable gases. High-quality insulating materials consisting of fiber tiles enable energy-saving operation and a short heating time. Thanks to the low heat storage and thermal conductivity, hinged tube furnaces attain an maximum furnace temperature of 1100°C or 1300°C.

With various options these tube furnaces can be precisely adapted to your requirements: from various working tubes of different types of materials to protective gas or vacuum operation. For optimal temperature uniformity, all RS furnaces are also available as three-zone tube furnaces with state-of-the-art PLC control. This three-zone control compensates for the heat loss at the tube ends, and an extended uniform zone arises.

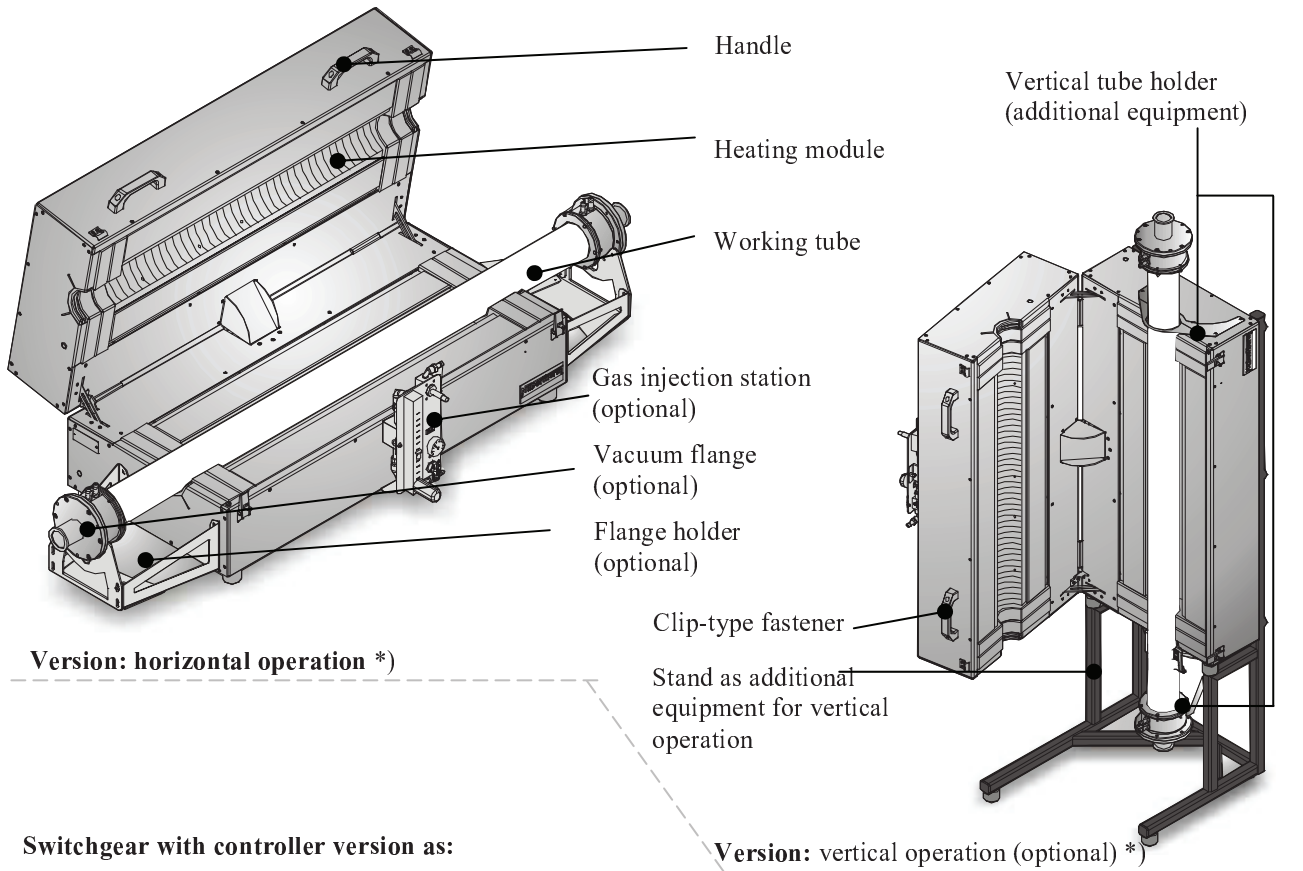
#### This product also stands out because of its:

- Housing consisting of structured stainless steel sheets
- Tmax 1100°C: thermocouple type K
- Tmax 1300°C: wear-free thermocouple type S
- Available as horizontal or vertical version. Retrofitting possible for vertical operation with additional vertical frame
- Hinged version for easy insertion of the working tube
- Working tube made of material C 530 for operation in air included with delivery. Standard working tube according to table; see section on "Accessories"
- Switchgear separate from furnace, with controller in separate wall or free-standing cabinet
- Standard working tube according to table; see section on "Accessories"

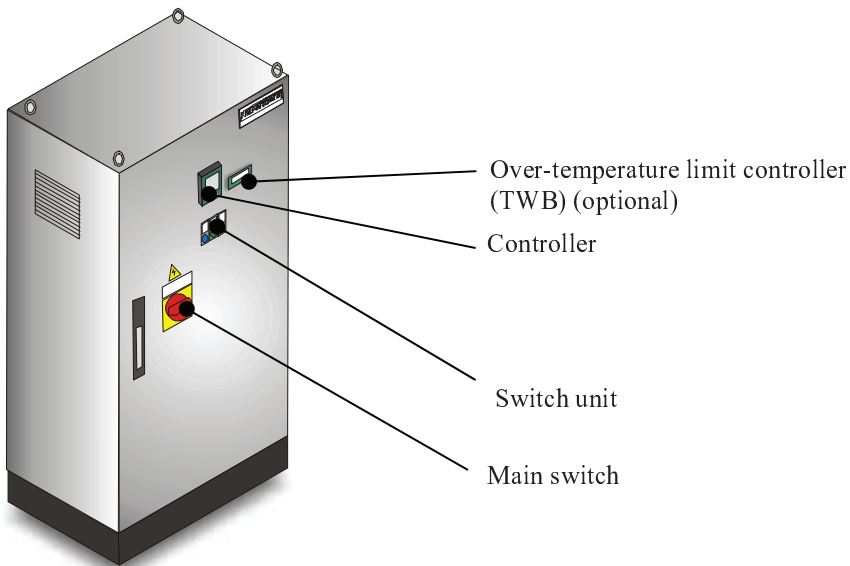
#### Additional equipment

- Charge control with temperature measurement in the working tube and in the furnace chamber behind the tube
- Working tubes designed for the process requirements
- Temperature displayed in the working tube with additional thermocouple
- Various gas injection packages (section on "Accessories") for protective gas and vacuum operation
- Three-zone version for optimizing the temperature uniformity
- Ceramic half-shell for protecting the heating elements or as base for the charges
- Stand for for vertical operation
- Base frame with integrated switchgear and controller
- Alternative working tube according to table; see section on "Accessories"
- Other accessories: See section on "Accessories"

## 1.2 Overview of the Complete Oven

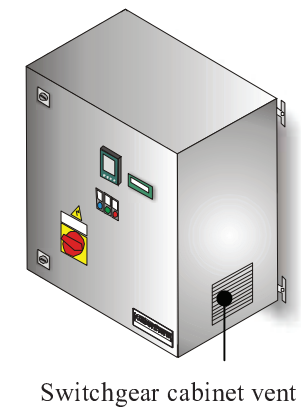


Switchgear with controller version as:



**Free-standing cabinet**

\*) = included with delivery depending on version



**Wall cabinet system \*)**

Fig. 1: General overview: hinged tube furnace RS .../.../... with switchgear and controller (figure shows special version)

### 1.3 Key to the Model Names

Example	Explanation
RS 120/1000/11 └───┬───>	RS = hinged tube furnace
RS <b>120</b> /1000/11 └───┬───>	<b>120</b> = max. possible tube outside diameter in mm
RS 120/ <b>1000</b> /11 └───┬───>	<b>1000</b> = heated tube length in mm
RS 120/1000/ <b>11</b> └───┬───>	<b>11</b> = Tmax 1100°C <b>13</b> = Tmax 1300°C

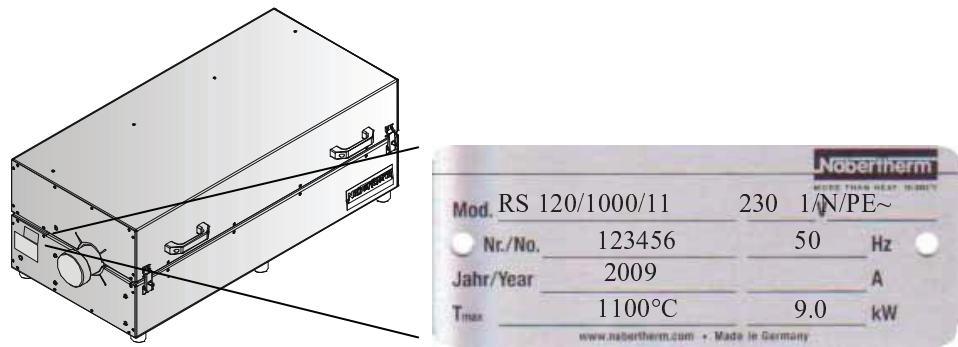
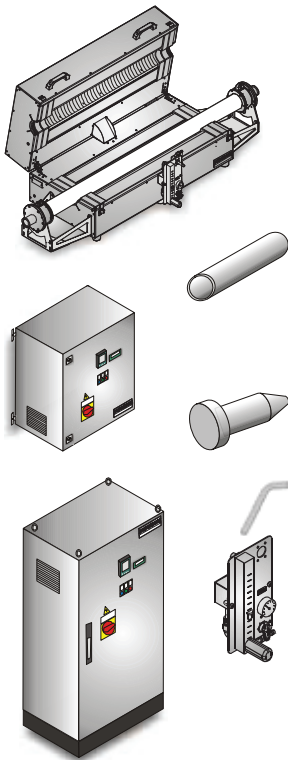


Fig. 2: Example of model designation (rating plate)



## 1.4 Scope of Delivery

### Included with delivery:



System components	Number	Comment
Hinged tube furnace model RS	1 x	Nabertherm GmbH
Switchgear *)	1 x	Nabertherm GmbH
Standard working tube *)	1 x	Nabertherm GmbH
Working tube with flange for gas-tight protective gas operation *)	1 x	Nabertherm GmbH
Vertical tube holder *)	1 x	Nabertherm GmbH
Fiber plug *)	2 x	Nabertherm GmbH
Fiber plug with protective gas ports depending on version	2 x	Nabertherm GmbH
Allen wrench	1 x	Nabertherm GmbH
Gas supply panel *)	1 x	Nabertherm GmbH
Stand for vertical operation *)	1 x	Nabertherm GmbH
Base frame with integrated switchgear and controller *)	1 x	Nabertherm GmbH
Ceramic half-shell to protect the heating elements *)	1 x	Nabertherm GmbH
Other components depending on version	- - -	See delivery documents



Type of document	Number	Comment
Operating instructions for tube furnace model RS	1 x	Nabertherm GmbH
Operating instructions for controller	1 x	Nabertherm GmbH
Wiring diagram	1 x	Nabertherm GmbH
Operating instructions for gas supply panel *)	1 x	Nabertherm GmbH
Installation instructions for flange *)	1 x	Nabertherm GmbH
Operating instructions for over-temperature limit controller *)	1 x	
Other documents depending on version	1 x	See the documentation folder

\*) = included with delivery depending on version



### Note

Please carefully retain all documents. During fabrication and before delivery, all the functions of this furnace system have been tested.

## 2 Specifications



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

### Hinged tube furnaces

Model	Exterior dimensions in mm			Max. tube Ø outside/mm	Heated length mm	Power kW	Length at constant temperature ΔT 10K	Weight <sup>2)</sup> in kg
	W <sup>1)</sup>	D	H					
RS 80/300/11	555	475	390	80	300	1.8	100	80
RS 80/500/11	755	475	390	80	500	3.4	170	90
RS 80/750/11	1005	475	390	80	750	4.6	250	105
RS 120/500/11	755	525	440	120	500	4.8	170	95
RS 120/750/11	1005	525	440	120	750	6.3	250	110
RS 120/1000/11	1255	525	440	120	1000	9.0	330	125
RS 170/750/11	1005	575	490	170	750	11.5	250	115
RS 170/1000/11	1255	575	490	170	1000	11.5	330	130
RS 80/300/13	555	475	390	80	300	3.6	100	80
RS 80/500/13	755	475	390	80	500	6.0	170	90
RS 80/750/13	1005	475	390	80	750	9.3	250	105
RS 120/500/13	755	525	440	120	500	7.8	170	95
RS 120/750/13	1005	525	440	120	750	12.6	250	110
RS 120/1000/13	1255	525	440	120	1000	12.6	330	125
RS 170/750/13	1005	575	490	170	750	12.6	250	115
RS 170/1000/13	1255	575	490	170	1000	12.6	330	130

