

## Operating Instructions

### High-Temperature Furnace (Tabletop Model)

LHT 01/17 D - LHT 03/17 D

M01.1068 ENGLISCH

Original instructions

■ Made  
■ in  
■ Germany

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

---

### **Copyright**

© Copyright by  
Nabertherm GmbH  
Bahnhofstrasse 20  
28865 Lilienthal  
Federal Republic of Germany

Reg: M01.1068 ENGLISCH  
Rev: 2022-09

No responsibility is accepted for the correctness of this information. We reserve the right to make technical alterations.

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Introduction .....</b>  | <b>5</b>  |
| 1.1      | Explanation of the Symbols and Warnings .....  | 5         |
| 1.2      | Product Description.....   | 8         |
| 1.3      | Complete Overview of the Furnace.....  | 10        |
| 1.4      | Key to the Model Names.....  | 14        |
| 1.5      | Scope of Delivery.....   | 14        |
| <b>2</b> | <b>Specifications .....</b>  | <b>15</b> |
| <b>3</b> | <b>Warranty and Liability .....</b>  | <b>16</b> |
| <b>4</b> | <b>Safety .....</b>  | <b>17</b> |
| 4.1      | Defined Application .....  | 17        |
| 4.2      | Requirements for the Furnace Operator .....  | 18        |
| 4.3      | Requirements for the Operating Personnel.....  | 19        |
| 4.4      | Protective Clothing.....   | 20        |
| 4.5      | Basic Measures During Normal Operation .....   | 20        |
| 4.6      | Basic Measures in Case of Emergency .....  | 21        |
| 4.6.1    | What to Do in an Emergency .....   | 21        |
| 4.7      | Basic Measures for Servicing and Maintenance.....  | 22        |
| 4.8      | Environmental Regulations .....  | 22        |
| 4.9      | General Risks with the Furnace.....  | 23        |
| 4.10     | Safeguarding against Dangers from Excess Temperatures .....  | 24        |
| <b>5</b> | <b>Transportation, Installation and Initial Start-Up.....</b>  | <b>25</b> |
| 5.1      | Delivery.....  | 25        |
| 5.2      | Unpacking .....  | 27        |
| 5.3      | Transport Securing Device/Packaging .....  | 29        |
| 5.4      | Constructional and Connection Requirements .....   | 29        |
| 5.4.1    | Location of the Furnace .....  | 29        |
| 5.5      | Assembly, Installation, and Connection.....  | 31        |
| 5.5.1    | Installing the Insulation Block and Exhaust Air Tube (only LHT 01/17 D).....                             | 31        |
| 5.5.2    | Venting Exhaust Fumes .....  | 33        |
| 5.5.3    | Connecting the Furnace to the Power Supply .....   | 34        |
| 5.6      | Initial Start-Up .....   | 35        |
| 5.6.1    | Molybdenum Disilicide (MoSi <sub>2</sub> ) Heating Elements .....  | 36        |
| <b>6</b> | <b>Operation .....</b>   | <b>39</b> |
| 6.1      | Controller .....   | 39        |
| <b>7</b> | <b>Operation, Display and Switch Elements (depending on design).....</b>                                 | <b>40</b> |
| 7.1      | Turning on the Controller/Furnace .....  | 40        |
| 7.2      | Turning off the Controller/Furnace .....   | 40        |
| <b>8</b> | <b>Pre-Set Programs.....</b>   | <b>40</b> |
| 8.1      | Over-Temperature Limiter with Manual Reset and Adjustable Cutout Temperature (Additional Equipment)..... | 41        |
| 8.2      | Air Inflow Lever .....   | 42        |
| 8.3      | Loading/Charging .....   | 43        |
| 8.3.1    | Stackable Saggar.....  | 43        |
| <b>9</b> | <b>Servicing, Cleaning, and Maintenance .....</b>  | <b>46</b> |
| 9.1      | Furnace Insulation.....  | 47        |

|           |   |           |
|-----------|---|-----------|
| 9.2       | Shutting the System Down for Maintenance.....                       | 48        |
| 9.3       | Regular Maintenance of the Furnace.....                             | 48        |
| 9.4       | Regular Maintenance Tasks – Documentation.....                      | 49        |
| 9.5       | Regular Maintenance Tasks – Heating Elements/Furnace Chamber.....   | 50        |
| 9.6       | Maintenance Table Key .....   | 50        |
| 9.7       | Checking the Heating Element Screws .....                           | 51        |
| 9.8       | Operating and Auxiliary Materials.....                              | 53        |
| 9.9       | Cleaning Products .....   | 53        |
| <b>10</b> | <b>Malfunctions .....</b>   | <b>54</b> |
| 10.1      | Error Messages of the Controller .....                              | 55        |
| 10.2      | Warnings of the Controller.....                                     | 57        |
| 10.3      | Malfunctions of the Switchgear .....                                | 59        |
| <b>11</b> | <b>Spare Parts/Wearing Parts.....</b>                               | <b>61</b> |
| 11.1      | Electrical Schematics/Pneumatic Schematics .....                    | 61        |
| 11.2      | Removing and Installing Heating Elements .....                      | 61        |
| 11.2.1    | Tightening Torque for Screw Connections on Heating Elements .....   | 66        |
| 11.3      | Replacing a Thermocouple.....                                       | 67        |
| 11.4      | Replacement/Readjustment of the Door Insulation Structure .....     | 70        |
| 11.5      | Separate the Snap-In Coupling (Plug) from the Furnace Housing ..... | 71        |
| 11.6      | Replacing a Fuse .....  | 71        |
| 11.7      | Repairing the Insulation .....                                      | 72        |
| <b>12</b> | <b>Accessories (Options) .....</b>                                  | <b>73</b> |
| 12.1      | Gas Supply System (Accessories).....                                | 74        |
| 12.2      | Operation of Compressed Gas Containers .....                        | 75        |
| 12.3      | Separate the Snap-In Coupling (Plug) from the Furnace Housing ..... | 76        |
| 12.4      | Electrical Schematics/Pneumatic Schematics .....                    | 76        |
| <b>13</b> | <b>Nabertherm Service.....</b>                                      | <b>76</b> |
| <b>14</b> | <b>Shut-Down, Dismantling, and Storage.....</b>                     | <b>78</b> |
| 14.1      | Transportation/Return Transportation .....                          | 79        |
| <b>15</b> | <b>Declaration of Conformity .....</b>                              | <b>80</b> |
| <b>16</b> | <b>For Your Notes .....</b>   | <b>81</b> |

# 1 Introduction

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

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

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

## 1.1 Explanation of the Symbols and Warnings



### Note

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

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

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

Graphic symbols correspond to **ISO 3864**. In accordance with the **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.

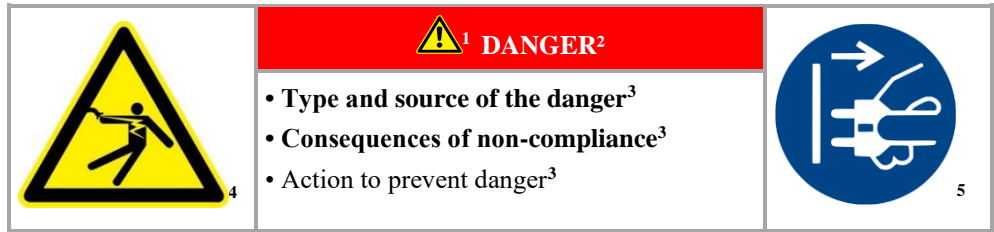
|                |   |
|----------------|---|
| <b>NOTE</b>    | Refers to a hazard that could damage or destroy the equipment.                      |
| <b>CAUTION</b> | Refers to a hazard with a minor or medium risk of injury.                           |
| <b>WARNING</b> | Refers to a hazard that could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

### Structure of the Warning:

All Warnings are Structured as Follows

|  |  |
|--|--|
|  | <sup>1</sup> <b>WARNING</b> <sup>2</sup>   |
|  | <ul style="list-style-type: none"> <li>• <b>Type and source of the danger</b><sup>3</sup></li> <li>• <b>Consequences of non-compliance</b><sup>3</sup></li> <li>• <b>Action to prevent danger</b><sup>3</sup></li> </ul> |

or



| Position | Description   | Explanation   |
|----------|---|---|
| 1        | Hazard Symbol   | Indicates the risk of injury  |
| 2        | Signal Word   | Classifies the danger   |
| 3        | Reference Texts                                       | <ul style="list-style-type: none"> <li>Type and source of the danger</li> <li>Possible consequences of non-compliance</li> <li>Measures/prohibitions</li> </ul> |
| 4        | Graphical Symbols (optional)<br>According to ISO 3864 | Consequences, measures, and prohibitions  |
| 5        | Graphical Symbols (optional)<br>According to ISO 3864 | Instructions or prohibitions  |

#### Information Symbols in the Instructions:



##### Note

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



##### Rule - Rule Sign

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



##### Rule – Important Information for Operators

This symbol draws the operator's attention to important information and operating instructions that must be observed.



##### Rule – Important Information for Maintenance Personnel

This symbol draws the maintenance personnel's attention to important operating and maintenance instructions (service) that must be observed.



##### Rule – Pull Out the Power Plug

This symbol tells the operator to pull out the power plug.

**Rule – 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 – Risk of Device Toppling Over**

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

**Warning – Suspended Load**

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

**Warning – Danger if Heavy Loads are Lifted**

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

**Warning – Risk to the Environment**

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

**Warning – Fire Danger**

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

**Warning – Risk of Explosive Substances or Explosive Atmosphere**

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

**Prohibited – Important Information for Operators**

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

### Warning Signs on the Furnace:



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

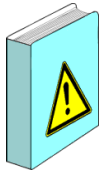
You may not always realize that surfaces, such as furnace components, furnace walls, doors and materials, and even liquids are hot. Do not touch the surface.



#### Warning – Danger of Electric Shock!

Warning, dangerous electric voltage

## 1.2 Product Description



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

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

Designed as tabletop models, these compact high-temperature furnaces have a variety of advantages. The first-class workmanship using high-quality materials, combined with ease of operation, make these furnaces all-rounders in research and the laboratory.

These high-temperature furnaces are perfectly suited for sintering of translucent zirconia units. The special molybdenum disilicide heating elements offer best possible protection against chemical interaction between charge and heating elements.

The zirconia units are positioned in ceramic saggars. Up to three saggars can be stacked into the high-temperature furnace.

When using liquid shading colors it must be ensured that the charge has been fully dried before starting the sintering process.

#### Other Characteristics of this Product are:

- Tmax 1650 °C
- Furnace chamber with volume of 1 or 4 liters
- Special molybdenum disilicide heating elements offer the best possible protection against chemical interactions between the charge and the heating elements
- Dual-shell housing made from sheets of textured stainless steel with additional cooling for low external temperatures
- Space-saving design with lift door that opens upward
- Depending on the model, the delivery may include a starter set for charging in one level, with more levels available as accessories
- Infinitely adjustable fresh-air flap
- The furnace can be charged with up to two (LHT 01/17 D) or three (LHT 03/17 D) saggars, 15 or 25 single crowns per level (depending on model)
- Exhaust air opening in the top
- Type S thermocouples
- Exact temperature control also at lower temperatures for drying
- Controller P580 (LHT 01/17 D) or P570 (LHT 03/17 D) with option to store up to 50 programs
- Can be used to sinter blanks from all leading manufacturers



- NTLog Basic for Nabertherm Controller: recording of process data with a USB flash drive
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.