1) without tube                      2) without switchgear

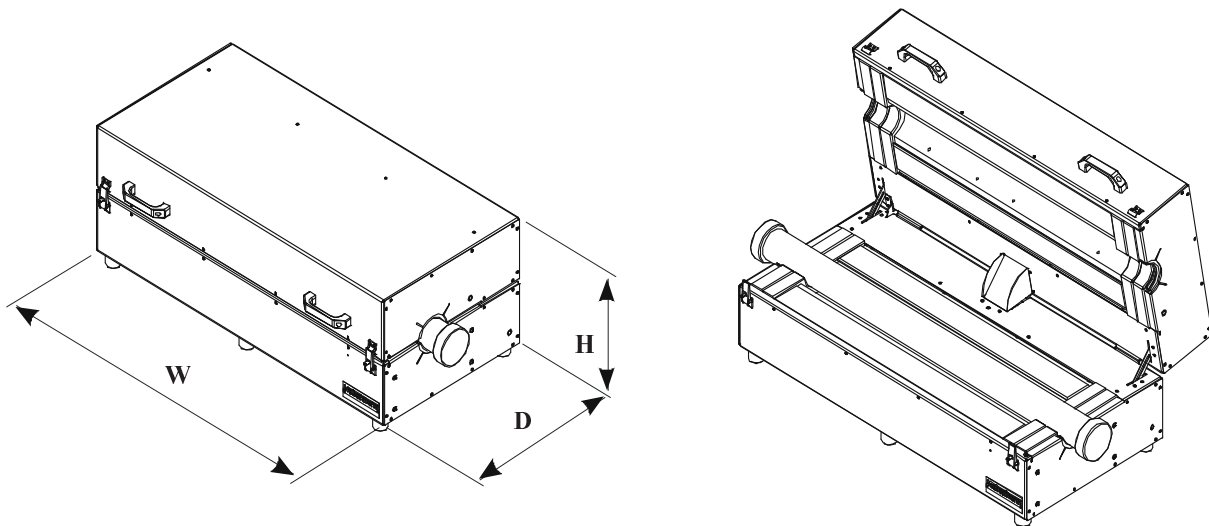


Fig. 3: Dimensions of hinged tube furnaces of model series RS

<b>Electrical connection</b>		<b>1-phase:</b>	<b>3-phase:</b>
		<b>RS 80/300/11</b> <b>RS 80/500/11</b> <b>RS 80/300/13</b>	<b>RS 80/750/11<sup>1)</sup></b> <b>RS 120/500/11<sup>1)</sup></b> <b>RS 120/750/11<sup>2)</sup></b> <b>RS 120/1000/11<sup>2)</sup></b> <b>RS 170/750/11<sup>2)</sup></b> <b>RS 170/1000/11<sup>2)</sup></b> <b>RS 80/500/13<sup>2)</sup></b> <b>RS 80/750/13<sup>2)</sup></b> <b>RS 120/500/13<sup>2)</sup></b> <b>RS 120/750/13<sup>2)</sup></b> <b>RS 120/1000/13<sup>2)</sup></b> <b>RS 170/750/13<sup>2)</sup></b> <b>RS 170/1000/13<sup>2)</sup></b>
	Voltage:	110 V – 240 V	200 V – 240 V or 380 V – 480 V
	Frequency:	50 or 60 Hz	50 or 60 Hz
<b>Thermal protection class</b>	Furnaces:	<b>as per DIN EN 60519-2</b> without safety controller: class 0 with safety controller: class 2	
<b>Protection class</b>	Furnaces	IP20	
	Switching cabinet:	IP43	
<b>Ambient conditions for electrical equipment</b>	Temperature: humidity:	+5°C to 40°C, max. 80% noncondensing	
<b>Weights</b>	Switching system	Depending on version (see shipping documents)	
1) Heating only at one phase      2) Heating only between two phases			
<b>Emissions</b>	Continuous sound pressure level:	< 80 dB(A)	

## 2.1 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:

- Everyone involved in operation, installation, maintenance, or repair of the oven 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.
- Not using the oven as intended,
- Improper installation, start-up, operation, or maintenance of the oven,

- Operation of the oven with defective safety equipment or improperly installed or non-functioning safety and protective equipment,
- Not observing the references in the operating instructions to transportation, storage, installation, start-up, operation, maintenance, or equipping the oven,
- Making unauthorized changes to the oven,
- Making unauthorized changes to the operating parameters,
- Making unauthorized changes to the parameterization, the settings, or the program,
- Original parts and accessories are designed especially for Nabertherm ovens. 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.
- Catastrophes due to third-party causes and force majeure.

### 3 Safety

#### 3.1 Intended Use



This Nabertherm system was designed and manufactured after careful selection of the harmonized standards to be observed plus other technical specifications. It therefore corresponds to the state of the art, ensuring the highest possible degree of safety.

Only materials with known characteristics and melting temperatures may be used. Check the material safety data sheets if necessary.

Use of the furnace for any other purpose whatsoever such as processing products other than those intended or handling hazardous substances or substances posing a health hazard constitutes improper use and must be agreed upon with Nabertherm in writing.

Whether or not the materials used in the furnace can potentially corrode or destroy the insulation or heating elements must be ascertained.

For furnaces with over-temperature limit controllers, the cutoff temperature must be set to prevent overheating of the material.

Modifications to system equipment must be agreed upon with Nabertherm in writing. It is not permitted to remove, bypass, or shut down safety devices.

The installation instructions and safety guidelines must be observed. Otherwise, the furnace will not be considered as being used as designated, and all claims against Nabertherm GmbH will be void.

Removal of the fiber plugs, flange and protective cover when hot (> 400°C) is prohibited. The resulting thermal shock will otherwise destroy the working tube and possibly the heating elements as well.

Operating with power sources, products, operating equipment, additives, etc., which are subject to the Ordinance on Hazardous Substances or causing risks to the health of operating personnel in any way is not permitted.



- This furnace is designed for **commercial** use. The furnace must **not** be used for warming animals, wood, grain, etc.

- The heating of food and drink for the purpose of consumption is not permitted.
- The furnace must not be used as a workplace heater.
- Do not use the furnace to melt ice or similar materials.
- Do not use the furnace for metal working.
- Do not use the furnace as a clothes dryer.

**Note**

See safety instructions in the individual sections.

**Caution**

Operating the furnace with explosive gases or mixtures, including explosive gases or mixtures created as a result of heating/drying, is prohibited.

This furnace features **no** safety technology for processes which produce combustible mixtures, for example debinding.

If the furnace is still used for such processes despite this fact, the concentration of organic gas mixtures in the furnace must never exceed 3% of the lower explosion limit (LEL). This pre-requisite applies not only to normal operation but, in particular, to exceptional situations such as process disruptions (caused, for example, by the failure of a power unit). You must ensure that the furnace is adequately ventilated and vented.

Nabertherm offers a broad range of furnaces which were especially developed for processes involving the use of combustible gas mixtures.

**Note**

This product does **not** comply with the ATEX Directive and may **not** be used in ignitable atmospheres. It must not be operated with explosive gases or mixtures or during processes where explosive gases or mixtures are produced.

### 3.2 Requirements for the Oven Operator



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

This level of safety when operating the oven can be achieved only if all the necessary measures have been taken. It depends on the oven 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 oven 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 oven. These instructions must be available at all times for anyone working with or on the oven;

- all the safety and operating instruction signs on the oven can be read properly. Damaged or unreadable signs must be replaced immediately,
- oven 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 by Section 5 of the Occupational Safety Act) to determine any other hazards that may result from the working conditions particular to the oven'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 by Section 6 of the Ordinance Regulating the Use of Operating Equipment).
- operating personnel still in training initially perform their work at the oven under the supervision of an experienced person. Successful completion of the training period must be confirmed in writing.



**Note**

In Germany, the VBG and BGZ accident prevention regulations must be followed. The accident prevention regulations applicable in the country where the oven is installed must be followed.

### 3.3 Requirements for the Operating Personnel



The oven may be operated only by persons who are trained, instructed, and authorized to do so. These persons must know the operating instructions and act accordingly. The authorizations of the operating personnel must be clearly defined.

Only adequately qualified and authorized persons may operate, maintain, or repair the oven. Operating personnel are instructed regularly in all aspects of occupational safety and environmental protection and are familiar with all the operating instructions, in particular, safety instructions.

Only trained personnel may operate the control and safety equipment.

**The operator should complete these details:**

- Operator \_\_\_\_\_
- The oven may only be transported by \_\_\_\_\_
- The oven may only be installed by \_\_\_\_\_
- The oven may only be commissioned by \_\_\_\_\_
- Initial instructions may only be given by \_\_\_\_\_
- Faults may only be rectified by \_\_\_\_\_
- The oven may only be maintained by \_\_\_\_\_
- The oven may only be cleaned by \_\_\_\_\_
- The oven may only be serviced by \_\_\_\_\_
- The oven may only be repaired by \_\_\_\_\_
- The oven may only be shut down by \_\_\_\_\_

### 3.4 Protective Clothing



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

### 3.5 Basic Measures During Normal Operation



#### **Warning! General Hazards!**

Before turning on the system, check and be sure that only authorized personnel are in the working zone of the system and that no-one can be injured by operation of the system!!

Before every production start, check and be sure that all safety systems are functioning properly!

Before every production start, check the system for visible damage and be sure that it is only operated in perfect condition! Notify management immediately of any defects found!

Before every production start, remove all materials/objects from the working zone of the system which are not required for production!

The system may only be started from the designated work station (e.g. the PC/control console).

**At least once a day (see also Service and Maintenance), the following check tasks must be performed:**

- check the system for externally detectable damage,
- check the function of all safety systems (e.g. the EMERGENCY STOP system),
- check all hydraulic or pneumatic hoses for leaks and correct connection (if present in the system),
- check gas or oil lines for leaks and correct connection (if present in the system).



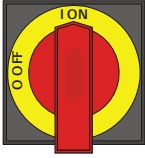
#### **Warning - General hazards! - Furnace opening temperature**

Opening the furnace when hot (>180 °C / >356 °F) is prohibited. The resulting thermal shock can destroy the working tube and possibly the heating elements as well.

## 3.6 Basic Measures in Case of Emergency

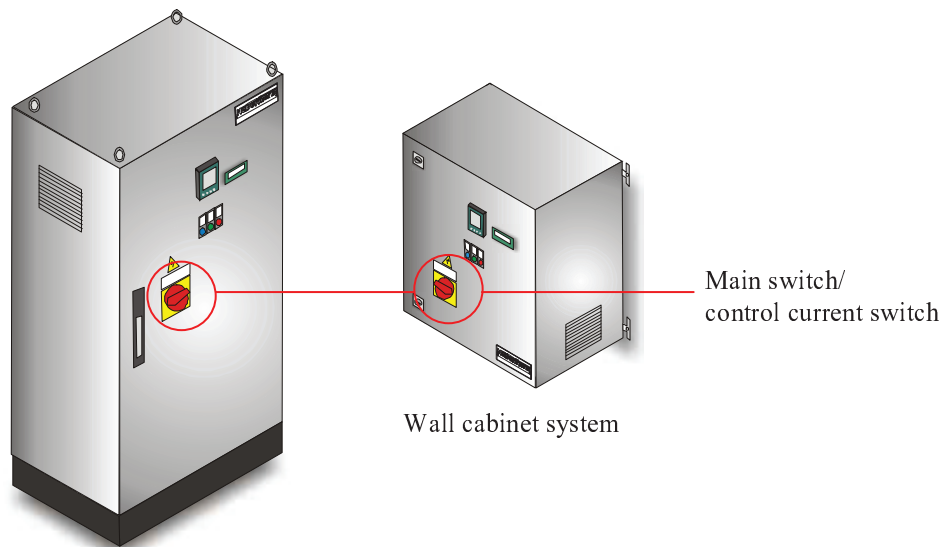
### 3.6.1 What to do in an Emergency

#### Furnaces with main switch



#### Note

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



Free-standing cabinet system

Fig. 4: Example: switchgear with main switch

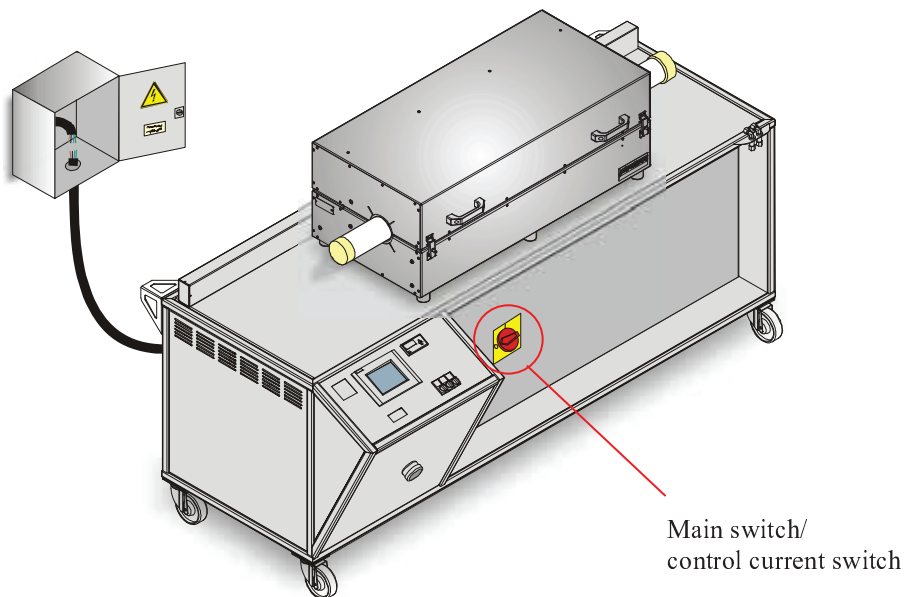


Fig. 5: Example: furnace with main switch





Furnaces with power plug



**Note**

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

<b>! DANGER</b>		
	<ul style="list-style-type: none"> <li>• <b>Danger of electric shock.</b></li> <li>• <b>Risk of fatal injury.</b></li> <li>• Work on electrical equipment may be carried out only by qualified electricians or by trained personnel authorized by Nabertherm.</li> <li>• Before starting work, pull out the power plug</li> </ul>	

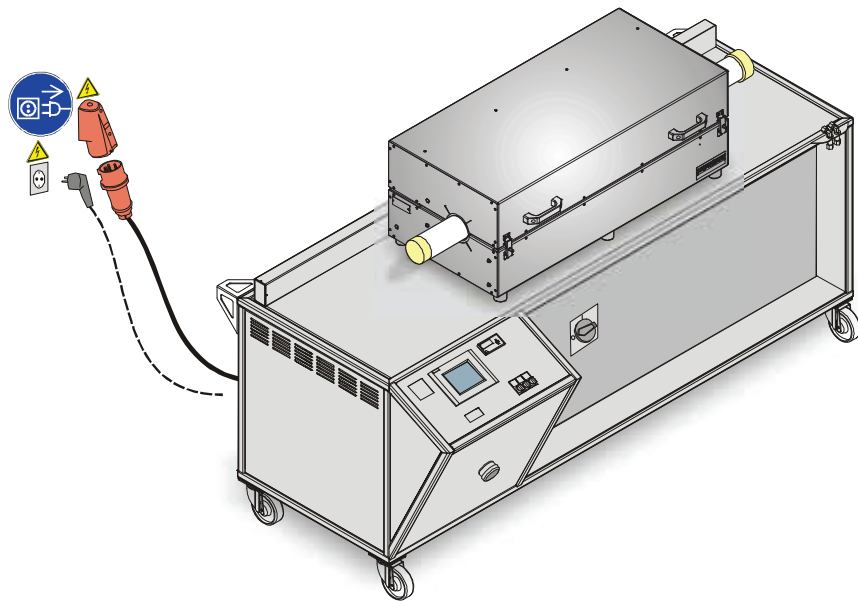


Abb. 6: Example: furnace with power plug



**Risks during Normal Operation!**

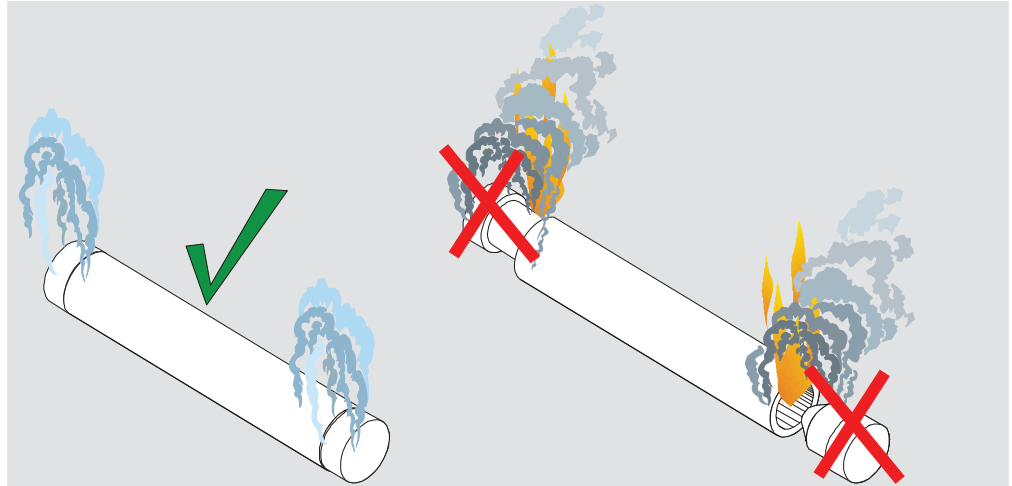
Switch the oven off immediately in case of unexpected occurrences in the oven (e.g. a lot of smoke or unusual smells). Wait until the oven has cooled naturally to room temperature.

**Warning - Danger of Electric Shock!**

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

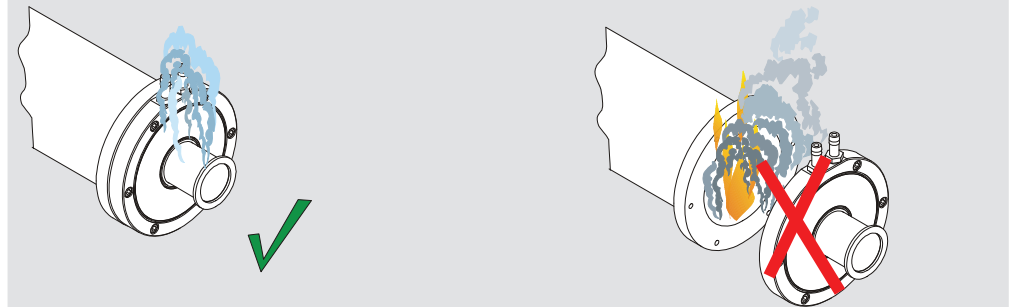
**Warning! General hazards!**

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.



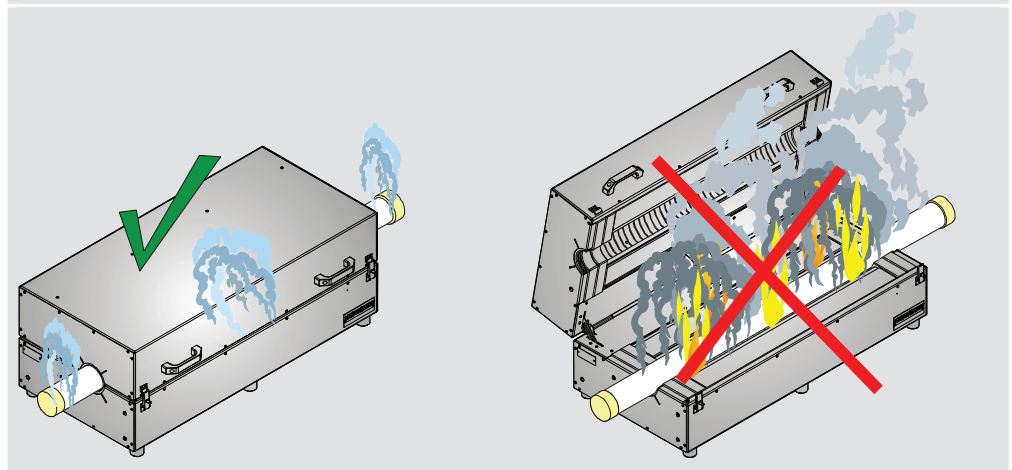
**Warning - General hazards!**

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.



**Warning - General hazards!**

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



### 3.7 Basic Measures for Servicing and Maintenance



Maintenance work must be performed by authorized persons following the maintenance instructions and the accident prevention regulations. We recommend that the 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 oven 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 oven 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 equipment before carrying out maintenance or repair work (if applicable).

When cleaning ovens, 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 oven,
  - 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.

### 3.8 Environmental Regulations

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

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 oven contains no substances that make a hazardous waste classification necessary. However, residues of process materials may accumulate in the oven 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.

### 3.9 Explanation of the Symbols and Warnings



#### Note

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

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

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

Graphic symbols correspond to **ISO 3864**. In accordance with the American National Standard Institute (ANSI) **Z535.6** the following warning information and words are used in this document:



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

<b>NOTICE</b>
<b>CAUTION</b>
<b>WARNING</b>
<b>DANGER</b>

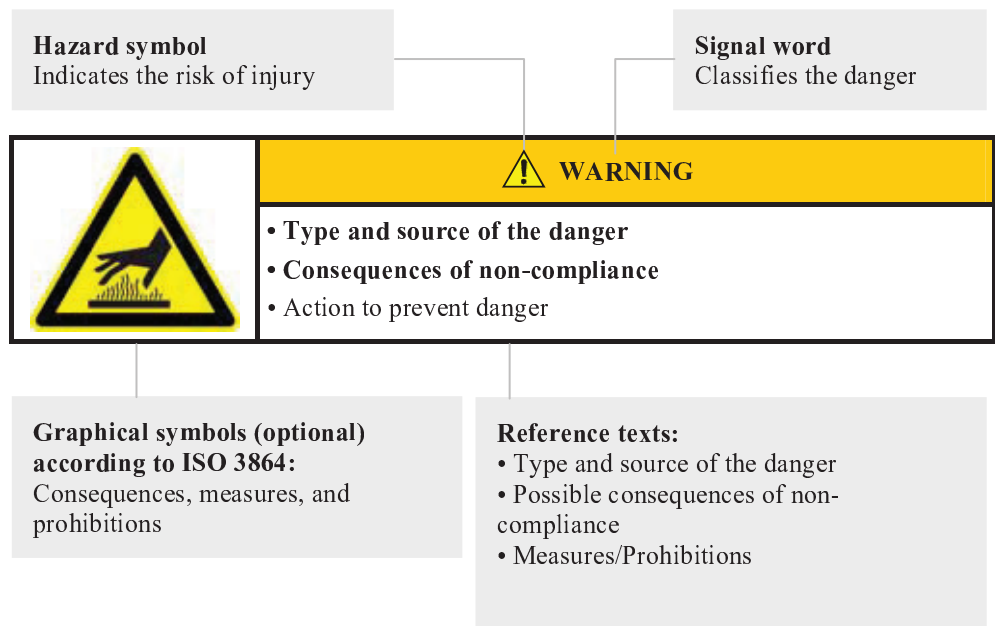
Refers to a hazard that could damage or destroy the equipment.

Refers to a hazard with a minor or medium risk of injury.

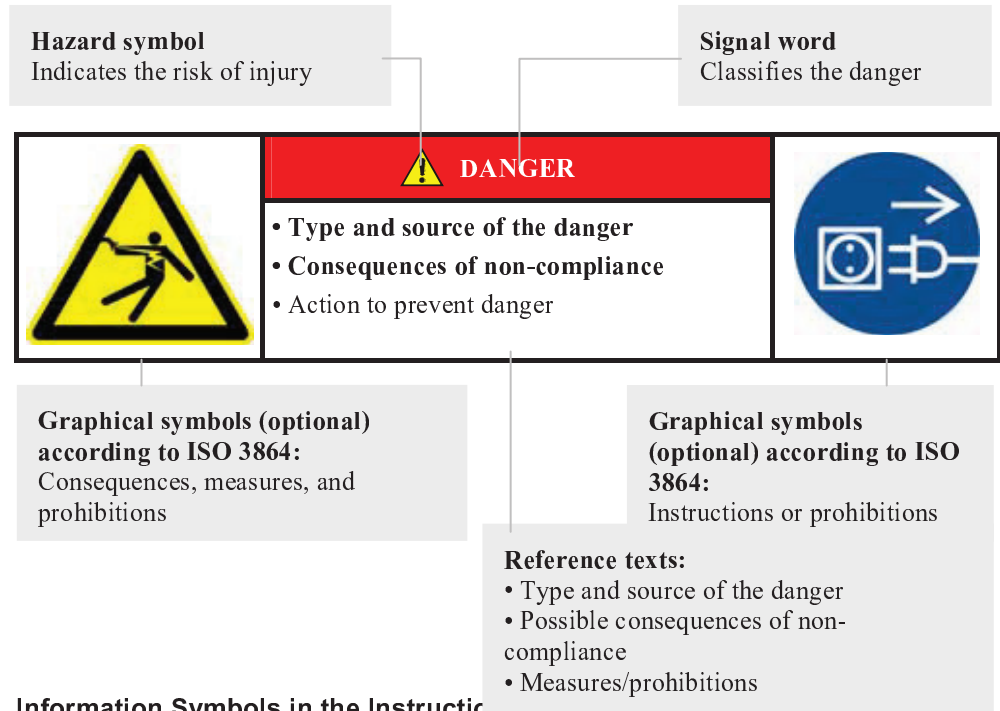
Refers to a hazard that could cause death, serious or irreversible injury.

Refers to a hazard that could directly cause death, serious or irreversible injury.

#### Structure of the warning: All warnings are structured as follows



or



**Information Symbols in the Instruction...**



**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 followed. 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 followed.



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



**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 Oven:**



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

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



**Warning - Danger of Electric Shock!**

Warning, dangerous electric voltage

### 3.10 General Risks with the Oven



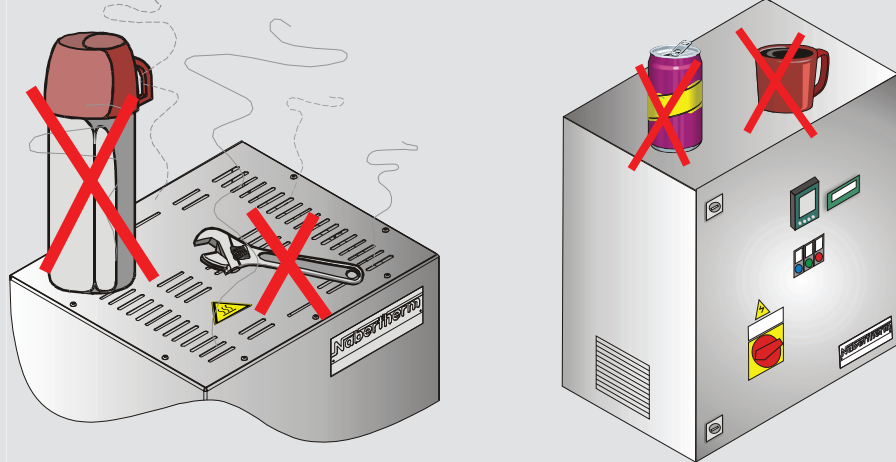
**Warning! General hazards!**

- 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.