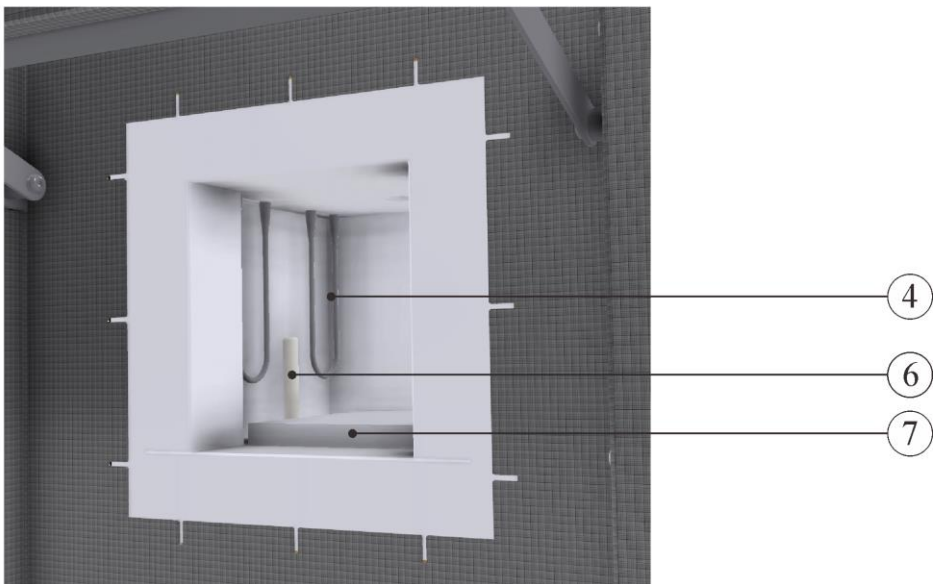
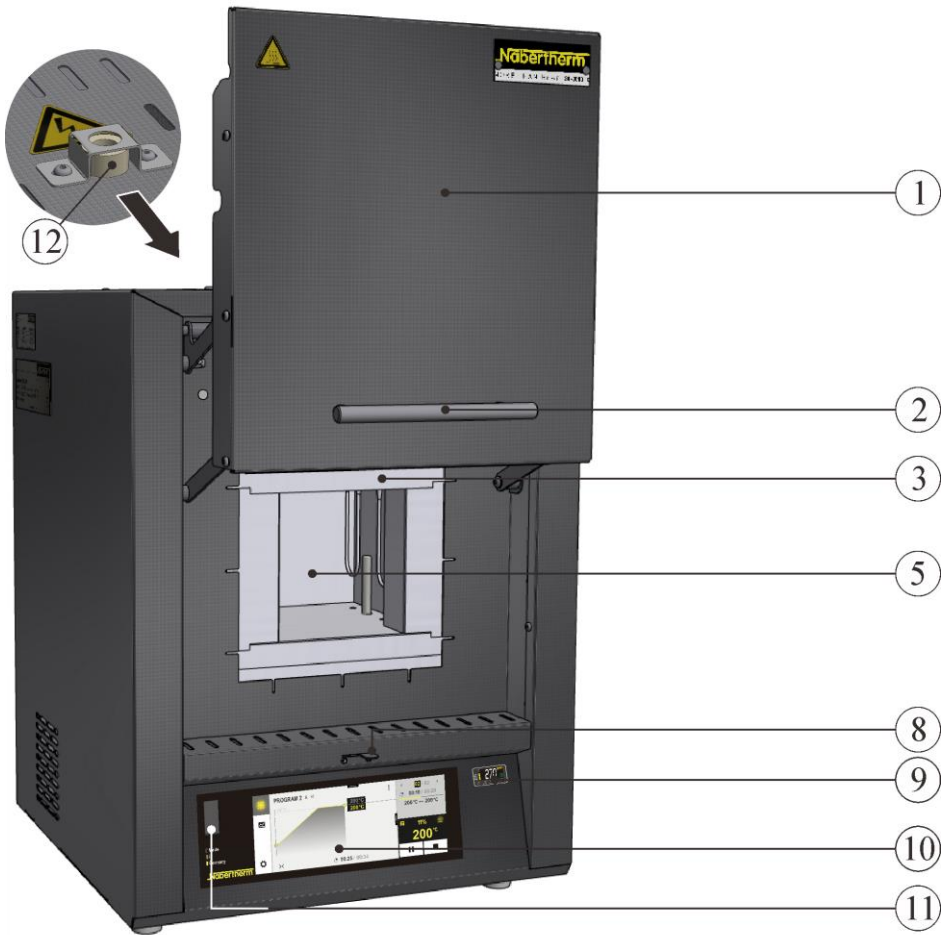
#### **Additional Equipment**

- Over-temperature limiter with manual reset as over-temperature protection for the furnace and the charge
- Protective gas connection for non-flammable protective or reaction gases for LHT 03/17 D
- Manual or automatic gas supply system

#### **Accessories**

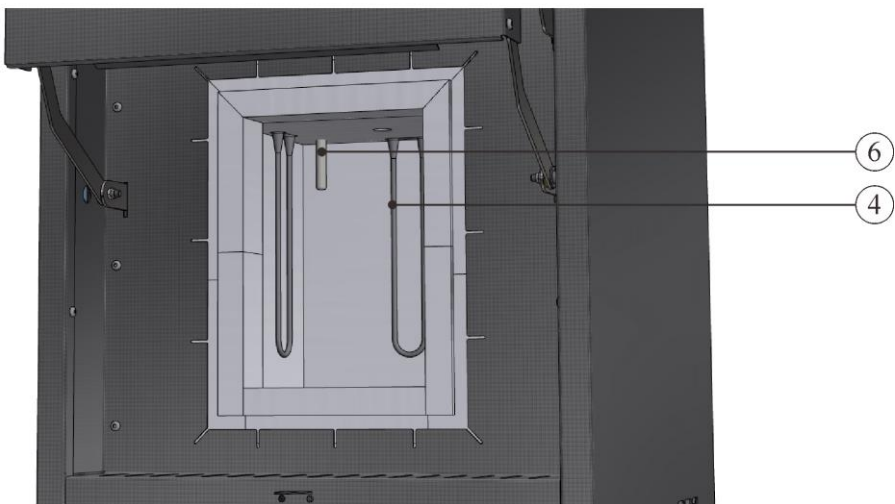
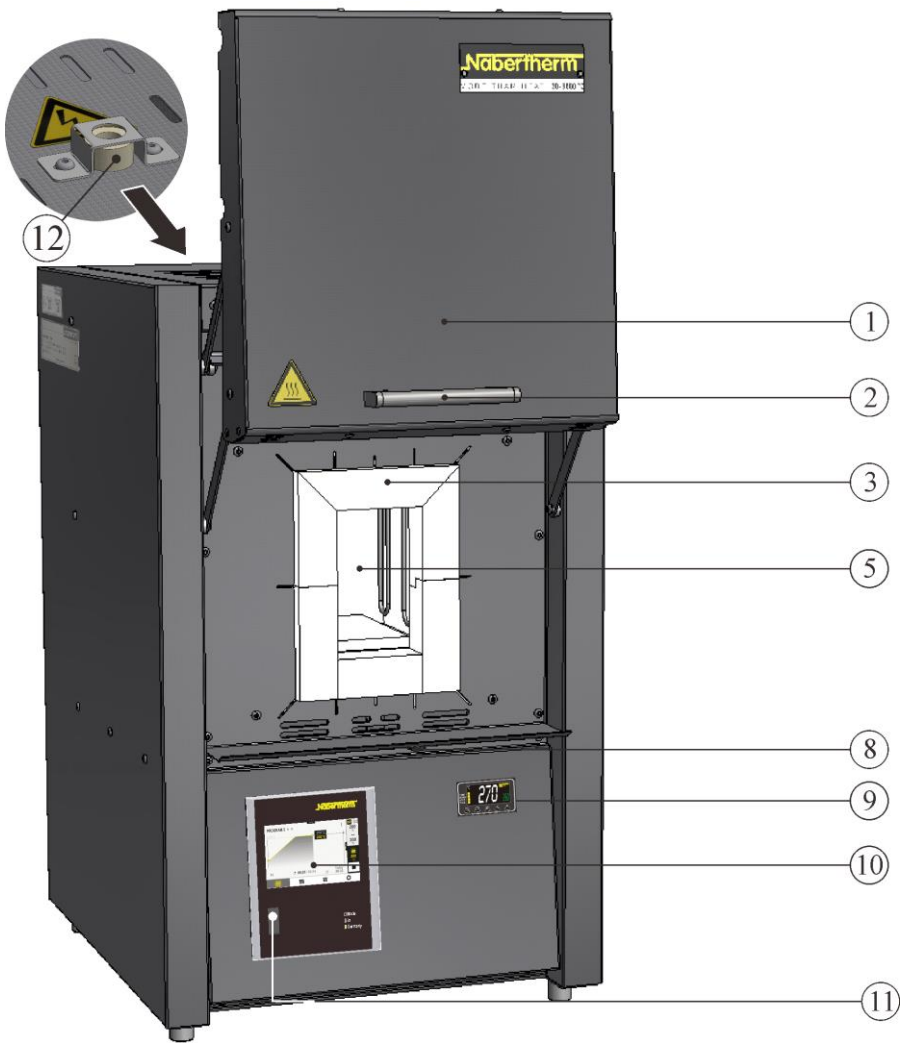
- LHT 01/17 D - Rectangular saggar, can be stacked for charging in up to two levels
- LHT 03/17 D - Round saggar, can be stacked for charging in up to three levels
- Process control and documentation via VCD software package for monitoring, documentation and control

### 1.3 Complete Overview of the Furnace



**LHT 01/17 D** (similar to picture)

Fig. 1: High-temperature furnace (the figure shows a special design with over-temperature limiter)



**LHT 03/17 D** (similar to picture)

Fig. 2: High-temperature furnace (the figure shows a special design with over-temperature limiter)



Fig. 3: High-temperature furnace – rear view (similar to picture)

| No. | Name  |
|-----|---|
| 1   | Lift door   |
| 2   | Handle  |
| 3   | Insulation from non-classified fiber material   |
| 4   | Heating elements made from molybdenum disilicide ( $\text{MoSi}_2$ )  |
| 5   | Furnace chamber   |
| 6   | Thermocouple  |
| 7   | Floor plate LHT 01/17 D (accessory)   |
| 8   | Fresh-air flap to control fresh air   |
| 9   | Over-temperature limiter with manual reset as over-temperature protection for the furnace and the charge (additional equipment) |
| 10  | Controller P580 (LHT 01/17 D) or P570 (LHT 03/17 D)   |
| 11  | USB interface   |
| 12  | Exhaust air tube  |
| 13  | Power switch with integrated fuse (for switching furnace on/off)  |
| 14  | Additional power connection (for accessories)   |
| 15  | Fuse for additional power connection (for accessories)  |
| 16  | Ethernet interface (additional equipment)   |
| 17  | Power plug with snap-in coupling  |

**Additional Equipment**



Fig. 4: Example (similar to picture)

Over-temperature limiter with manual reset as over-temperature protection for the furnace and the charge



Fig. 5: Example (similar to picture)

**Protective gas connection for purging the furnace with non-flammable protective or reaction gases, not gas-tight**

Gas supply system (1) for non-flammable protective and reaction gases with shut-off valve and flow meter with control valve, piped and ready to connect (similar to picture)  
 As manual or automatic gas supply system

**Accessories**

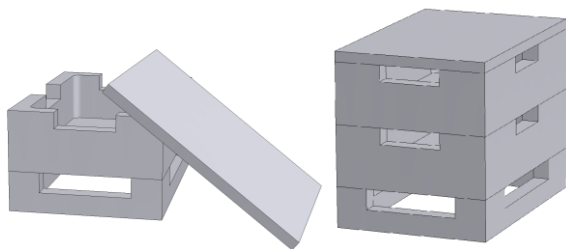


Fig. 6: Rectangular saggars with lid for LHT 01/17 D (similar to picture)

**Rectangular saggars**

For optimum utilization of the furnace chamber, the material is placed in ceramic saggars. Saggars can be stacked in several levels, depending on the furnace model. The saggars have slits to allow the air to circulate. The top saggars should be closed with a ceramic lid.