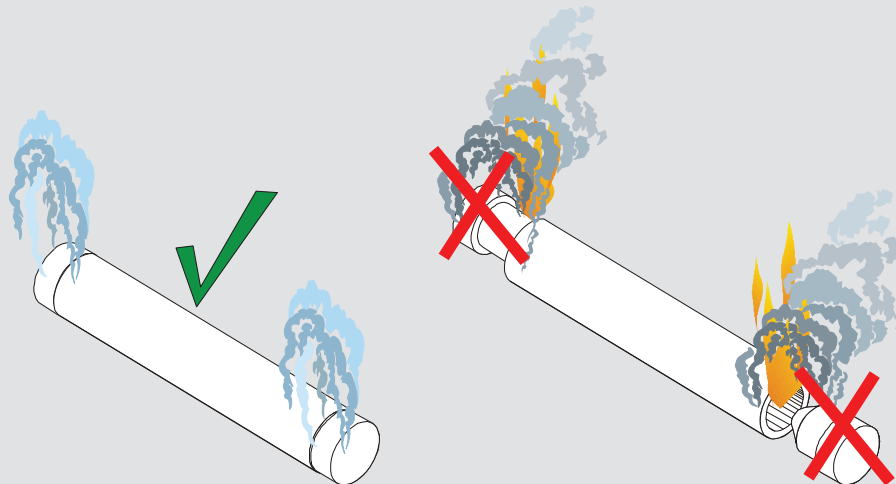
**Warning! General hazards!**

No objects may be placed or set down on the furnace or switchgear. Doing so creates a fire or explosion hazard.



**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.





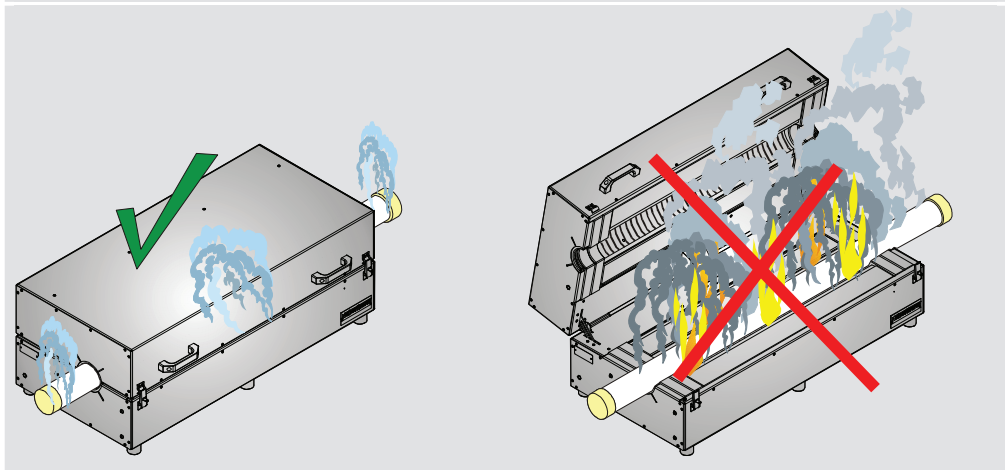
**Warning - General hazards!**

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.



**Warning - General hazards!**

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





## 4 Transportation, Installation, and Commissioning

### 4.1 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 oven is being lifted, parts of the oven or the oven itself could topple over, slip, or fall. Before the oven 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 oven 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 oven 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.

## 4.2 Unpacking

### Transporting with a forklift



Do not exceed the maximum permitted load for the forklift.

1. For unloading purposes, our furnaces are delivered on a wooden transport frame. Only transport the furnace packaged and using suitable transportation facilities to avoid possible damage. The packaging should only be removed at the installation location. During transportation, adequate protection to prevent slipping, tipping and damage must be ensured. Transportation and assembly work must be carried out by at least 2 persons. Do not store the furnace in damp rooms or in the open air.
2. Drive the forklift prongs under the transport frame of the furnace system, being careful of sensitive parts such as the attachments and lines and removing them if necessary. Make sure that the forks of the forklift are positioned **completely** under the transport frame. Note adjacent materials being transported.







Fig. 7: Forklift prongs are pushed **completely** beneath the transport frame

3. Carefully lift the furnace, paying attention to the center of gravity. When lifting the system, ensure that the ends of the fork and the load itself do not strike nearby stacked materials.
4. Check the furnace for stable position and attach transportation locks if necessary. Drive carefully, slowly, in the lowest position. Do not move along sloping surfaces.
5. Carefully set the furnace down at the installation location. Note adjacent materials being transported. Avoid sudden lowering.

	<p style="text-align: center;"><b>⚠ CAUTION</b></p> <ul style="list-style-type: none"><li>• <b>Device may slip or topple over.</b></li><li>• <b>Damage to the device.</b></li><li>• Risk of injury from lifting heavy loads.</li><li>• Transport device only in original packaging.</li><li>• Several people must carry the device.</li></ul>	
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**Symbols:**

The international standard symbols for handling packaging are defined in ISO R/780 (International Organization for Standardization) and in DIN 55 402 (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.

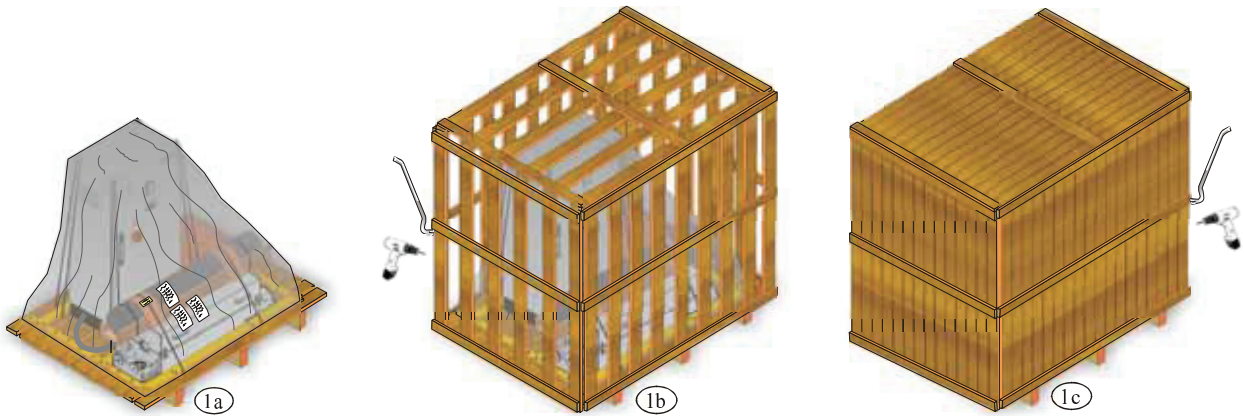


Fig. 8: Packaging unit of the furnace system as: 1a – subframe, 1b – wooden crate or as 1c – wooden box



Use hand guards

1. Check the transportation packaging for possible damage. The packaging varies according to size, weight and destination, and accordingly comes in one of the following forms: on a pallet (subframe), as a wooden crate or as a wooden box (see figures 1a to 1c).

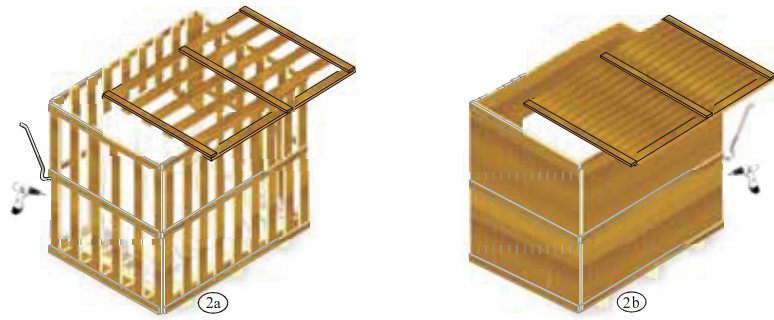


Fig. 9: Remove lid

- 2.. Loosen screws/cramps and then cautiously remove lid upwards.



Fig. 10: Remove wooden crate

3. Loosen screws/cramps and then cautiously remove circumferential wooden crate from the subframe.

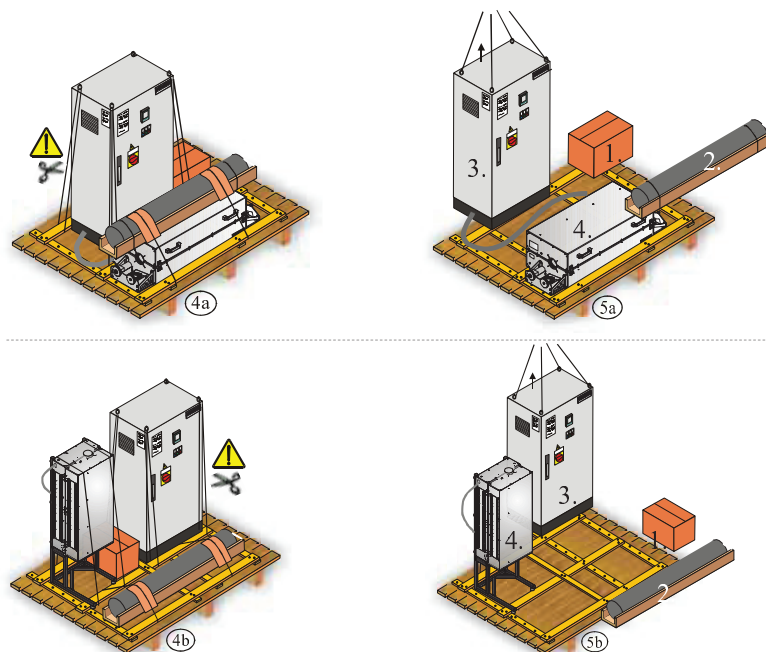


Fig. 11: Figures 4a-5a show tube furnace, model with horizontal operation  
 Figures 4b-5b show tube furnace, model with vertical operation

4. Remove foil, tensioning straps and other packaging material. When cutting the foil and tensioning straps (see Fig. 4a/b) be careful of cables and adjacent components. Unload small packaged units first, then the switchgear and furnace (see Fig. 5a/b).

Compare the scope of delivery with the delivery note and the order documents; see section on "Delivery".

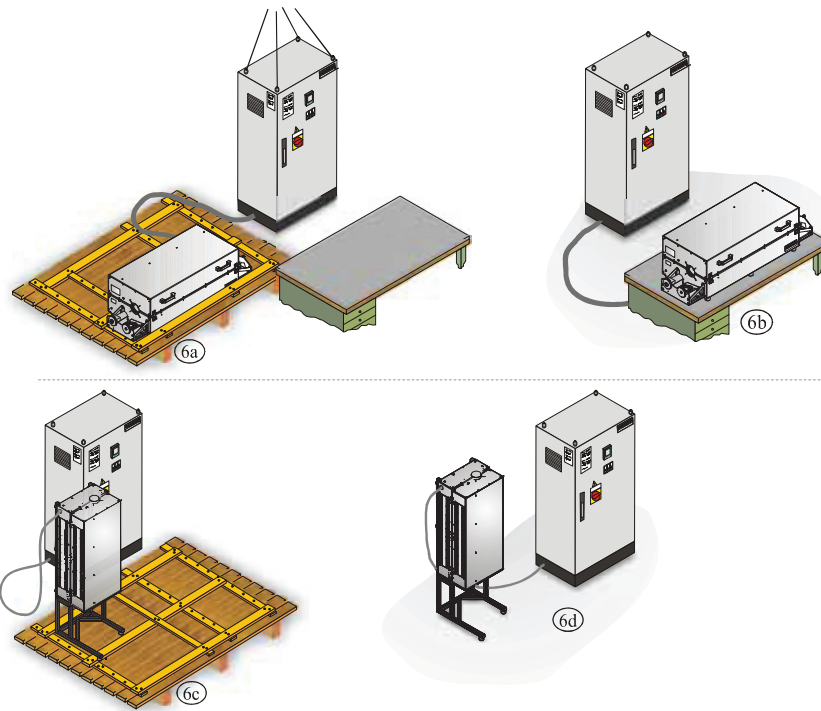
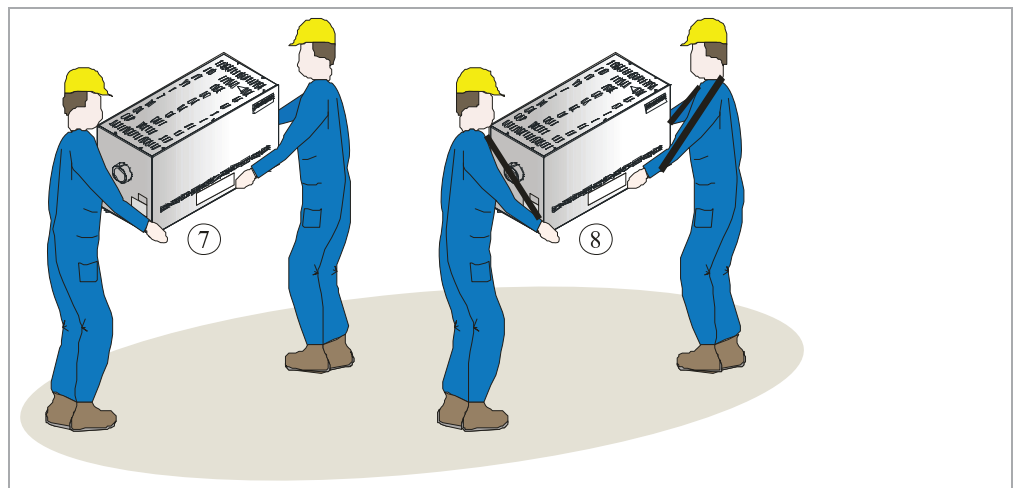


Fig. 12: Figures 6a-6b show tube furnace, model with horizontal operation  
 Figures 6c-6d show tube furnace, model with vertical operation

5. Lift first the switchgear to the installation location (6a/c), then the furnace (6b/d). Note the maximum cable length between the switchgear and the furnace. The cable must not be damaged. Lay cables so that nobody can step on or trip over them. A damaged cable must be replaced immediately.



6. Hold the furnace securely by the bottom sides to carry it.
7. For furnaces weighing more than 25 kg, transport work must be carried out by at least 2 people. If transport straps are used, they must be attached crosswise only. Ensure that they are secure.






**Note**

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



**Note**

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

	 <b>CAUTION</b>	
	<ul style="list-style-type: none"> <li>• <b>Device may slip or topple over.</b></li> <li>• <b>Damage to the device.</b></li> <li>• Risk of injury from lifting heavy loads.</li> <li>• Transport device only in original packaging.</li> <li>• Several people must carry the device.</li> </ul>	

### 4.3 Transportation Securing Equipment/Packaging



**Note**

**No special** transportation securing equipment is available for this oven

The oven packaging prevents damage during transportation. Make sure that you remove all packaging material (also inside the oven 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.

## 4.4 Constructional and Connection Requirements

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

- The furnace must be installed in a dry room in accordance with the safety instructions.
- The table/supporting surface must be flat to enable the furnace to be installed straight. The furnace must be placed on a **noncombustible** base (stone, metal, etc.).
- The carrying capacity of the table must be designed to bear the weight of the furnace incl. accessories.
- The floor covering must consist of non-flammable material, so that hot material falling out of the furnace will not cause the floor covering to ignite.

Despite good insulation, the furnace radiates heat from its external surfaces. If necessary, this heat must be conducted away (**a ventilation engineer must be consulted if required**). In addition, the furnace must be positioned at a minimum safety distance of 0.5 m on each side and 1 m above the furnace away from combustible materials. In individual cases more space must be chosen in order to match the local conditions. The minimum distance away from **noncombustible materials** may be reduced to 0.2 m at the **sides**.

Should gases or vapors escape from the charge, then sufficient air supply and ventilation at the installation location or an appropriate exhaust gas line must be provided.

A suitable exhaust for the burner exhaust must be provided by the customer.

### Free-standing cabinet system

The floor must be even and allow the switching system to be installed in a properly level manner.

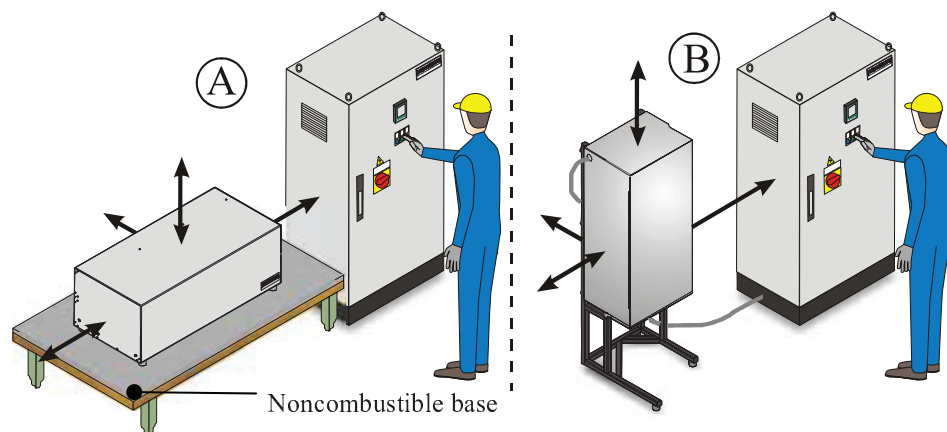


Fig. 13: Installation of a tube furnace with free-standing cabinet system

A = Tube furnace model with horizontal operation

B = Tube furnace model with vertical operation

### Wall cabinet system

The wall must offer a secure fastening location. The top edge of the cabinet (C) box should have a maximum height of 2.00 m so that all controls can be reached easily.

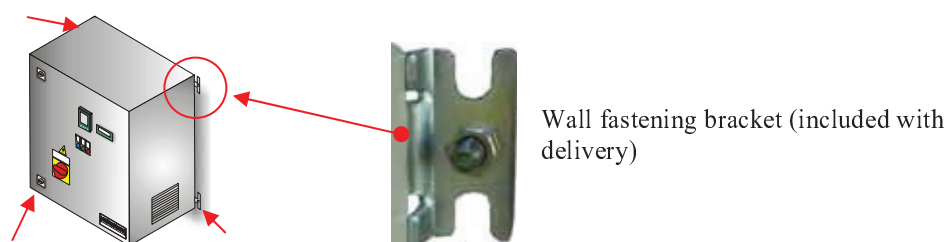


Fig. 14: Example: Wall cabinet system

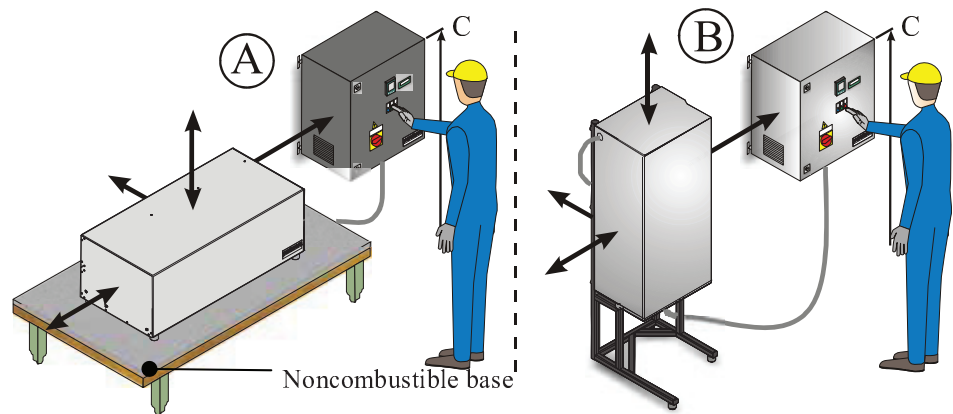


Fig. 15: Installation of a tube furnace with wall cabinet system  
 A = Tube furnace model with horizontal operation  
 B = Tube furnace model with vertical operation



**Note**

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





The installation location must have sufficient ventilation.

Environmental conditions such as temperature and humidity can be found in the chapter "Technical data". At higher ambient temperatures than specified, we recommend the use of the switch cabinet cooling unit.

The switching system must be easy to access.

Moreover, the switching system must be protected against heat, dust and moisture.

	<b>WARNING</b>
	<ul style="list-style-type: none"> <li>• <b>Overheating</b></li> <li>• <b>Damage to the device</b></li> <li>• Do NOT install device in unventilated niches.</li> <li>• Ensure sufficient ventilation for dissipating heat.</li> </ul>

	<b>! DANGER</b>
	<ul style="list-style-type: none"> <li>• <b>Fire- danger to health.</b></li> <li>• <b>Risk of fatal injury.</b></li> <li>• Adequate ventilation must be ensured at the installation location to conduct waste heat and any exhaust gases away.</li> </ul>



## 4.5 Assembly, Installation, and Connection

### 4.5.1 Venting Exhaust Fumes

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

A commercially available 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.

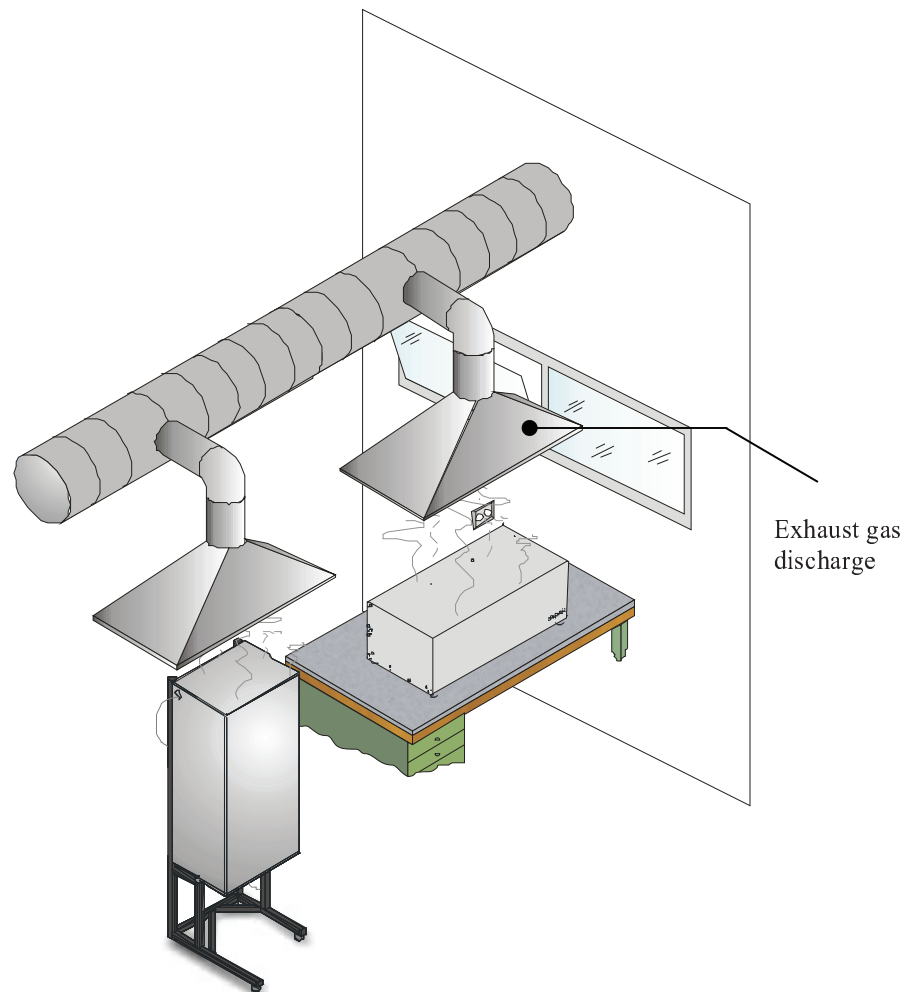


Fig. 16: Example: Assembly of a vent system



**Note**

The exhaust gases can only be discharged if the room is aerated via an appropriate supply air opening.



**Note**

Roof work and/or masonry by the customer is required for the exhaust gas discharge. The size and design of the exhaust gas discharge must be determined by a ventilation technician. The national regulations of the local country apply.

## 4.5.2 Connecting the Oven to the Power Supply

Requirements such as the load capacity of the installation surface, provision of power (electricity), etc. must be fulfilled on-site by the customer.

- Attend to sufficient dimensioning and fusing of the power line according to the furnace's characteristics.
- Ensure protected laying of the connection line from the furnace to the switching system.
- Grounding of the furnace and switching system (compliant with VDE 0100, part 410) is a prerequisite for the current-operated e.l.c.b. system of the heater.
- Test the ground resistance (in accordance with VDE 0100); see also accident prevention regulations.
- Electrical systems and equipment in accordance with BGV A3.

### Connection to AC power with power cord:

Plug the power plug into a suitable outlet, taking into account the information on the rating plate for line voltage, line type, and maximum power requirement. The distance between the furnace and the outlet should be minimized; avoid using extension cords.

### Connection to AC power without power cord:

The AC power connection is to be made via a permanent connection in the switchgear cabinet either on the prepared terminals or, for models without separate switchgears, directly on the main switch. Note the details on the rating plate regarding line voltage, line type and maximum power requirement.

The fuse protection and the cross section of the AC power connection to be provided depend on the environmental conditions, the length of the line, and the method of line placement. The manner hence should be determined by a qualified electrician at the installation location.

- The power cable must not be damaged. Do not place any objects on the power cable. Lay cables so that nobody can step on or trip over them.
- A power cord may be replaced only by an approved equivalent type of cord.
- Ensure that the furnace connection line is laid in a protected manner.

The design must correspond to the respective locally applicable standards and regulations. Ensure correct grounding conductor connection.

For multiple phases, they should be connected with a clockwise rotating field in the order L1, L2, L3.

Before turning the system on for the first time, ensure that a **clockwise rotating field** is ensured. This is the prerequisite of flawless system function.



#### Note

For wiring and electrical connections, see the attached circuit diagram. The electrical equipment of the machine can also be seen in the circuit diagram.



#### Note

The national regulations of the respective country of operation apply.



#### Warning! Electrical hazard!

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

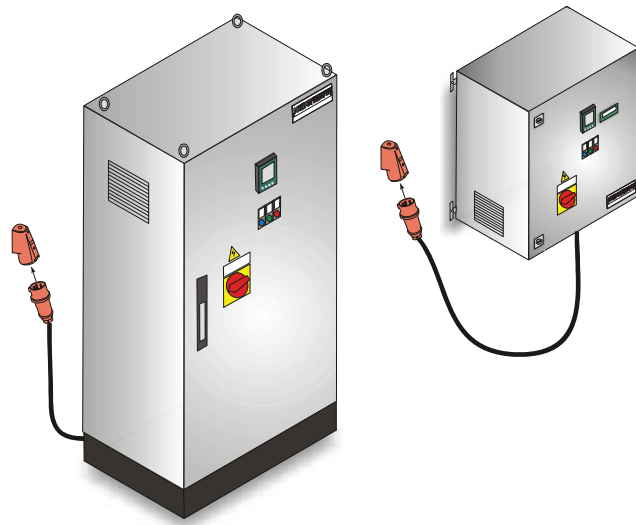


Fig. 17: Power connection **with** power cord

For wiring and electrical connections, see the attached wiring diagram. The electrical equipment of the machine can also be seen in the wiring diagram.