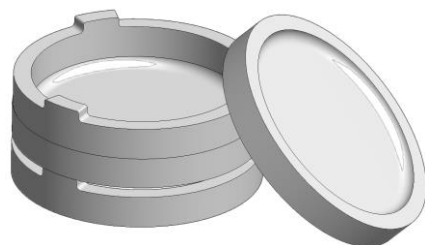


Fig. 7: Round saggars for LHT 03/17 D (similar to picture)

**Round saggars**

Saggars are recommended when working with zirconium oxide. A saggars consists of the sintering bowl as the bottom part and the spacer ring with ventilation openings. The material is very resistant to temperature changes and can also be used with short heating and cooling times.

## 1.4 Key to the Model Names

| Example             | Explanation  |
|---------------------|--|
| LHT 03/17 D         | LHT = High-Temperature Furnace   |
| LHT <b>03</b> /17 D | <b>01</b> = 1 liter furnace chamber (volume in L)<br><b>03</b> = 4 liter furnace chamber (volume in L) |
| LHT 03/1 <b>7</b> D | <b>17</b> = Tmax 1650 °C (3002 °F)   |
| LHT 03/17 <b>D</b>  | <b>D</b> = Dental model  |

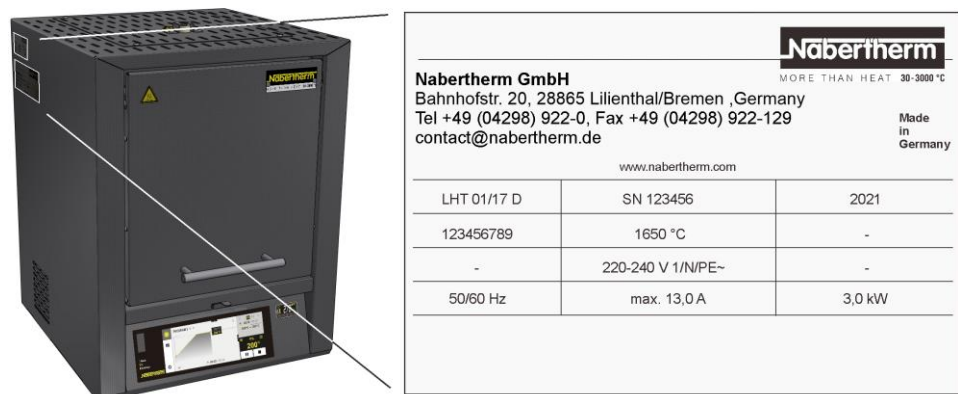










Fig. 8: Example model designation (type plate)

## 1.5 Scope of Delivery

The scope of supply includes:

|   | System component                           | Quantity | Comment         |
|---|--|----------|-----------------|
|   | High-Temperature Furnace LHT ../17 D       | 1 x      | Nabertherm GmbH |
|  | Allen key                                  | 1 x      | Nabertherm GmbH |
|  | Exhaust air pipe                           | 1 x      | Nabertherm GmbH |
|  | Mains power cable                          | 1 x      | Nabertherm GmbH |
|  | Charge saggars (starter-set) <sup>1)</sup> | 1 x      | Nabertherm GmbH |
|  | Sintering dish/Spacer ring <sup>2)</sup>   | 4)       | Nabertherm GmbH |
|  | Gas supply system <sup>1)</sup>            | 1 x      | Nabertherm GmbH |

|   |  |       |                        |
|---|--|-------|------------------------|
|  | Process documentation VCD software package <sup>2)</sup> | 1 x   | Nabertherm GmbH        |
|   | Other components depending on variant                    | - - - | See delivery documents |

|  | Type of document  | Quantity | Comment         |
|---|---|----------|-----------------|
|   | Operating instructions, High-Temperature Chamber Furnace                | 1 x      | Nabertherm GmbH |
|   | Operating instructions, controller                                      | 1 x      | Nabertherm GmbH |
|   | Operating instructions, over-temperature limit controller <sup>1)</sup> | 1 x      | Nabertherm GmbH |
|   | Operating instructions for gas injection pane <sup>2)</sup>             | 1 x      | Nabertherm GmbH |
|   | Operating Instructions VCD software package <sup>2)</sup>               | 1 x      | Nabertherm GmbH |
|   | Other documents depending on variant                                    | 1 x      |                 |

<sup>1)</sup>in scope of delivery depends on design/furnace model

<sup>2)</sup>in scope of delivery depend on need, see shipping papers

<sup>3)</sup>quantity depends on furnace model

<sup>4)</sup>quantity depends on on need, see shipping papers



#### Note

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



#### Note

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

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

## 2 Specifications



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

| Model          | T <sub>max</sub><br>°C | Inner dimensions<br>in mm |     |     | Volume<br>in L | Maximum<br>units | Outer dimensions<br>in mm |     |                  | Weight<br>in kg | Minutes<br>to T <sub>max</sub> <sup>1</sup> |
|----------------|------------------------|---------------------------|-----|-----|----------------|------------------|---------------------------|-----|------------------|-----------------|---|
|                |                        | b                         | d   | h   |                |                  | W                         | D   | H+c <sup>2</sup> |                 |   |
| LHT 01/17<br>D | 1650                   | 110                       | 120 | 120 | 1              | 30               | 385                       | 425 | 525+195          | 28              | 10  |
| LHT 03/17<br>D | 1650                   | 135                       | 155 | 200 | 4              | 75               | 470                       | 630 | 760+260          | 75              | 60  |

<sup>1</sup>when connected to 230 V, 1/N/PE (incl. saggar)

<sup>2</sup>including open lift door

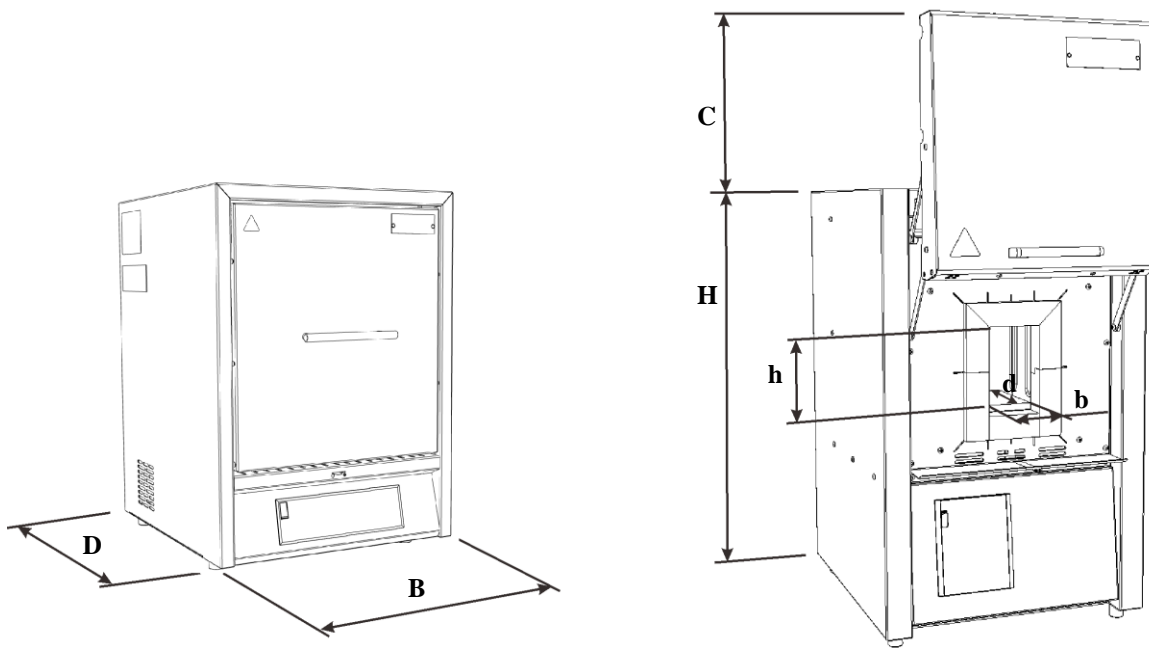


Fig. 9: Dimensions

| Model                                       | Electrical connection:          | Voltage<br>in V                              | Amperage<br>in A | Connected load<br>in kW | Frequency<br>in Hz |
|---|---------------------------------|--|------------------|-------------------------|--------------------|
| LHT 01/17 D                                 | 1/N/PE or 2/PE                  | 220 - 240                                    | 14.8             | 2.2                     | 50 or 60           |
| LHT 03/17 D                                 |                                 | 220 - 240                                    | 13.0             | 3.0                     | 50 or 60           |
| Thermal protection type                     | Furnace                         | according to EN IEC 60519-1                  |                  |                         |                    |
| Protection type                             | Furnace                         | IP20   |                  |                         |                    |
| Ambient conditions for electrical equipment | Temperature:<br>Humidity:       | +5 °C to + 40 °C max.<br>80% non-condensing  |                  |                         |                    |
| Weights                                     | Furnace with accessories        | Depending on design (see shipping documents) |                  |                         |                    |
| Emissions                                   | Continuous sound pressure level | < 70 dB(A)                                   |                  |                         |                    |

### 3 Warranty and Liability



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

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

- All persons involved in operation, installation, maintenance, or repair of the furnace must have read and understood the operating instructions. No liability will be accepted for damage or disruption to operation resulting from non-compliance with the operating instructions.
- Not using the furnace as intended
- Improper installation, start-up, operation, or maintenance of the furnace,
- Operation of the furnace with defective safety equipment or improperly installed or



non-functioning safety and protective equipment

- Not observing the information in the operating instructions with respect to transportation, storage, installation, start-up, operation, maintenance, or equipping the furnace
- Making unauthorized changes to the furnace
- Making unauthorized changes to the operating parameters
- Making unauthorized changes to the parameterization, the settings, or the program
- Nabertherm accepts absolutely no liability for damage caused by using parts that are not original Nabertherm parts. Original parts and accessories are designed especially for Nabertherm furnaces. Replace parts only with original Nabertherm parts. Otherwise the warranty will be void.
- Catastrophes due to third-party causes and force majeure

## 4 Safety

### 4.1 Defined Application



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

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

Furnaces in this series are suitable for sintering technical ceramic pieces such as bridges and crowns made of zirconium oxide.

The use of paint solvents can lead to accelerated wear of the heating elements. If solvents are used, good pre-drying is necessary to minimize their impact on the heating elements.

#### **Improper furnace operation:**

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



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

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



#### Note

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



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

The furnace must not be used to heat the workplace.

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

Do not use the furnace as a clothes dryer.

#### The operator is liable for any resulting damages.



#### For all furnace systems

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

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

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



#### Note

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

## 4.2 Requirements for the Furnace Operator



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

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

#### The Operator must ensure that

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

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

The use of paint solvents can lead to accelerated wear of the heating elements. If solvents are used, good pre-drying is necessary to minimize their impact on the heating elements.



**Note**

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

### 4.3 Requirements for the Operating Personnel





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

Only adequately qualified and authorized persons may operate, maintain, and repair the system.

These personnel are informed regularly about all issues involving occupational safety and environmental protection and are familiar with all the operating instructions, especially those involving safety,

Only trained personnel may operate the control and safety equipment.

|   |  |
|---|--|
|  |  <b>DANGER</b>  |
|   | <ul style="list-style-type: none"> <li>• <b>Danger caused by incorrectly entered cut-off temperature at the over-temperature limiter/over-temperature limiter with motor driven reset</b></li> <li>• <b>Risk of fatal injury</b></li> <li>• If, as a result of over-temperature from the charge and/or the operating equipment, a charge is likely to be damaged at this pre-set cut-off temperature of the over-temperature limiter/over-temperature limiter with motor driven reset, or if the charge itself becomes a source of danger for the furnace or its surroundings, the cut-off temperature must be reduced on the over-temperature limiter/over-temperature limiter with motor driven reset to the maximum permissible value.</li> </ul> |

#### 4.4 Protective Clothing



Wear protective clothing



Wear goggles to protect your eyes.



Wear heat-resistant gloves to protect your hands.