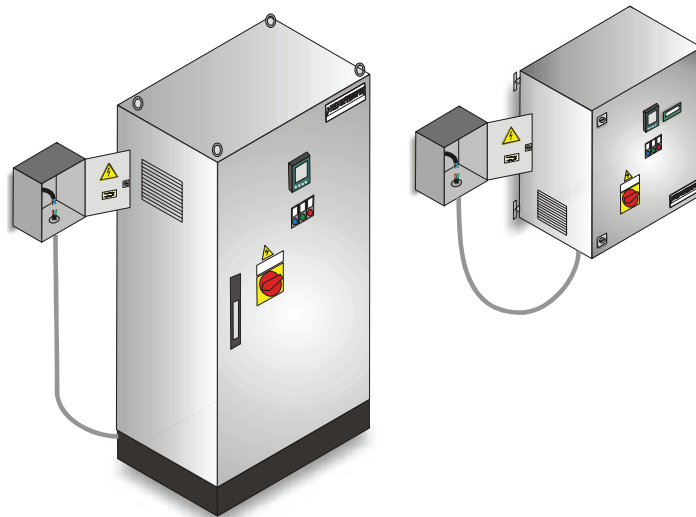


Fig. 18: Power connection **without** power cord

	<b>NOTICE</b>	
	<ul style="list-style-type: none"> <li>• <b>Danger from incorrect voltage</b></li> <li>• <b>Damage to the oven.</b></li> <li>• Check voltage before connecting and commissioning the oven.</li> <li>• Compare the voltage with the details on the type plate.</li> </ul>	

### 4.5.3 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.





#### Warning - General hazards! - Furnace opening temperature

Opening the furnace when hot ( $>180\text{ }^{\circ}\text{C}$  /  $>356\text{ }^{\circ}\text{F}$ ) is prohibited. The resulting thermal shock can destroy the working tube and possibly the heating elements as well.



#### Caution - damage to components!

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

 <b>WARNING</b>	
	<ul style="list-style-type: none"><li>• <b>Working tube</b></li><li>• <b>Danger of burning.</b></li><li>• Do NOT touch working tube, load, flange. Wait until the furnace has naturally cooled down to room temperature.</li></ul>

#### Version: horizontal operation

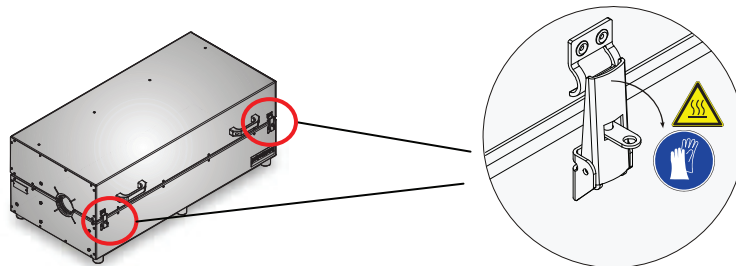


Fig. 19: Open furnace (quick-action lock)

The quick-action locks located on the furnace must be opened. Handles and quick-action locks can attain high temperatures during operation. Either wear protective gloves or wait until the furnace has naturally cooled down to room temperature.

When opening the furnace wait for the permissible furnace opening temperature.

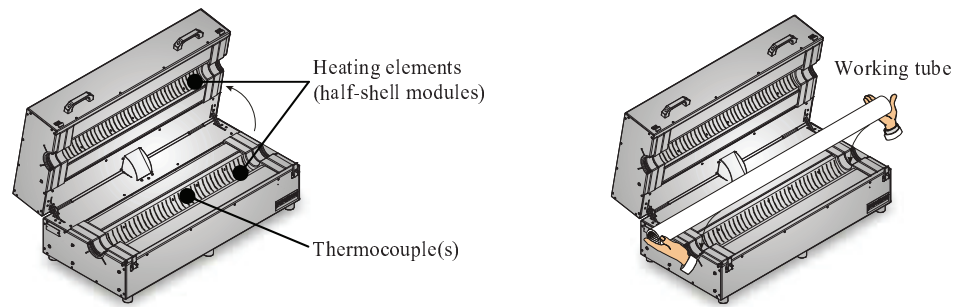


Fig. 20: Insert working tube

Grasp the handles of the furnace lid and cautiously open the furnace until you feel a stop. After fully unpacking the working tube, carefully lay it in the bottom half-shell module. Check that no packaging material is still in the working tube.

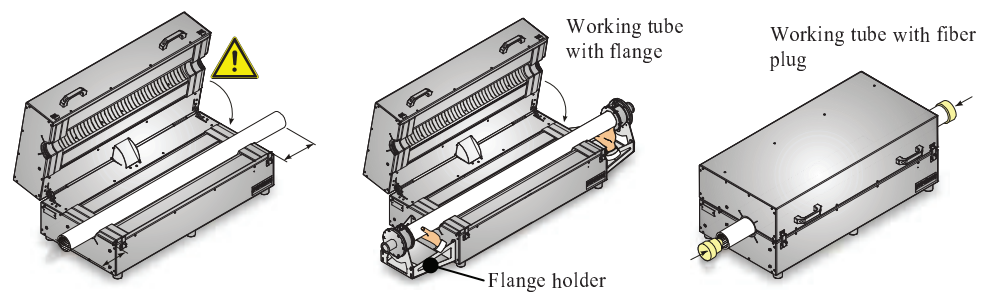


Fig. 21: Align working tube/close furnace

A uniform distribution of heat requires the working tube to be centered. Working tubes with flanges come with flange holders. Flange holders must be installed before laying down the working tube. Close the tube ends with the provided fiber plugs. Grasp the handles of the furnace lid and cautiously close the furnace. The furnace lid may have a high weight depending on the furnace size and design. The furnace must be locked with the quick-action locks. The furnace must be put into operation if it has not been locked with the quick-action locks.

**Version: vertical operation**

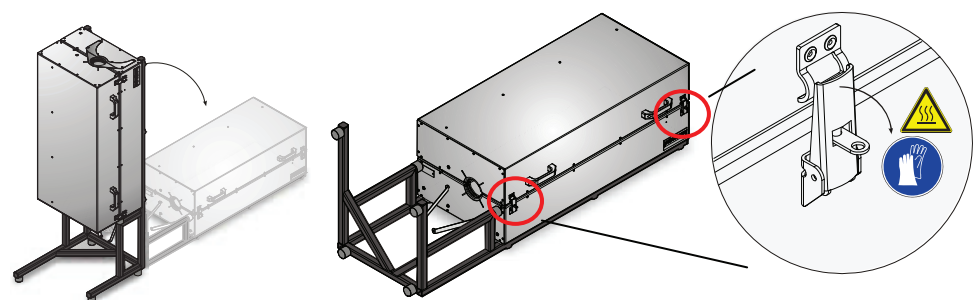


Fig. 22: Lay down furnace and open (quick-action lock)

For safely installing the working tube, we recommend cautiously tilting the furnace on the floor as shown in the figure above. The quick-action locks located on the furnace must be opened. Handles and quick-action locks can attain high temperatures during operation. Either wear protective gloves or wait until the furnace has naturally cooled down to room temperature.

When opening the furnace wait for the permissible furnace opening temperature.

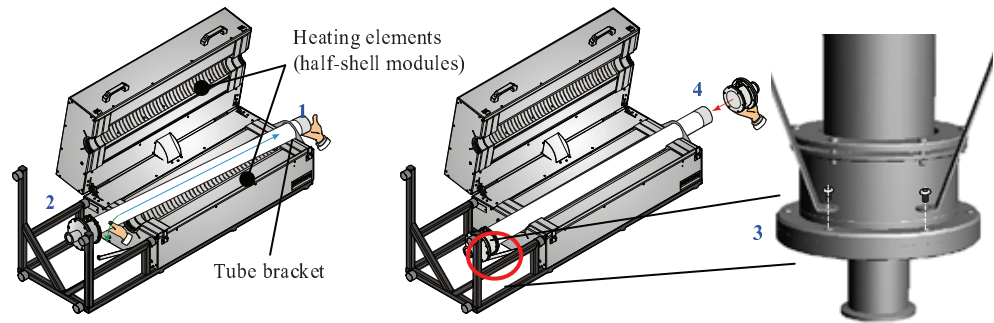


Fig. 23: Insert working tube and secure

Grasp the handles of the furnace lid and cautiously open the furnace until you feel a stop. After fully unpacking the working tube, carefully push it through the opening (1) of the tube bracket. Then carefully lay the working tube into the bottom half-shell module (2). Connect the holders with the bolts located on the flange (3). Check the bolted connections so that the working tube does not strike downwards while the furnace is being straightened. Failure to observe this rule will result in the destruction of the working tube. Now mount the flange still missing onto the end of the working tube (4) (assembly: see section entitled "Flange Assembly").

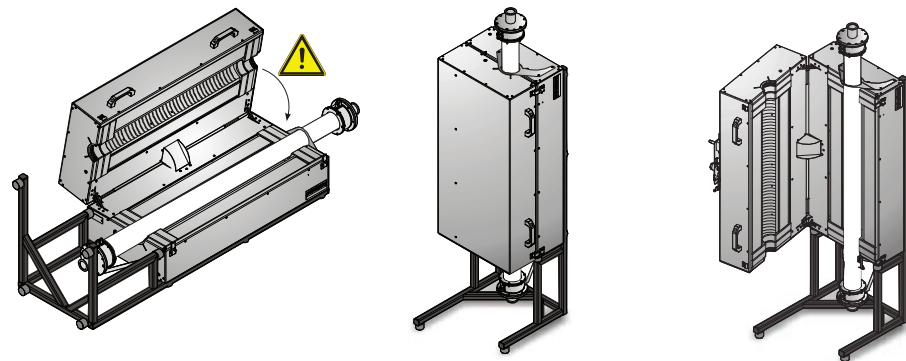
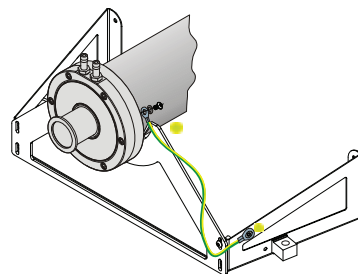


Fig. 24: Close furnace and set upright

Grasp the handles of the furnace lid and cautiously close the furnace. The furnace lid may have a high weight depending on the furnace size and design. The furnace must be locked with the quick-action locks. The furnace must be put into operation if it has not been locked with the quick-action locks. Cautiously and slow set the furnace upright. Be careful of the power cord to the furnace.

### Grounding a metal working tube



Metal working tubes must always be grounded at the flange before commissioning. Failure to follow this rule poses a risk of electrocution.



#### 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.

#### 4.5.4 Installation of the Flange Holder and Flange



**Note**

Assembly/disassembly: see separate instructions

#### 4.6 Commissioning

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 oven 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.



**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.

## 4.7 Recommendations for Heating the Oven for the First Time



To achieve a protective oxide layer on the heating elements, the furnace must be heated to **100°C below the maximum temperature, depending on the employed working tube** and according to the **heating rates** given below. This temperature must be **maintained** for approx. **1 hour**. This process must be carried out on commissioning, after exchanging the heating elements or to regenerate the oxide layer. Odor pollution may occur during heating; this is due to the escape of binder from the insulating material. We recommend ventilating the furnace location well during the first heating phase.

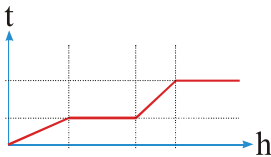
## 4.8 Maximum permissible heating rates



### Warning - General hazards!

When heating the furnace, comply with the following heating rates depending on the working tube, unless otherwise directed.

**Failure to observe this rule will lead to the destruction of the working tube and possibly to the heating elements.**



- Working tubes made of **vitreous silica: not required.**
- Working tubes made of **C 530** (Sillimantin) or **APM** (CrFeAl alloy) with an outside diameter < 120 mm: **not required.**
- Working tubes made of **C 610** (Pythagoras), **C 799** (Alsint) with an outside diameter < 120 mm: **300°C/h.**
- All working tubes with outside diameter **from 120 mm: 200°C/h.**

### Tears in 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 effect on the functioning or quality of the furnace.



## 5 Operation

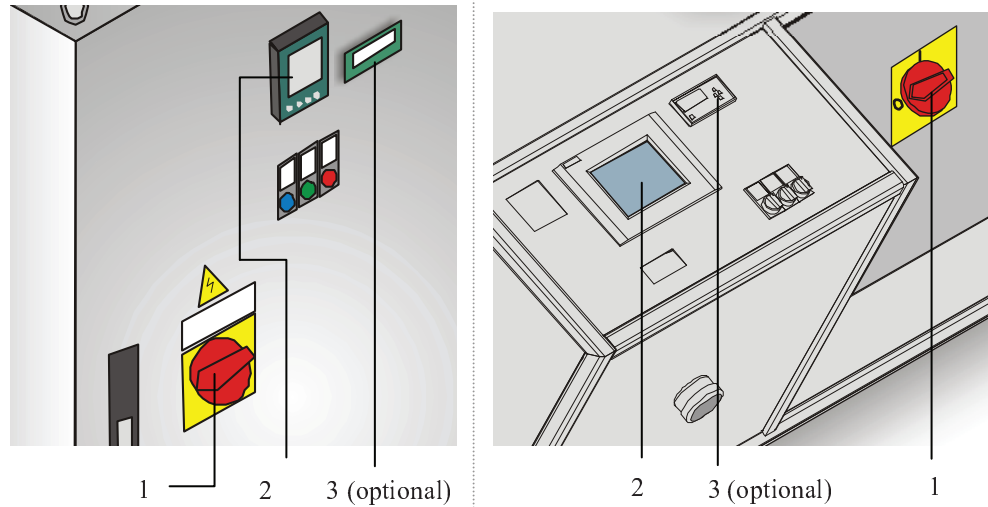
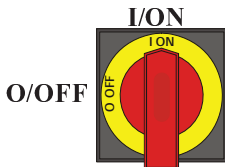



Fig. 25: Furnace system with controller



1. The power switch (1) is used to switch the control current on (**I/ON**) or off (**O/OFF**). When the control current is switched on, the heating chamber temperature is indicated in the LED display on the controller (2).
2. The desired heating and cooling program is set on the controller (2). See separate instructions for a description of the controller.
3. The temperature of the over-temperature limit controller (3) (optional) must be set 30°C higher than that of the controller. See separate operating instructions for a description of the over-temperature limit controller (TWB).

### Note

Constant operation at maximum temperature may lead to increased wear on the heating elements and insulation. We recommend working at approx. **50°C below maximum temperature**.

<i>NOTICE</i>	
	<ul style="list-style-type: none"> <li>• <b>Overheating</b></li> <li>• <b>Damage to the batch</b></li> <li>• If, as a result of excessive heat, a batch is likely to be damaged by the pre-set response temperature of the over-temperature limit controller with manual/automatic reset or if the batch itself becomes a source of danger for the oven or its surroundings, the temperature setting on the over-temperature limit controller with manual/automatic reset must be reduced to the maximum permissible value.</li> </ul>

## 5.1 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 ( $> 400\text{ }^{\circ}\text{C}$ ). 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.



#### Warning - General hazards! - Furnace opening temperature

Opening the furnace when hot ( $>180\text{ }^{\circ}\text{C}$  /  $>356\text{ }^{\circ}\text{F}$ ) is prohibited. The resulting thermal shock can destroy the working tube and possibly the heating elements as well.



#### Caution - damage to components!

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

	<b>WARNING</b>
	<ul style="list-style-type: none"><li>• <b>Working tube</b></li><li>• <b>Danger of burning.</b></li><li>• Do NOT touch working tube, load, flange. Wait until the furnace has naturally cooled down to room temperature.</li></ul>

## 6 Servicing, Cleaning, and Maintenance



### Warning! General hazards!

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



### Warning - danger due to electrical current!

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



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

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

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

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

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

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

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

Safety switches and any limit switches present must be checked for function periodically (BGV A3) or according to the national guidelines of the country of operation.

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

If necessary, retighten the element holders (see chapter "Replacing the Heating Element"). Before carrying out this work, the voltage supply to the furnace and/or switching system must be switched off (disconnect mains power connector). The regulations (BGV A3) or corresponding national regulations in the relevant country of operation must be observed.

There are one or more contactors in the control system. The contacts of these circuit breakers are wearing parts and must therefore be serviced and/or replaced regularly (BGV A3) or according to the national guidelines of the country of operation.

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



### This furnace contains ceramic fiber material in the insulation.

Active handling of these fibers (e.g., exchange of the insulation) in the Federal Republic of Germany is subject to the conditions of the Ordinance on Hazardous Substances, Annex V, No. 7 ("Artificial mineral fibers") of June 12, 1998. In the rest of the European Union, ceramic fibers are categorized as follows by Directive 97/69/EC of the Commission of December 5, 1997 CARC. Cat. 2; R 49; Xi R 38. Work with the fiber insulation must therefore be done in such a way that as little fiber dust as possible is released.



### The following points must be noted when handling ceramic fiber:

- Dust development during processing should be minimized.
- Contact with skin and eyes should be avoided. The effects caused by fibers on the skin or in the eyes may cause mechanical irritation, as a result of which reddening and itching may occur.
- When processing large quantities of ceramic fibers, loose work clothing with long sleeves, gloves and safety glasses should be worn.
- When working with ceramic fiber insulation inside furnaces, a half/quarter mask with P2 filter should additionally be worn.

The furnace and its operating equipment must be regularly checked in accordance with the regulations of the employer's liability insurance association (BGV A3) or the corresponding national regulations in the relevant country of use!

## 6.1 Shutting the system down for maintenance



### Warning! General hazards!

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

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

- The furnace must be completely emptied.
- Notify operating personnel and specify a supervisor.
- Switch off the main switch and disconnect the mains power connector.
- Lock the main switch and secure against restoration of power using a padlock.
- Attach a warning sign on the main switch.
- Seal off a large area around the servicing area.
- Check for disconnection of power.
- Ground and short-circuit the working area.
- Cover any nearby parts still under power.



### Warning! General hazards!

Do not touch any object without first checking its temperature.



### Warning - Danger of Electric Shock!

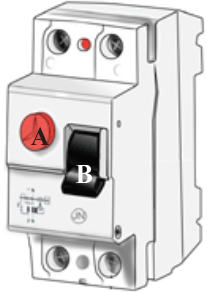
Work on the electrical equipment may be done only by qualified, authorized electricians. During work it must be ensured that the oven and the switching equipment cannot be activated by mistake (pull out the power plug) and that all moving parts in the oven are secured. Observe BGV A3 or the corresponding national regulations in the country where the oven is installed. Wait until the oven and the connected parts have cooled to room temperature.



## 6.2 Regular Maintenance of the Oven

Item/ maintenance point	Action	Maintenance Interval					Operati ng	Qualifi ed
		Day	Week	Month	Quarte r	Year	Personnel	
Safety test in accordance with BGV A3 or corresponding national regulations	According to regulations					●		X
EMERGENCY STOP device	Press the button or power switch	●					X	
Drives and 3rd-party subassemblies (if present)	Maintain according to manufacturers' instructions. Visual inspection.							X
Safety and limit switches (if present)	Perform functional test					●		X
Furnace chamber, exhaust holes and pipes	Clean and check for damage; vacuum out carefully	●					X	
Sealing surfaces: Door collar	Visual inspection	●					X	
Seals (if present)	Clean/replace		●				X	
Heating elements	Visual inspection		●					X
Working tube, fiber plugs and flanges	Visual inspection. E.g. check for cracks	● ■				●		X
Check for uniform power consumption by heating system	Functional test					●	X	
Thermocouple	Visual check of display at the controller				●		X	
Check settings	Check according to work schedules	●					X	
Settings at the over-temperature limit controller (if present)	Each time the heat treatment program is changed	●					X	
Legend:	■ = clean      ● = check, replace      x = performed by							

Fig. 26: Maintenance table

	<p><b>Note</b></p> <p>Ground fault circuit interrupters (earth leakage circuit breakers) installed on the rear side (see section on "Overall View of the System") are equipped with a test button (A) for carrying out a simple function test. The test button should be operated for checking every 4 weeks. The test is successful if the switch (B) jumps to "0" when the test button is pressed. Following the successful test, set the switch back to "I". If the switch does not jump to "0", have the defective ground fault circuit interrupter replaced by a qualified electrician and checked by means of a measuring device. The system must not be put in operation without a functioning ground fault circuit interrupter. For performing the test the furnace system must be switched on.</p>
---	---

Example



**Note**

If used, over-temperature limit controllers with manual or automatic reset (see Overview of the Oven) must be checked regularly to ensure that they function as intended. To check whether the over-temperature limit controllers respond, start the oven and set the required set point on the temperature control unit below the set point of the controller. For more information, see the operating instructions for over-temperature limit controller with automatic reset/over-temperature limit controller with manual reset.



**Note**

Operating furnaces with heating transformers can trigger an upstream fault-current circuit breaker due to the EMC filter circuitry. For this reason, fault-current circuit breakers should not be used as protection switchgear.



**Warning - Danger of Electric Shock!**

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



**Note**

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

### 6.3 Operating and Auxiliary Materials

### 6.4 Cleaning Products



Follow the procedure for shutting down the furnace system (in the "Operation" section). Then the power plug must be pulled out of the socket. Wait until the furnace cools down naturally.

Use commercially available detergent which is either water-based or non-combustible and free of any solvents to clean the housing of any deposits; use a vacuum cleaner for the interior.

**Follow the labeling and the instructions on the packaging of the detergent.**

Wipe the surface with a damp, lint-free cloth. The following detergents can also be used:

This list must be completed by the operator.	
Component and location	Detergent
Outer surfaces (frames *)	Use commercially available detergent which is either water- or non-combustible and free of any solvents for cleaning *)
Outer surface (stainless steel)	Stainless still cleaner
Interior	Carefully clean with a vacuum cleaner (avoid the heating elements)

Insulation materials	Carefully clean with a vacuum cleaner (avoid the heating elements)
Door seal (if included)	Use commercially available detergent which is either water-or non-combustible and free of any solvents for cleaning
Instrument panel	Wipe the surface with a damp, lint-free cloth. (e.g. glass cleaner)
*) You must be sure that the cleaner does not damage the water-soluble and, hence, environmentally safe paint (the clear should be tried first on an interior, normally unseen location).	

Fig. 27: Detergent

Do the cleaning from beginning to end without breaks to protect the surfaces.

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





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

**Please follow the section entitled "Environmental Protection Rules and Regulations"**



### Caution

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

 	 <b>DANGER</b>	
	<ul style="list-style-type: none"> <li>• <b>Danger of electric shock.</b></li> <li>• <b>Risk of fatal injury</b></li> <li>• Before cleaning, pull out the power plug.</li> <li>• Do NOT pour water or cleaning products over the inside or outside surfaces</li> <li>• Allow oven to dry completely before operating it again</li> </ul>	

## 7 Faults

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

Call the local electrician for faults that you cannot localize.

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

Type of errors	Possible causes	Correcting the error
Controller does not switch on.	<ul style="list-style-type: none"> <li>-No voltage available.</li> <li>-Controller defective.</li> </ul>	<ul style="list-style-type: none"> <li>-Check connection fuse(s), renew if necessary.</li> <li>-Check controller fuses (if available), renew if necessary.</li> <li>-Check plug connector.</li> </ul>
Controller indicates fault.	-See separate instructions for controller.	-See separate instructions for controller.
No heating chamber heating after starting program.	<ul style="list-style-type: none"> <li>-Error in program input.</li> <li>-Connection fuse(s) defective.</li> <li>-Heating element defective</li> </ul>	<ul style="list-style-type: none"> <li>-Check heating program (see separate instructions for controller)</li> <li>-Check connection fuse(s), renew if necessary.</li> <li>Notify Nabertherm Service if the new fuse trips on screwing in.</li> <li>-Have checking carried out by Nabertherm Service.</li> </ul>
Very slow heating of the heating chamber	-Connection fuse(s) defective.	<ul style="list-style-type: none"> <li>-Check connection fuse(s), renew if necessary.</li> <li>Notify Nabertherm Service if the new fuse trips on screwing in.</li> </ul>
Selected end temperature not reached.	<ul style="list-style-type: none"> <li>-Lack of heater output due to undervoltage.</li> <li>-Heating element defective</li> <li>-Ends of the working tube not closed (fiber plugs, vacuum flanges)</li> </ul>	<ul style="list-style-type: none"> <li>-Have checking carried out by Nabertherm Service.</li> <li>-Close ends of the working tube (fiber plugs, vacuum flanges)</li> </ul>



## 8 Spare Parts/Wearing Parts



### Ordering Spare Parts:

Our Nabertherm Service team is available to you all around the world. Due to our considerable production depth we deliver most spare parts from the warehouse overnight or can make them ready for delivery within short deadlines. You can order Nabertherm spare parts easily and simply directly from the factory. If you cannot find the spare part you want we will be glad to help you. Spare parts can be ordered in writing, by phone or on the Internet -> see the section entitled "Nabertherm Service".

### Availability of Spare Parts and Wearing Parts:

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



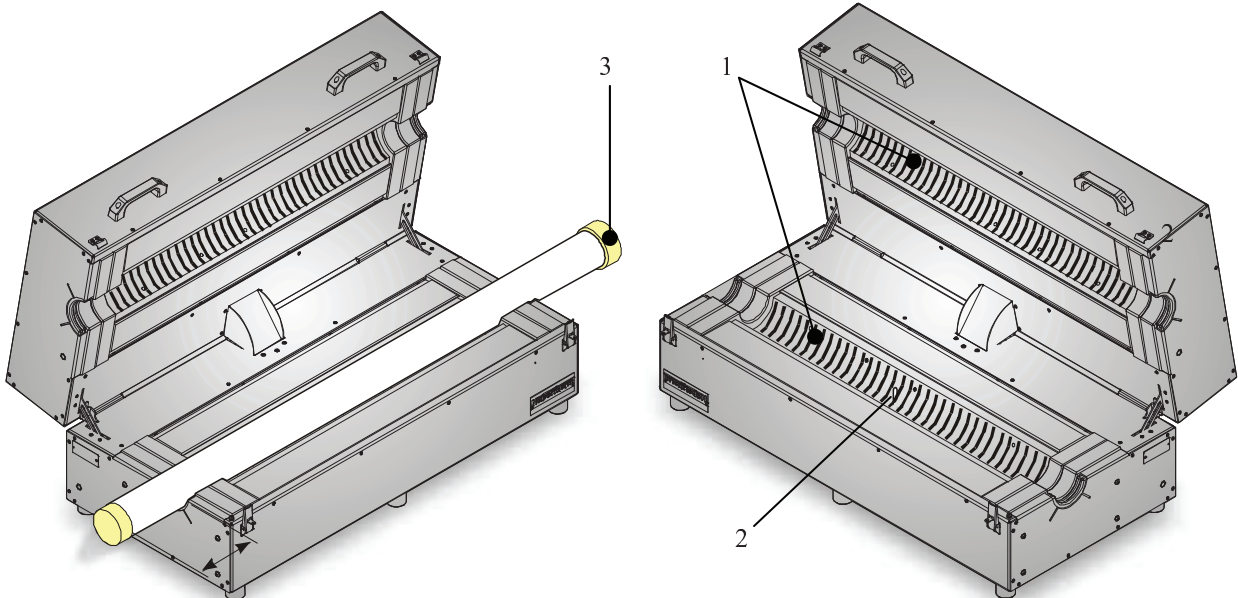
#### Note

Contact our Nabertherm Service for removing and installing replacement and wear parts. See section on "Nabertherm Service". Work on the electrical equipment may only be performed by qualified and authorized specialist electricians. This applies also to repairs not described below.



#### Note

Original parts are designed especially for Nabertherm ovens. 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.