#### 4.5 Basic Measures During Normal Operation



##### Risks during normal operation

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

Each time, before starting production check and ensure that all the safety equipment functions as intended (for example, that the contact safety switch switches the heating off when the lid is opened).

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

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

**At least once every day (see also Servicing and Maintenance) check the following:**

- Check the furnace for obvious external damage (visual check), for example insulation, heating elements, power cable, exhaust gas system, if applicable.

- Check that all safety equipment is functioning (for example, that the contact safety switch switches the heating off when the door is opened).

## 4.6 Basic Measures in Case of Emergency

### 4.6.1 What to Do in an Emergency



**Note**

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

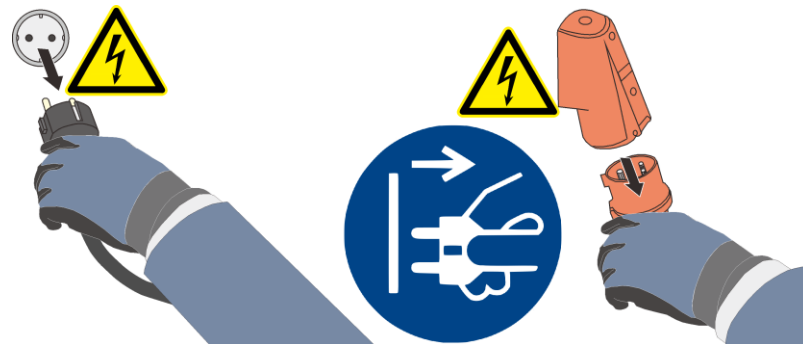


Fig. 10: Pull the power plug (similar to picture)



**Risks during Normal Operation!**

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

In case of fire, keep door and the air feed lever closed. This will allow you to prevent the spread of smoke and keep out a supply of oxygen.





### **Warning – Danger of Electric Shock!**

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

## **4.7 Basic Measures for Servicing and Maintenance**



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

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

Clear an adequate area around the system to facilitate the repair work.

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

Relieve the pressure on hydraulic and pneumatic equipment before carrying out maintenance or repair work. (if applicable).

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

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

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

## **4.8 Environmental Regulations**

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

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

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

- lubricating grease and oils
- hydraulic oils
- refrigerants
- solvent-based cleaning fluids must not be allowed to contaminate the soil or enter the sewage system.

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



### **Note**

The operator must ensure that national environmental regulations are observed.

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

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

#### 4.9 General Risks with the Furnace



##### Warning – General hazards!

Risk of burning on the furnace housing

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

Risk of crushing from moving parts (door hinges)

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

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

##### Risk of fire if using an extension cable:

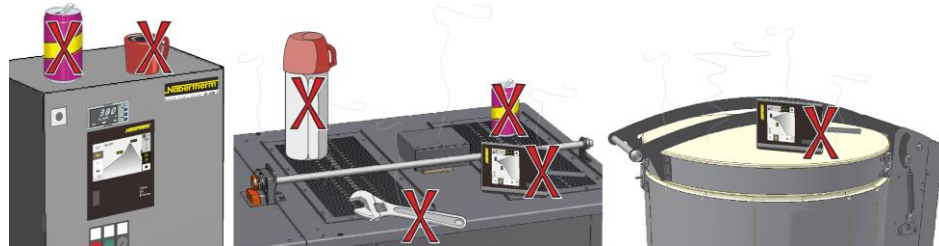
For all furnace models with a plug-in connection:

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



##### Warning – General Hazards




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





##### Warning – Influence on Implants from Electromagnetic Fields

It can be assumed that there is no risk from **electromagnetic fields**. Deviating from this, there may be a risk for people with active implants (such as a pacemaker, insulin pump) and passive implants, as the function of the implant may be affected also with a field strength below the permissible threshold. Proper function must be ensured on the basis of the technical specifications of the implant through an individual assessment by a suitable expert (for example, an occupational physician).



|   |   |   |
|---|---|---|
|  |  <b>DANGER</b>   |  |
|   | <ul style="list-style-type: none"> <li>• <b>Danger from electrocution</b></li> <li>• <b>If there is no earth connection, or the earth connection is poorly connected, the result may be a deadly electrical shock.</b></li> <li>• Do not insert any metallic objects such as thermocouples, sensors or tools into the furnace chamber without having previously ensured that the plant has been correctly earthed. Entrust the job of making a earth connection between the object and the furnace housing to a qualified electrical technician. Any objects inserted into the furnace must be inserted only through those openings intended for this purpose.</li> </ul> |   |



|   |  |
|---|--|
|  |  <b>DANGER</b>   |
|   | <ul style="list-style-type: none"> <li>• <b>Danger caused by incorrectly entered cut-off temperature at the over-temperature limiter/over-temperature limiter with motor driven reset</b></li> <li>• <b>Risk of fatal injury</b></li> <li>• If, as a result of over-temperature from the charge and/or the operating equipment, a charge is likely to be damaged at this pre-set cut-off temperature of the over-temperature limiter/over-temperature limiter with motor driven reset, or if the charge itself becomes a source of danger for the furnace or its surroundings, the cut-off temperature must be reduced on the over-temperature limiter/over-temperature limiter with motor driven reset to the maximum permissible value.</li> </ul> |

#### 4.10 Safeguarding against Dangers from Excess Temperatures

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

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



|   |  |
|---|--|
|  |  <b>DANGER</b>  |
|   | <ul style="list-style-type: none"> <li>• <b>Danger caused by incorrectly entered cut-off temperature at the over-temperature limiter/over-temperature limiter with motor driven reset</b></li> <li>• <b>Risk of fatal injury</b></li> <li>• If, as a result of over-temperature from the charge and/or the operating equipment, a charge is likely to be damaged at this pre-set cut-off temperature of the over-temperature limiter/over-temperature limiter with motor driven reset, or if the charge itself becomes a source of danger for the furnace or its surroundings, the cut-off temperature must be reduced on the over-temperature limiter/over-temperature limiter with motor driven reset to the maximum permissible value.</li> </ul> |

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

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



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

Fig. 11: Removing the sticker (similar to picture)

## 5 Transportation, Installation and Initial Start-Up

### 5.1 Delivery

#### Check that Everything is Complete

Compare the delivered items with the delivery note and the purchase order documents.

**Immediately** notify the carrier and Nabertherm GmbH of any missing or damaged parts, as complaints at a later date cannot be acknowledged.

#### Danger of Injury

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

#### Safety Instructions

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

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



#### Risks during Normal Operation!

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



#### Note

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

#### Transportation with a Pallet Truck

Observe the maximum permitted capacity of the pallet truck.

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

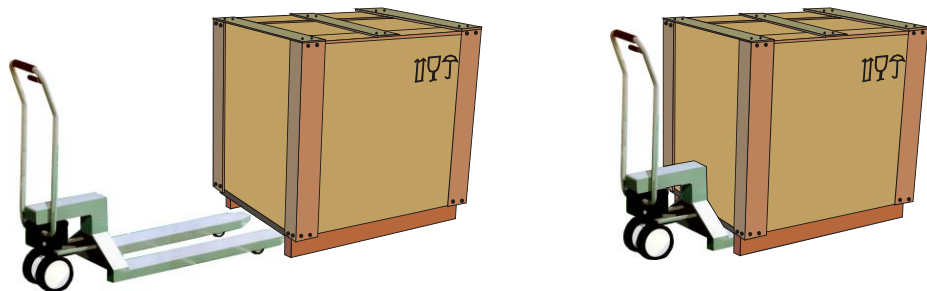


Fig. 12: Pallet truck is pushed **completely** beneath the transportation frame

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

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

**Symbols:**

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

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

## 5.2 Unpacking



**Note**

Keep the packaging unit and transportation protection in case you have to return the furnace. Install the transportation protection in the reverse order, as shown in “Transportation Protection/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.

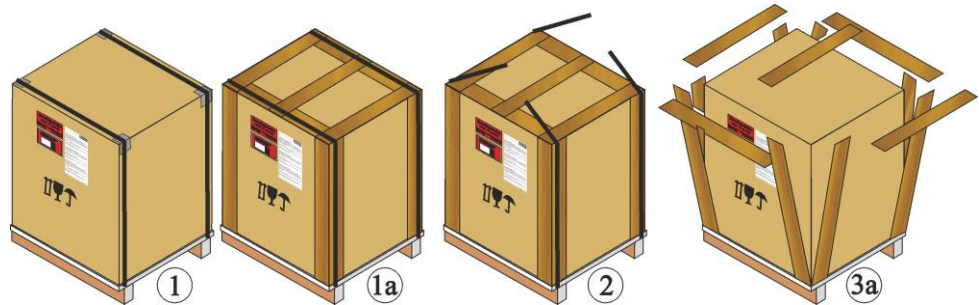
Because we use several different packaging units, we recommend that you take a few photos of the furnace in its original packaging.

|  |   |  |
|--|---|--|
|  | <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> |  |

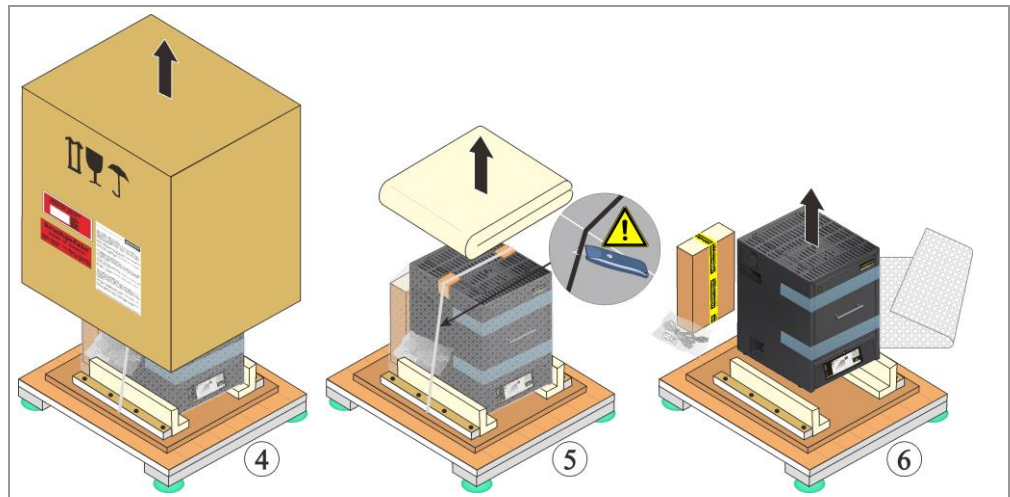
1. Check the transport packaging for any signs of damage. The packaging differs depending on size, weight or installation site and, based on this, is provided in one of the following ways. On a pallet, in a wooden cage or in a wooden box.



Wear protective gloves



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



5. A flat box containing the accessories for your furnace is located on the rear wall of the furnace. Compare the scope of delivery with the delivery note and the order documents, see chapter "Delivery". Loosen screws or nails from the retaining strips and remove.



6. To carry, grip furnace from below at the sides and make sure you have a firm grip.

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



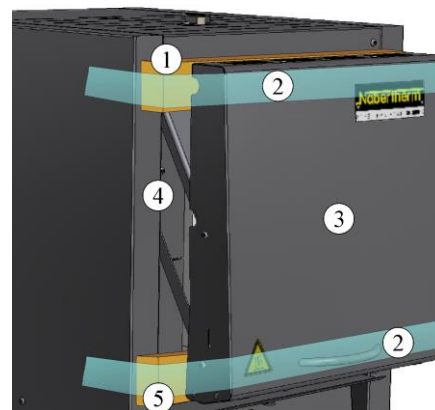
**Note**

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

### 5.3 Transport Securing Device/Packaging

To protect against transportation damage, the furnace is equipped with a transportation lock, which must be removed before commissioning the furnace.

**First** remove the adhesive strips and then pull out the transportation lock. Pulling the furnace door slightly towards you makes it easier to remove the transportation lock from the furnace (see figure: Removing the transportation lock).