Tube furnace model RT .../11-13

Abb. 28: Example: replacement parts at the tube furnace

### Half-shell module

Ser. No.	Furnace model	Name	Part Number	Unit No.	Enclosed with spare part delivery
1	RS 80/300/11	Half-shell module	692 200 037	2	2 x fiber paper 2x1000x500 mm
	RS 80/500/11		692 200 038		
	RS 80/750/11		692 200 028		
	RS 120/500/11		692 200 039		
	RS 120/750/11		692 200 040		
	RS 120/1000/11		692 200 031		
	RS 170/750/11		692 200 045		
	RS 170/1000/11		692 200 046		
	RS 80/300/13		692 200 035		
	RS 80/500/13		692 200 032		
	RS 80/750/13		692 200 034		
	RS 120/500/13		692 200 041		
	RS 120/750/13		692 200 030		
	RS 120/1000/13		692 200 029		
	RS 170/750/13		692 200 044		
	RS 170/1000/13		692 200 048		

### Thermocouple


Ser. No.	Furnace model	Name	Part Number	Quantity per zone	Enclosed with spare part delivery
1	RS 80/300/11	Thermocouple type K	540300060	1	---
	RS 80/500/11				
	RS 80/750/11				
	RS 120/500/11				
	RS 120/750/11				
	RS 120/1000/11				
	RS 170/750/11				
	RS 170/1000/11				
	RS 80/300/13	Thermocouple type S	540300283		
	RS 80/500/13				
	RS 80/750/13				
	RS 120/500/13				
	RS 120/750/13				
	RS 120/1000/13				
	RS 170/750/13				
	RS 170/1000/13				

### Fiber plug

Ser. No.	Name	Tube inside Ø	Part Number	Unit No.	Enclosed with spare part delivery
3	Fiber plug	30	691600587	2	---
		40	691600593		
		50	691600930		
		60	691600594		
		70	691600971		
		80	691600599		
		100	691600600		
		150	691601720		
	Fiber plug with gas	30	601603853		

	connection	40	601603854		
		50	601603927		
		60	601603855		
		70	601603936		
		80	601603856		
		100	601603857		
		150	- - -		


### Other spare parts

Ser. No.	Name	Part Number	Furnace model	Comment
			For all furnace models	
			Unit No.	
4	-Semiconductor fuse	*)	1	
5	-Fiber paper 1 mm	691600929	MnB	
6	-Fiber paper 2 mm	691600399	MnB	
7	-Fiber paper 3 mm	691600414	MnB	
8	-Fiber wadding	691600518	MnB	
9				
10				

\*) = Spare part supply depending on version

MnB = Quantity as required

### Tools

Ser. No.	Furnace model	Name	Part Number	Unit No.	
- - -	All models	Allen wrench 3 mm	493 000 009	MnB	

MnB = as needed

## 8.1 Repairing the Insulation

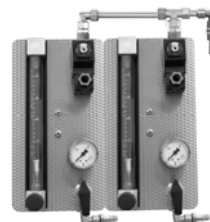
The insulation of the furnace consists of a very high-quality refractory material. Heat expansion may cause tears in the insulation even after a few heating cycles. However, these have no affect on the function or quality of the furnace. However, if entire "sections" of the insulation come loose, Nabertherm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

## 9 Accessories (Options)

### 9.1 Laboratory Gas Supply Station



Gas panel (individual panel)  
for simple protective gas applications.



Gas panel (double panel)  
for operating with two non-combustible types of  
gas.

Fig. 29: Laboratory gassing stations

Gassing stations are conceived for commercial applications in laboratories. Nabertherm furnaces can be upgraded with various equipment packages for operation with non-combustible gases. The various equipment packages can be delivered together with the furnace, but also at a later time as well. You can select from gas panels which function just manually or both manually and automatically. We provide gas supply systems for non-combustible protective gas (argon Ar, nitrogen N<sub>2</sub> and inert gas N<sub>2</sub>H<sub>2</sub> 95/5) with shut-off valve, flowmeter and control valve.

### 9.2 Over-temperature Limit Controller

Nabertherm GmbH furnaces are equipped **as standard** with an over-temperature limit controller monitor to protect against over-temperature in the furnace chamber.

The over-temperature limit controller with manual reset monitors the temperature in the oven chamber. The display shows the last trigger temperature that was set. When the furnace chamber temperature exceeds the set triggering temperature, the heating is switched off to protect the furnace or charge.

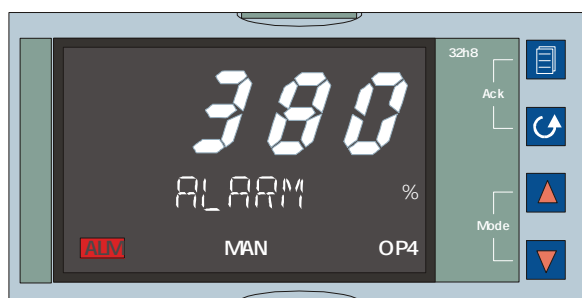



Fig. 30: Over-temperature limit controller with manual reset 32h8i



#### Note

See additional operating instructions for description and function

### 9.3 Available Working Tubes

 Working tube Outside Ø x inside Ø x length in mm	Order number	80-300	80-500	80-750	120-500	120-750	120-1000	170-750	170-1000	Comment
		Model RS								
<b>C 530 (Sillimantín)</b>	(part number)	<b>Model RS</b>								
40 x 30 x 700	692070276	o								
60 x 50 x 650	692070106	o								
60 x 50 x 850	692070305		o		o					
60 x 50 x 1100	692070101			o		o		o		
60 x 50 x 1100	692070101			o		o		o		
70 x 60 x 1070	692070048			o		o		o		
80 x 70 x 650	692070036	•								
80 x 70 x 850	692070108		•		o					
80 x 70 x 1100	692070109			•		o		o		
95 x 80 x 1070	692070049					o		o		
120 x 100 x 850	692070110				•					
120 x 100 x 1100	692070111					•		o		
120 x 100 x 1350	692070131						•		o	
120 x 100 x 1400	692070279									
170 x 150 x 1100	692071659							•		
170 x 150 x 1350	692071660								•	
<b>Vacuum tube<sup>1</sup> C610</b>										
60 x 50 x 1030	692070179	o								
60 x 50 x 1230	692070180		o		o					
60 x 50 x 1480	692070181			o		o		o		
80 x 70 x 1230	692070182		o		o					
80 x 70 x 1480	692070183			o		o		o		
120 x 100 x 1230	692070184				o					
120 x 100 x 1480	692070185					o		o		
120 x 100 x 1730	692070186						o		o	
170 x 150 x 1480	692070187							o		
170 x 150 x 1730	692070188								o	
<b>Vacuum tube<sup>2</sup> APM</b>										
75 x 66 x 1090	691402564	o								
75 x 66 x 1290	691402565		o							
75 x 66 x 1540	691400835			o						
115 x 104 x 1290	691402566				o					
115 x 104 x 1540	691402567					o				
115 x 104 x 1790	691402568						o			
164 x 152 x 1540	691402569							o		
164 x 152 x 1790	691402570								o	

\*) Only working tubes with outside diameters as when the furnace was acquired may be used, since the insulation of the furnace was drilled to this dimension.



**Key**

- Standard working tube.
- Working tube optionally available.
  - 1) For use with water-cooled end flanges.
  - 2) With welded flanges for use with water-cooled flange covers.
  - 3) Tubes/rectors, incl. attached sleeves for the rotary drive. Replacement tubes without sleeves.



**Note**

Proper functioning can be guaranteed only with original working tubes or with working tubes with surface-ground ends from Nabertherm.



**Note**

For using vacuum tubes you need the corresponding flange holders. Nabertherm Service will be glad to assist you in selecting the right flange holders.

## 10 Electrical Connections (Circuit Diagram)



**Note**

See the Appendix for the wiring diagram for this system.

## 11 Nabertherm Service



Contact Nabertherm Service at any time for maintenance and repair.

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



**Mail**

Nabertherm GmbH  
Bahnhofstrasse 20  
28865 Lilienthal/Germany



**Phone or Fax**

Phone: +49 (4298) 922-0  
Fax: +49 (4298) 922-129



**Web or e-mail**

[www.nabertherm.com](http://www.nabertherm.com)  
[contact@nabertherm.com](mailto:contact@nabertherm.com)

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

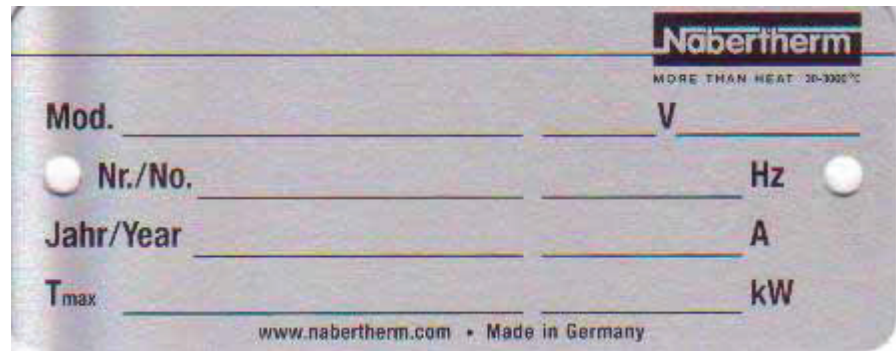


Fig. 31: Example: Type plate

## 12 Shut-Down, Dismantling, and Storage

### To be Completed by the Operator

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

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



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

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Oils and other substances that are hazardous to water must be completely removed before the oven is dismantled for reuse 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 oven may be lifted only at the intended points.

Use only the stated lifting and securing equipment to lift the oven/parts.

Consider a total weight of \_\_\_\_\_ kg when choosing suitable lifting equipment.

For transportation, consider a permitted floor weight of at least \_\_\_\_\_ kg/m<sup>2</sup>.



Before transporting the oven, attach the following securing equipment:

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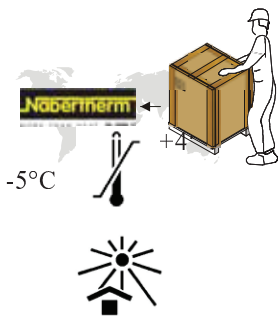
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**Note**

Read the sections on "Safety" and "Transportation"

## 12.1 Transportation/Return Transportation



**If you still have the original packaging, this is the safest way to send an oven.**

Otherwise:

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

- **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 oven 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 oven on a level floor to prevent distortion.**
- **Packaging and transportation may be carried out only by qualified and authorized persons**

If your oven has transportation securing equipment (see "Transportation Securing Equipment"), 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 oven is sent without accessories, unless the technician expressly requests them.

Enclose a detailed description of the fault along with the oven – 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



**EC Declaration of Conformity**  
in accordance with EC directives 2006/95/EEC and  
EMC directive 2004/108/EEC

Hereby

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**Nabertherm GmbH**  
**Bahnhofstr. 20, 28865 Lilienthal, Germany**

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declares that the product specified below conforms to the relevant fundamental safety and health requirements of the appropriate EU Directive both in its basic design and construction as well as in the version marketed by us. The declaration will cease to be valid if any modifications are made to the machine without our approval.

#### Hinged Tube Furnaces

<b>Model</b>	RS 80/300/11	RS 80/300/13	RS 80/500/11	RS 80/500/13	RS 80/750/11
	RS 80/750/13	RS 120/500/11	RS 120/500/13	RS 120/750/11	RS 120/750/13
	RS 120/1000/11	RS 120/1000/13	RS 170/750/11	RS 170/750/13	RS 170/1000/11
	RS 170/1000/13				

For all Furnaces: With switchgear 110 – 480 V and Nominal frequency 50/60 Hz.

The following harmonized standards were applied:

- DIN EN 61010-1 (07.2011)
- DIN EN 60335-1 (11.2010)
- DIN EN 61000-6-1 (10.2007) , DIN EN 61000-6-3 (09.2007)

Lilienthal, 29.05.2007



Thomas Adamek  
Quality Management



Wolfgang Bartilla  
Research and Development

## 14 Glossary

Terms	Explanation
Smelting	Smelting solid material in furnaces as a result of an increase in temperature is called melting.
Charge	The amount of metal provided for a discontinuously operating furnace in the form of block or circulation material.
Emission	In the sense of the air pollution laws, the air contamination proceeding from a system; in a more general sense, it can also include noise, exhaust heat, odors, water contamination, etc.
Endogas	This is a special <b>protective gas atmosphere</b> of endogas/nitrogen mixtures for the heat treatment of steel and nonferrous metals in industrial furnace systems. A typical gas composition is 20% CO, 40% H <sub>2</sub> and the rest N <sub>2</sub>
Exogas	This is a special <b>protective gas atmosphere</b> of exogas/nitrogen mixtures for the heat treatment of steel and nonferrous metals in industrial furnace systems. A typical gas composition is 10% CO <sub>2</sub> , 5% H <sub>2</sub> and the rest N <sub>2</sub>
Molybdenum disilicide (MoSi <sub>2</sub> )	This material is characterized by good high-temperature stability and thermal conductivity and by its good oxidation and corrosion resistance at temperatures between 1000 and 1600°C. A thin, adhering protective layer consisting of quartz glass (SiO <sub>2</sub> ), which provides the element with good oxidation resistance, forms on the surface of the element at temperatures over 800°C. A wire coated with MoSi <sub>2</sub> can be heated until white-hot in air without the formation of molybdenum oxides.
Molybdenum oxide (MoO <sub>3</sub> )	Molybdenum and silicon oxidation takes place at temperatures of around 550°C. This leads to a yellowish powder consisting primarily of molybdenum oxide (MoO <sub>3</sub> ), which occurs in combination with oxygen.
Oxidation	Oxidation in the narrower and original sense is the chemical reaction of a material with oxygen. The resulting product is an oxide.
Holding mode	Mode of furnaces to hold at a predefined melt bath temperature.
Scale formation	Oxide formation or the formation of surface scale on the metal surface occurs in an oxidizing atmosphere due to a thermal influence (e.g. heat treatment).