- 1 Remove transportation lock upwards
- 2 Remove adhesive strip
- 3 Furnace lift-door
- 4 Furnace housing
- 5 Remove transportation lock downwards

Fig. 13: Removing the transportation lock (similar to picture)



**Note**

Save the transportation lock for possible shipping or for storing the furnace. To avoid damage to the furnace door insulation in the event of reshipping, the furnace must be locked again as shown in the above figure.

### 5.4 Constructional and Connection Requirements

#### 5.4.1 Location of the Furnace

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

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

- The floor covering must be made of non-flammable material so that hot material falling out of the furnace will not cause the floor covering to ignite.

### Installation Location

- The operator is responsible for adequate ventilation by installing the appropriate systems to supply fresh air and to vent exhaust air. If a batch emits gases or vapors, adequate ventilation of the installation site must be provided as well as a suitable exhaust air venting system. A suitable vent for combustion exhaust must be supplied by the customer
- Make sure that the heat radiated by the furnace is vented (consult a ventilation expert, if necessary)
- Although the furnace is well-insulated, the exterior surfaces of the furnace radiate heat. If necessary, this heat must be dissipated (**a ventilation technician may need to be consulted**). In addition, a minimum clearance (**S**) of 0.5 m on all sides and 1 m above the furnace must be maintained to flammable materials. In individual cases, more space must be chosen in order to match the local conditions. For **nonflammable materials**, the minimum **side** clearance can be reduced to 0.2 m.
- The furnace must be protected against weather and caustic atmospheres. Nabertherm accepts no liability or warranty claim for any corrosion damage as a result of installation in damp surroundings or for similar reasons.

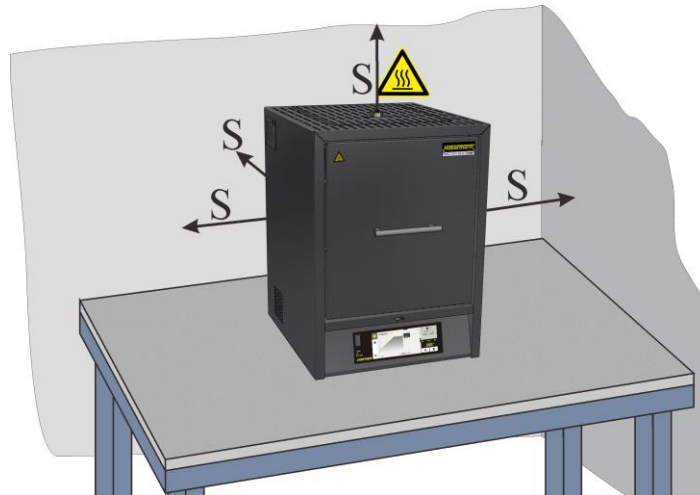




Fig. 14: Minimum safety distance to flammable materials (Table-top model) (similar to picture)


|   |  |
|---|--|
|  |  <b>DANGER</b>   |
|   | <ul style="list-style-type: none"> <li>• <b>Risk of 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 remove exhaust heat and exhaust gases</li> </ul> |



### Note

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

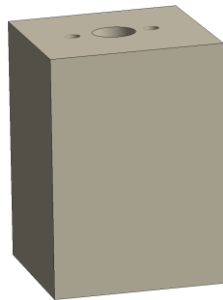


|   |   |
|---|---|
|  | <p style="text-align: center;"><b>⚠ DANGER</b></p> <ul style="list-style-type: none"> <li>• <b>Danger associated with the use of an automatic extinguishing system</b></li> <li>• <b>Danger to life from electrocution through wetness, suffocation caused by extinguishing gas, etc.</b></li> <li>• If automatic extinguishing systems are in place to fight fires and protect the building, e.g. sprinkler systems, care must be taken during their planning and installation that no additional hazards are created, for example by extinguishing a pilot light, mixing hardening oil and extinguishing water, shutdown of electrical equipment, etc.</li> </ul> |
|---|---|

## 5.5 Assembly, Installation, and Connection

### 5.5.1 Installing the Insulation Block and Exhaust Air Tube (only LHT 01/17 D)

To avoid damaging the furnace insulation and also the insulation block and exhaust air tube, both are delivered in a separate package. Before initial start-up, the insulation block and exhaust air tube must be inserted and secured in the intended opening. The furnace must not be started without the insulation block and exhaust air tube in place.



Insulation block (only LHT 01/17 D)

Exhaust air tube

Fig. 15: Included in scope of delivery (similar to picture)

#### Removing the protective plate of the exhaust air tube

Use a suitable tool to undo the screws on the protective plate of the exhaust air tube. Place the screws and the protective plate in a safe place so that they can be reused (disconnect the plug).

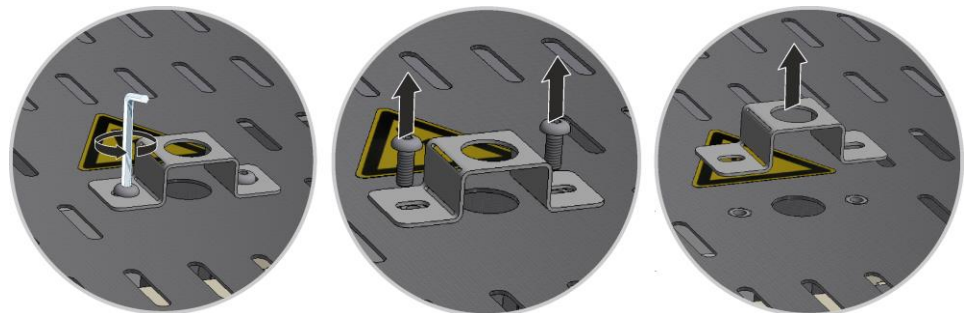


Fig. 16: Removing the protective plate from the exhaust air tube (similar to picture)

### Removing the top cover from the furnace housing

Unscrew all the screws of the panel with a suitable tool and keep them in a safe place for future use.

The number and position of the screws may differ from one furnace model to the next. The furnace may look different than the picture depending on the furnace model and features.

The cover must be lowered onto a soft material (such as foam rubber).

If present, pay attention to the protective ground cable of the back wall to the clamp. If necessary, disconnect the cable from the clamp.



Fig. 17: Removing the cover on model LHT 01/17 D (similar to picture)

### Installing the insulation block

Carefully remove the packaging from the insulation block. Place the insulation block on the center of the hole in the top of the furnace. Make sure that the two top holes (A) are parallel to the top of the furnace housing.

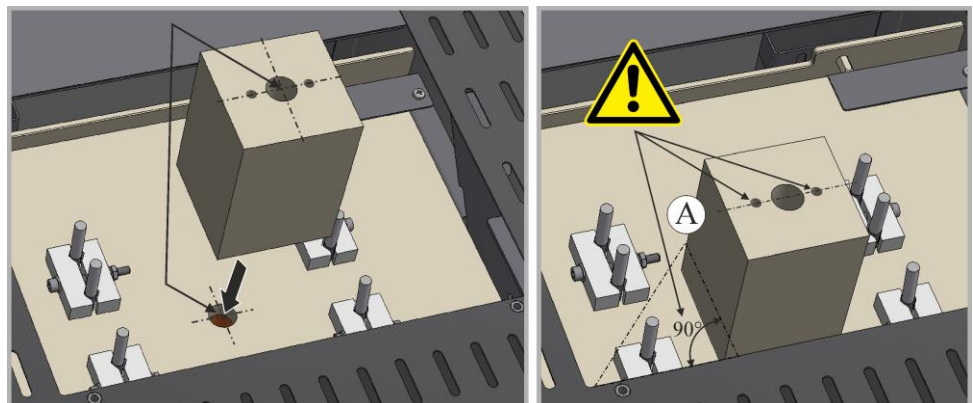


Fig. 18: Installing the insulation block (similar to picture)

### Positioning and installing the cover

Place the cover on the furnace housing and fix it in place with the screws that were previously removed.



Fig. 19: Installing the cover on model LHT 01/17 D (similar to picture)

### Installing the exhaust air tube

Carefully slide the exhaust air tube into the opening. The top of the exhaust air tube must sit on the furnace cover. Reinstall the protective metal sheet of the exhaust air tube with the screws that were previously removed.



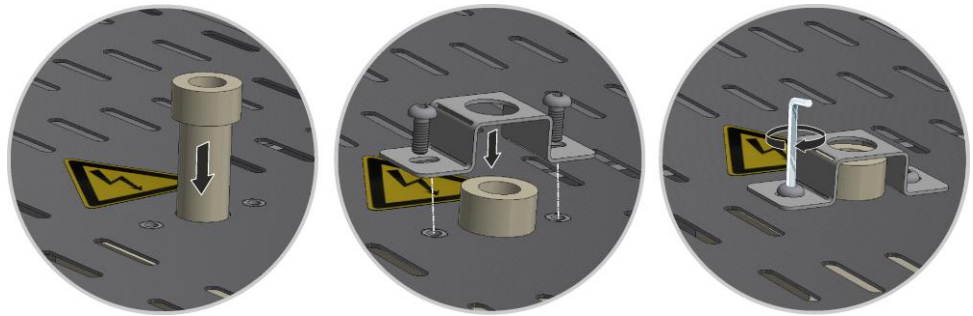


Fig. 20: Installing the exhaust air tube (similar to picture)



**Caution**

Make sure that no cables poke out or are caught. Beware of sharp edges.



**Note**

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

### 5.5.2 Venting Exhaust Fumes

We recommend connecting an exhaust air pipe to the furnace to remove the exhaust gases. For this purpose you can use a commercially available, metal exhaust gas pipe with NW80 to NW120. It must be installed continuously rising and fastened to the wall or ceiling. Center the pipe over the furnace vent.

The exhaust gas pipe must not be installed with a tight fit to the furnace vent pipe since this would prevent any bypass effect. This is necessary so that not too much fresh air is sucked in by the furnace.

We recommend feeding the exhaust air through a flue.

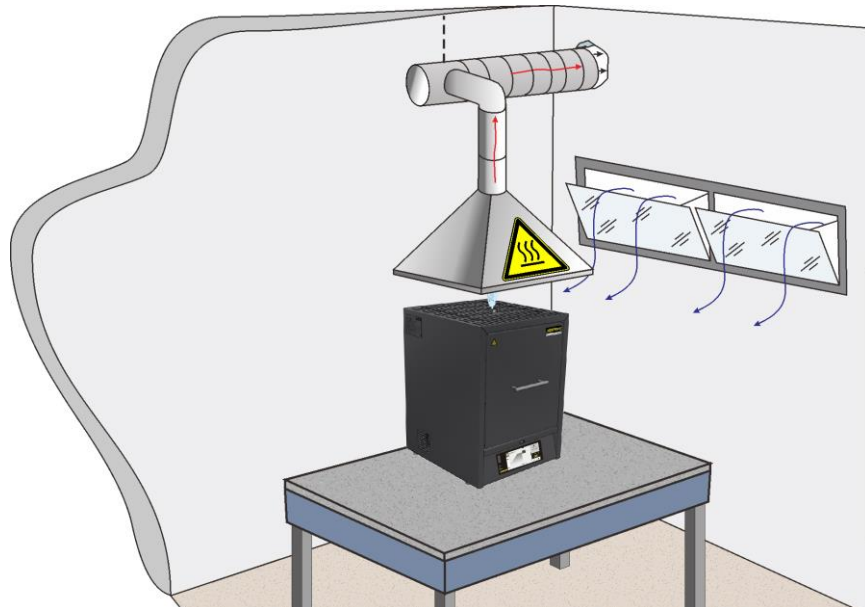


Fig. 21: Example: Assembling exhaust air piping (similar to picture)



**Caution**

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

**Note**

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

**Note**

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

### 5.5.3 Connecting the Furnace to the Power Supply

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

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

**Note**

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

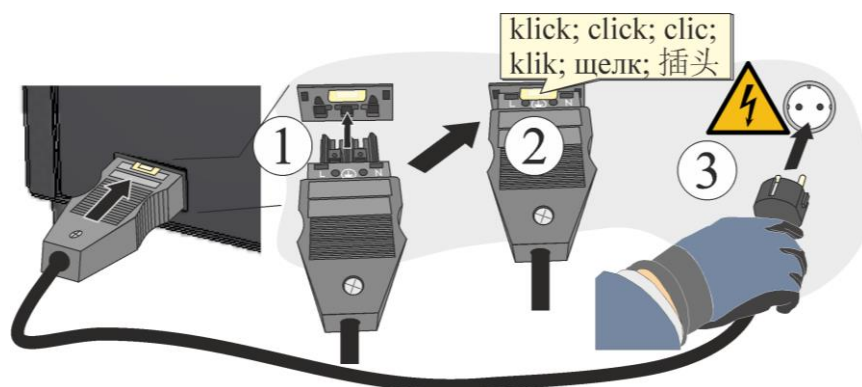


Fig. 22: Depending on model – supplied power cable included in scope of delivery (illustration similar)

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



**Note**

The national regulations of the respective country of operation apply.



**Warning – Danger of Electric Shock!**

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



**CAUTION**

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



**DANGER**

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

**5.6 Initial Start-Up**

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

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

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

The furnace may be used only for its intended purpose.

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

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

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

Incorrectly wired connections may destroy electric/electronic components.

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

Faulty connections can cause the furnace to start unexpectedly.

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

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

Before placing materials in the furnace, check whether they could harm or destroy the insulation or the heating elements. Materials that could damage the insulation include:

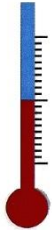
alkalis, alkaline earths, metal vapors, metal oxides, chlorine compounds, phosphorous compounds, and halogens.



**Note**

Use the pre-set program to create a protective oxide coating on the heating elements (see “Pre-Set Programs”).

### 5.6.1 Molybdenum Disilicide (MoSi<sub>2</sub>) Heating Elements



To generate a protective oxidated layer on the heating elements the furnace must be heated to below the maximum temperature 100 °C (212 °F) for approx. 5 hours (Example: The furnace is designed for a maximum temperature of approx. 1750 °C (3182 °F), hence a temperature of approx. 1650 °C (3002 °F) should be entered on the controller. But this temperature must be reached over the full period of five hours).

The entered temperature (example: 1650 °C (3002 °F)) should be held for approx. 5 hours. This process should be executed during the start-up, after replacing the heating elements or to regenerate the oxide layer.

When the furnace is heated up for the first time, annoying odors may result, these are do to the escape of binding agents from the insulation material. We recommend that the furnace location be well ventilated during the first warm-up phase. Let the furnace cool down naturally to room temperature.



**Note**

Use the pre-set program to create a protective oxide coating on the heating elements (see “Pre-Set Programs”).

**Chemical Resistance:**



Furnaces heated with molybdenum disilicide elements (MoSi<sub>2</sub>) are available for max. furnace chamber temperatures of 1600, 1750 and 1800 °C. The max. furnace chamber temperature refers to operation in air. At temperatures of over 800 °C, a layer of silicon oxide occurs on the surface of the heating element, protecting it against further oxidation. Such a protective layer is not formed at low temperatures. If the surface of the element is not protected, molybdenum and silicon oxidation can take place at temperatures of around 550 °C. This leads to the occurrence of a yellowish powder consisting primarily of molybdenum oxide (MoO<sub>3</sub>). This chemical reaction has no disadvantageous effects on the performance of the heating element.

If **non-combustible protective gases** are used, the max. permissible furnace chamber temperature is **reduced** to 100 °C (212 °F). When using forming gases (95/05 N<sub>2</sub>/H<sub>2</sub> or 98/02 Ar/H<sub>2</sub>) oxidation burns at regular intervals are necessary and signs of increased wear can appear on the heating elements and the insulation.

**Resistance to Metals and Oxides:**

The heating elements should never come into contact with solid materials.

**Metals:**

In an oxidizing atmosphere, the majority of metals form scale on the surface (oxide formation occurs due to a thermal influence in an oxidizing atmosphere). This metal oxide may react with the silicon oxide of the heating element and shorten its service life. If the furnace is used to melt metals, it must be ensured that the furnace chamber is protected against metal splashes, soiling and vapors which occur during the melting process

(particularly due to fluxing agents). Metal oxides also strongly corrode the insulation of the furnace.

**Alkalines:**

Alkaline compounds may corrode the heating elements. Alkaline compounds also lead to rapid destruction of the insulation.

**Ceramic:**

Ceramic may destroy the heating element on direct contact. Salts and oxides from the ceramic may additionally react with the silicon oxide of the heating element and shorten its service life.

**Glass:**

If glass is melted, the furnace atmosphere contains contaminants, the composition of which depends on the relevant glass product. These components usually act as a fluxing agent on the silicon oxide layer. As a result, its viscosity is reduced and the silicon oxide flows slowly down the heating element. However, new silicon oxide is immediately formed again, with the result that the service life is not noticeably shortened. The insulation may also be severely corroded depending on the type of glass.

**Note**

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



The use of paint solvents can lead to accelerated wear of the heating elements. If solvents are used, good pre-drying is necessary to minimize their impact on the heating elements.

**Note**

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

**Notice**

Observe the safety instructions for furnace furniture (sinter bowls, saggars, etc.) in the “Stackable Saggars” section.

**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.

### Cracks in the Insulation

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

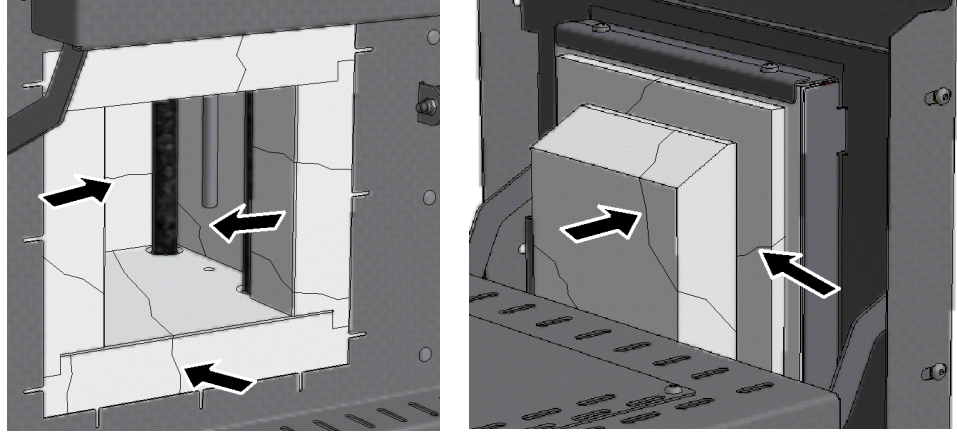
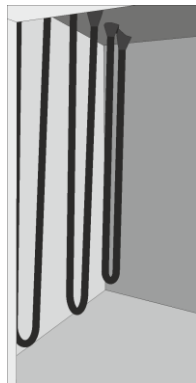


Fig. 23: Example: Cracks in the insulation after a few warm-up cycles (figure similar).

At the time of the first start-up and repeated heating up of the furnace one or more heating elements may become deformed.

It is due to the nature of molybdenum-disilicide in the heating elements that they tend to deform. But this appearance, however, has no influence on the function or quality of the furnace and, hence, is no reason for a complaint.



Before the first start-up



After the first start-up and/or after a few heating up phases.

Fig. 24: Example: Deformation of the heating elements made of molybdenum-disilicide

## 6 Operation

### 6.1 Controller

#### B510/C550/P580

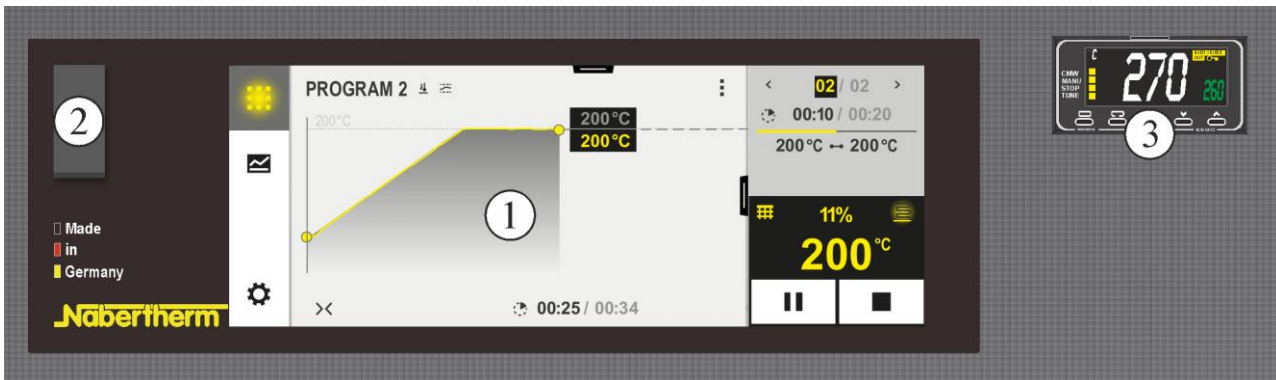


Fig. 25: Control field B510/C550/P580 (similar to picture)

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

#### B500/C540/P570



Fig. 26: Control field B500/C540/P570 (similar to picture)

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

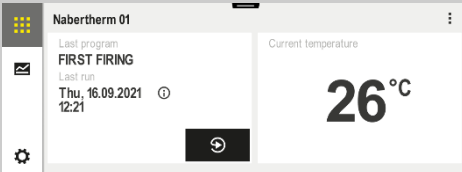


**Note**

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


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

### 7.1 Turning on the Controller/Furnace

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

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

### 7.2 Turning off the Controller/Furnace

| Turn off the controller   |   |   |
|---------------------------|---|---|
| Steps                     | Display   | Comments  |
| Turn off the power switch |  | Turn off the power switch by setting it to “O”<br>(power switch type differs depending on features/furnace model) |

## 8 Pre-Set Programs

The pre-set program for oxidation firings is stored in “P5” on the controller and should be used to create a protective oxide coating on the heating elements. This procedure should be carried out on start-up, when heating elements have been replaced or to regenerate the oxide layer. When the furnace is operated with reduction atmospheres (use of protective gas), this procedure must be repeated regularly.




**Note**

By default, the program for oxidation firings is stored in program location “P05”.




**Notice:** It is advisable to leave the values stored in P05 unchanged and to save changed programs only in the other program locations.

**Starting a program:**

Call up the stored program from the overview by pressing the  icon.

Select the program with program number “P05”.

The program is now loaded and can be started on the controller with the  button.

Acknowledge the subsequent security prompt by clicking “Yes”.

## 8.1 Over-Temperature Limiter with Manual Reset and Adjustable Cutout Temperature (Additional Equipment)

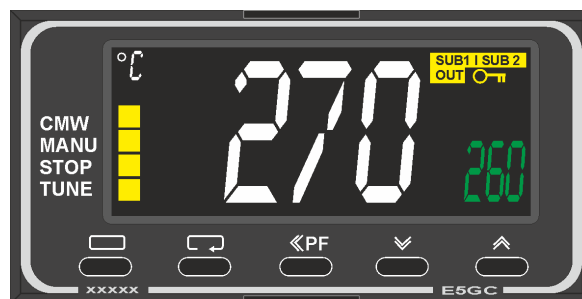









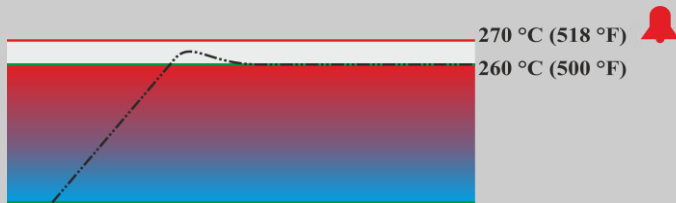






Fig. 27: Over-temperature limiter with manual reset (similar to picture)

| Button  | Description  | Display           |
|---|--|-------------------|
|   | The over-temperature limiter (2z) monitors the temperature in the furnace. The display shows the trigger temperature that was last set. If the furnace temperature rises above the set trigger temperature, the heating is switched off to protect the furnace and the charge. “ALM” alarm flashes on the over-temperature limiter.  | 260 °C<br><br>ALM |
|   | If the thermocouple sensor breaks, the over-temperature limiter switches the heating off to protect the furnace and the charge. “S.ERR” is displayed on the over-temperature limiter.  | S.ERR             |
|   | If the temperature in the furnace falls <b>below the value set on the over-temperature limiter</b> , press the following buttons to enable the heating so that the furnace can continue to operate:  |                   |
|   | <b>Enable heating:</b>   |                   |
|  | Press  for one second. The alarm message of the over-temperature limiter is reset and the heating is enabled.   |                   |
|   | <b>Setting the trigger temperature:</b>  |                   |
|  | Use the   buttons to set the required trigger temperature (example 270 °C)<br>Increase the value with  (260 ... 269, 270)<br>Decrease the value with  (270 ... 261, 260) | 270<br>↗<br>260   |

|   |   |               |
|---|---|---------------|
|   | <p>To change the value quickly: press and hold  .</p>  <p>270 °C (518 °F) <br/>260 °C (500 °F)</p> <p>Wait 1 second until the set trigger temperature is applied automatically. <b>Note:</b> Premature triggering of the over-temperature limiter can be avoided if the difference between the adjustable furnace temperature and the trigger temperature is not less than 10 °C.</p> |               |
|   | <p>The display jumps back to the start screen showing the trigger temperature. The current trigger temperature is displayed.</p> <p>Input finished.</p>   | <p>270 °C</p> |
|  | <p>For further information about operation, refer to the separate OMRON E5GC operating instructions.</p>  |               |

 **DANGER**



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

## 8.2 Air Inflow Lever

The volume of air fed to the furnace can be adjusted with the fresh air lever. The fresh air lever is located at the side of the door at the bottom. The position is explained by the symbols beside and on the lever.

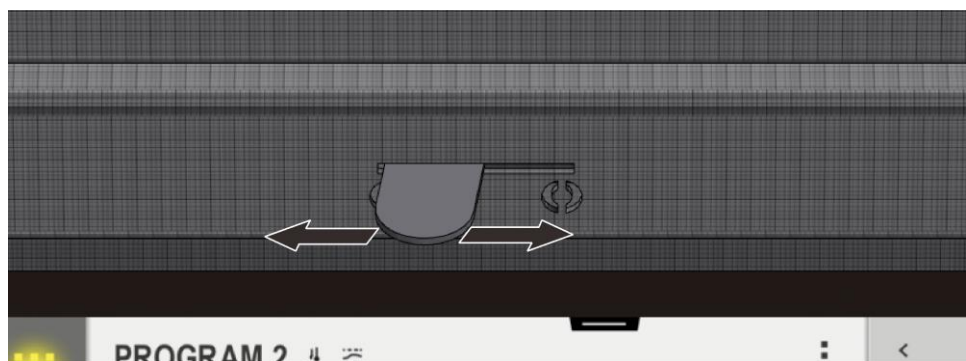


Fig. 28: Fresh air lever (figure similar)

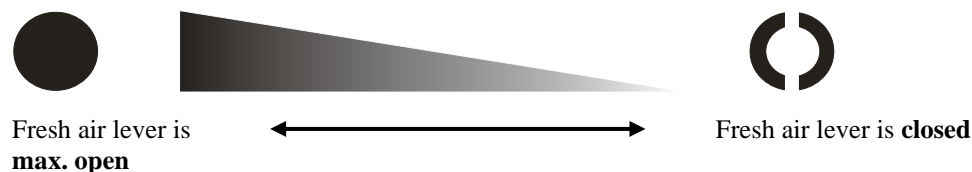


Fig. 29: Regulating the feed of fresh air (symbols)

**Note**

If the fresh air lever is open, under certain circumstances this may affect temperature uniformity in the furnace chamber.

**Note**

When the fresh air lever is opened fresh air is guided in the furnace chamber for drying or forced cooling. Please make sure that the fresh air lever is closed after drying in order to achieve a good temperature uniformity during sintering.

The application notes of the zirconia manufacturer should be generally taken into consideration in order to avoid damages at the charge e.g. due to fast cooling times.

## 8.3 Loading/Charging

### Furnace loading

Swivel the furnace door carefully away upwards.

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

When loading the furnace, ensure that the door collar and the heating elements are not damaged. Under all circumstances, avoid coming into contact with the heating elements when loading the furnace; this may lead to the immediate destruction of the heating elements.

If a large quantity of material is placed into the furnace chamber, the heating time may increase significantly.

If a crucible is used, make sure that the material to be melted is inserted carefully into the crucible. Crucibles are sensitive to shocks and impact. Metals expand more quickly and strongly than the crucible when heated. Be sure that the recommendations of the crucible manufacturer for maintenance and handling are carefully observed.

After loading, the furnace door must be closed carefully. The furnace door should be closed gently in order not to damage the insulation. Make sure that the door is closed correctly.

If possible, the furnace must **not** be opened when hot. If it has to be opened at a high temperature, this should take place as briefly as possible. Attention must be paid to adequate protective clothing and room ventilation, see chapter "Safety".

The stainless steel sheet may become discolored (particularly on opening when hot), but this does not impair the function of the furnace.

### Additional care measures

Ensure that objects like teapots, bottles, and similar items are kept away from the furnace.

### 8.3.1 Stackable Saggar

#### Saggar for sintering furnaces LHT 01/17 D

Nabertherm offers special-purpose saggars for charging the furnace.

For optimum utilization of the furnace chamber, the material is placed in ceramic saggars. The saggars have slits to allow the air to circulate. The container can be closed with a ceramic lid.

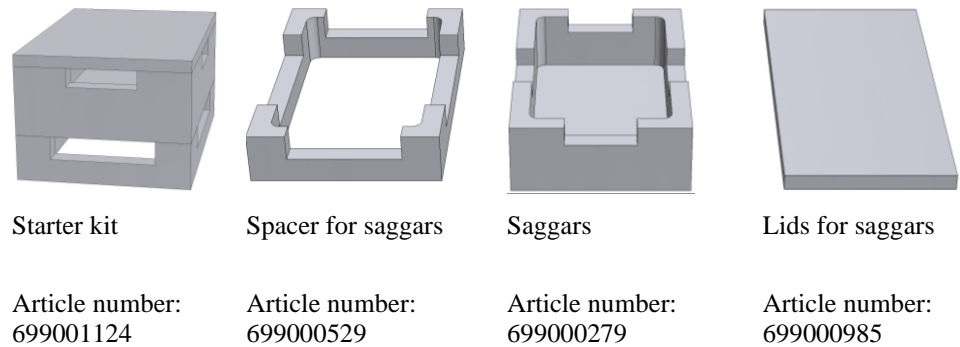


Fig. 30: Saggars with lid



**Note**

The accessories described above are designed for cold charging and discharging. Removing the accessories in hot condition is not possible.

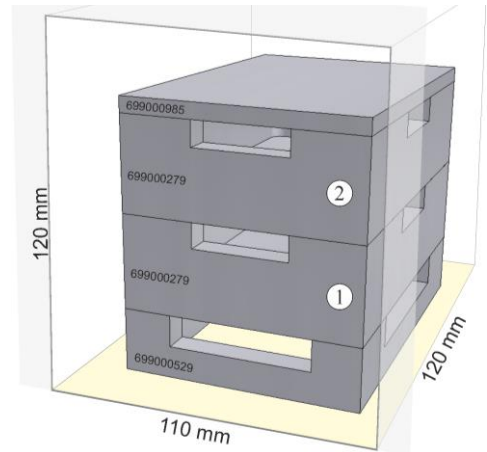
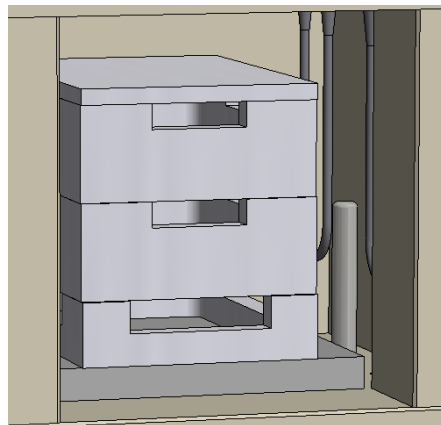


Fig. 31: Safe charging on up to 2 levels (similar to picture)

The lowest charge saggars must be positioned in the middle on the floor board (ceramic insert board) to ensure uniform heating of the charge.

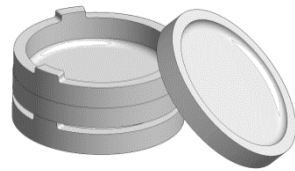
When charging make sure that neither the door collar nor the heating elements are damaged. Make absolutely no contact with the heating elements. Any contact with the heating elements can result in their destruction.

After charging, the furnace door must be closed carefully. The insulation of the furnace door must not push the charge saggars into the furnace chamber.

### Saggar for sintering furnaces LHT 03/17 D

Nabertherm offers special-purpose saggars for charging the furnace.

A saggar basically consists of the sintering dish as base and the spacer ring with ventilation openings. The material is highly resistant to temperature fluctuations and can be used for processes with short heat-up and cool-down times.



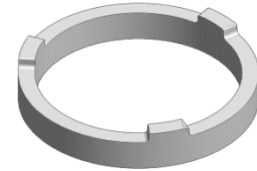
Starter-Set

Article No.: 699001066



Sintering Dish

Article No.: 699001054



Spacer Ring with Ventilation Openings

Article No.: 699001055

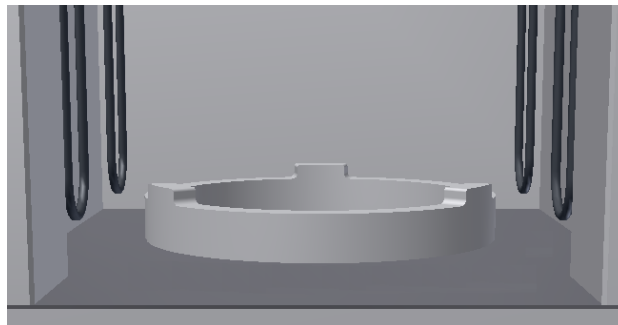
Fig. 32: Charge Saggar



#### Note

The accessories described above are designed for cold charging and discharging. Removing the accessories in hot condition is not possible.

When charging the furnace it must be ensured that the lower charge carrier is generally resting on the spacer ring. This provides for air-circulation under this carrier and improves the temperature uniformity. It is recommended to cover upper saggar with another sintering dish as **lid**.



For the protection of the sensitive furnace floor we recommend that you make it a general rule to leave the lowest spacer ring in the furnace. The spacer ring must be positioned in the middle of the floor. This ensures uniform heating of the charge. When setting down/lifting the sintering

dishes/spacer rings, they must always be raised slightly to prevent any unwanted sideways movement of the sintering dishes/spacer rings.

Fig. 33: Spacer ring (similar to picture)

The starter set consists of a charge saggar, a spacer ring as a base and a second sintering dish as lid. The use of additional saggars (sintering dish and spacer ring) allows charging on additional levels. Both furnace models are designed to get charged with up to three charge saggars.

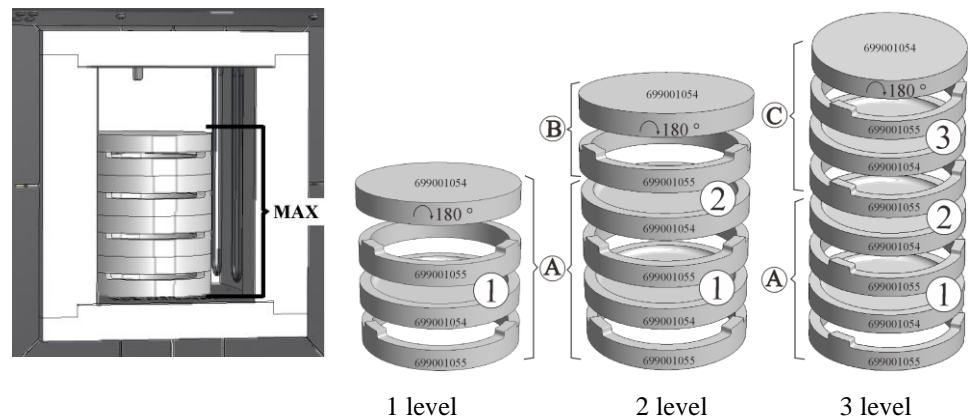


Fig. 34: Safe charging on up to three levels (similar to picture)

**Number of required charge levels in overview:**

- 1 level: Starter set which includes 2 sintering dishes and 2 spacer rings = (A)
- 2 levels: Starter set (A) + 1 sintering dish + 1 spacer ring (B)
- 3 levels: Starter set (A) + 2 sintering dishes + 2 spacer rings (C)



**Note**

The accessories described above are designed for cold charging and discharging. Removing the accessories in hot condition is not possible.

## 9 Servicing, Cleaning, and Maintenance



**Warning - General Hazards!**

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



**Warning - Danger due to Electrical Current!**

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



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

Operators may only correct malfunctions which are obviously due to operational error! Wait until the furnace chamber and attaching parts have cooled to room temperature.

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

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

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

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

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

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

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

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

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

## 9.1 Furnace Insulation

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

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



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

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

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

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

Smoking, eating and drinking at the workplace is prohibited.

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

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

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

## 9.2 Shutting the System Down for Maintenance

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

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



### **Warning - Dangers During Normal Operation!**

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



### **Warning – Danger of Electric Shock**

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

## 9.3 Regular Maintenance of the Furnace

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

| Component/ item/ function and action  | Comment                 | A | B | C  |
|---|-------------------------|---|---|----|
| <b>Safety test in accordance with DGUV V3 or corresponding national regulations</b><br>According to regulation  | According to regulation |   |   | X2 |
| <b>EMERGENCY STOP (if present)</b><br>Press the button  |                         |   | D | X1 |
| <b>Safety and limit switch (if present)</b><br>Function test  |                         |   | Y | X2 |
| <b>Furnace chamber, extraction holes and extraction tubes</b><br>Clean and inspect for damage, vacuum carefully |                         |   | M | X1 |
| <b>Sealing surfaces: Door collar/furnace collar</b><br>Visual inspection  |                         |   | D | X1 |



| Component/ item/ function and action   | Comment  | A | B                                | C  |
|--|--|---|----------------------------------|----|
| <b>Seals (if present)</b><br>Clean/replace   |  |   | W                                | X1 |
| <b>Heating elements/process insert hood (if present)</b><br>Visual inspection  |  |   | D                                | X1 |
| <b>Element holder screws, refer to “Checking Heating Element Screws” (if present)</b><br>Check the element holder screws and tighten carefully if required | <sup>1</sup> first time<br><sup>2</sup> subsequently   |   | W <sup>1</sup><br>Y <sup>2</sup> | X2 |
| <b>Check for uniform power consumption of the heating system</b><br>Function test  |  |   | Y                                | X2 |
| <b>Thermocouple</b><br>Visual inspection (visible part of the heating element inside the furnace chamber)  |  |   | D                                | X1 |
| <b>Lift bottom setting (if present)</b><br>Check that the lift bottom closes completely  |  |   | D                                | X1 |
| <b>Settings on over-temperature limiter (if present)</b><br>With each change to the heat treatment program   | With each change in the heat treatment program, check the cutout temperature (alarm value) on the over-temperature limiter |   |                                  | X1 |
| <b>Measurement and control accuracy</b><br>Calibration   |  |   | Y                                | X2 |
| <b>Switchgear fan</b><br>Function check  | Each start-up  |   | D                                | X1 |

**Key:** see “Maintenance Table Key”



**Warning – Danger of Electric Shock!**

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



**Notice**

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

## 9.4 Regular Maintenance Tasks – Documentation

| Component/ item/ function and action                                   | Comment | A | B | C  |
|--|---------|---|---|----|
| <b>Type plate</b><br>Legible   |         | - | Y | X1 |
| <b>Operating instructions</b><br>Ensure they are kept near the furnace |         | 3 | Y | X1 |
| <b>Component instructions</b><br>Ensure they are kept near the furnace |         | 3 | Y | X1 |

**Key:** see “Maintenance Table Key”

## 9.5 Regular Maintenance Tasks – Heating Elements/Furnace Chamber

| Component/ item/ function and action   | Comment   | A | B | C  |
|--|---|---|---|----|
| <b>Heating elements</b><br>Visual inspection: Formation of an oxide coating, cracks  |   | 2 | D | X1 |
| <b>Heating elements</b><br>Replace   |   | 1 | Y | X2 |
| <b>Heating element holes</b><br>Clean  | At the latest when replacing the heating elements | 2 | Y | X2 |
| <b>Heating element connections</b><br>Wiring to the connections, corrosion tendency on twisted ends (traces of burning), torsion-free installation |   | 3 | Y | X2 |
| <b>Heating element terminals</b><br>Check and, if necessary, tighten the screws of the terminals (observe torque)                                  | See “Replacing a Heating Element”                 | 2 | Y | X2 |
| <b>Power to heating elements</b><br>Check load of heating groups   |   | 3 | Y | X2 |

**Key:** see “Maintenance Table Key”

## 9.6 Maintenance Table Key

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

## 9.7 Checking the Heating Element Screws



### Warning – Danger of Electric Shock

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



### Caution – Damage to components!

Heating elements are extremely fragile. Avoid all stress or twisting of the heating elements. If this is not observed, the sensitive heating elements will be destroyed.

### Exhaust air pipe

First slacken the screws (1) from the exhaust air pipe guard plate using the enclosed Allen key. Lift the guard plate (2) from the exhaust air pipe and then carefully pull the exhaust air pipe (3) out straight upwards. Store the exhaust air pipe in a safe place, as its material is very sensitive.

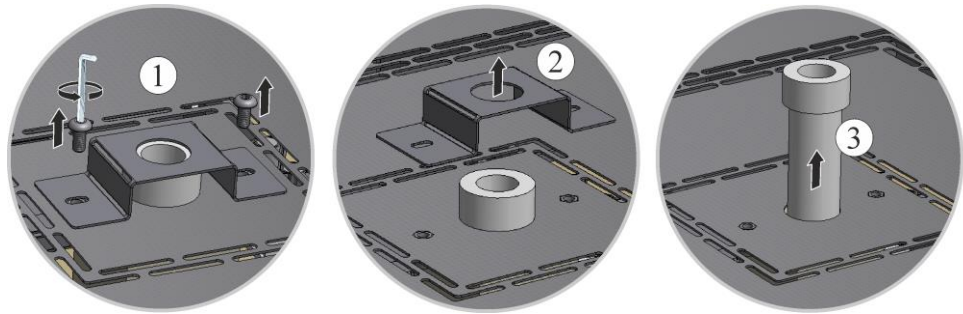


Fig. 35: Removing the exhaust air pipe (similar to picture)

### Removing the top cover from the furnace housing

Unscrew all the screws of the panel with a suitable tool and keep them in a safe place for future use.

The number and position of the screws may differ from one furnace model to the next. The furnace may look different than the picture depending on the furnace model and features.

The cover must be lowered onto a soft material (such as foam rubber).

If present, pay attention to the protective ground cable of the back wall to the clamp. If necessary, disconnect the cable from the clamp.



Fig. 36: Removing the cover on model LHT 01/17 D (similar to picture)



Fig. 37: Removing the cover on model LHT 03/17 D (similar to picture)

**Checking the element holder screws and retightening if necessary**

After one week of operation, and then each year, carefully re-tighten the screws (see Torque for Heating Element Screws). Avoid any stress or distortion of the heating elements. Make sure that the element holders do not twist when tightening the screws. If this is ignored, the sensitive heating elements can be damaged.

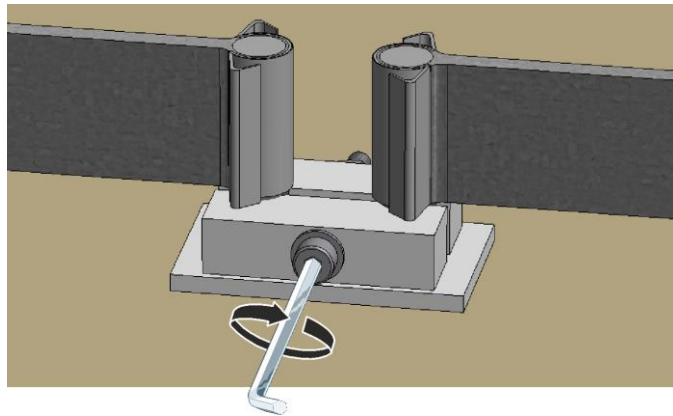


Fig. 38: Securing element holder screws (similar to picture)

**Positioning and installing the cover**

Place the cover on the furnace housing and fix it in place with the screws that were previously removed.



Fig. 39: Installing the cover on model LHT 01/17 D (similar to picture)



Fig. 40: Installing the cover on model LHT 03/17 D (similar to picture)

**Assembling the exhaust air pipe**

Carefully push the exhaust air pipe (1) into the intended opening. The head of the exhaust air pipe must lie on the furnace lid. Reassemble the exhaust air pipe guard plate (2) using the previously slackened screws (3).

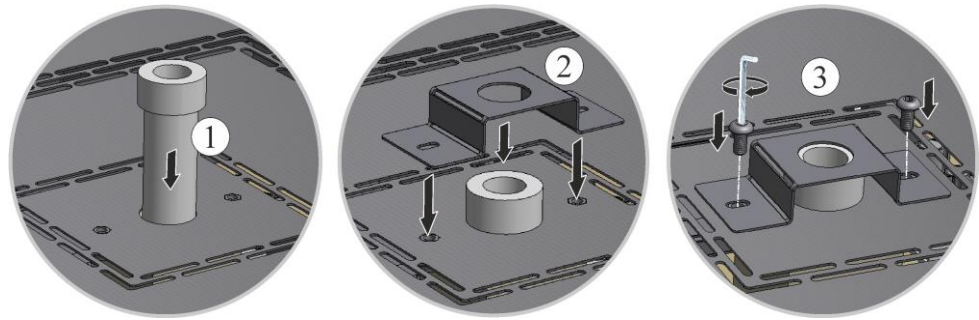


Fig. 41: Assembling the exhaust air pipe (similar to picture)



**Caution**

Make sure that no cables poke out or are caught. Beware of sharp edges.



**Note**

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

**Commissioning**

Insert the mains power connector (see chapter "Connection to the Mains Electricity"), then switch on the power switch and check the function of the furnace (see chapter "Operation").

**9.8 Operating and Auxiliary Materials**

**9.9 Cleaning Products**



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

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

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

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

| <b>This List must be Completed by the Operator.</b> |  |
|---|--|
| <b>Component and Position</b>                       | <b>Cleaning Product</b>  |
| Outer surfaces (frames)*                            | Use commercial cleaning products that are either water-based or non-flammable and free of any solvent* |
| Outer surface (stainless steel)                     | Stainless steel cleaner  |
| Inside  | Carefully clean with a vacuum cleaner (avoid the heating elements)                                     |
| Insulation materials                                | Carefully clean with a vacuum cleaner (avoid the heating elements)                                     |
| Door seal (if applicable)                           | Use commercial cleaning products that are either water-based or non-flammable and free of any solvent  |

**This List must be Completed by the Operator.**

| <b>Component and Position</b> | <b>Cleaning Product</b>   |
|-------------------------------|---|
| Instrument panel              | Wipe the surface with a damp, lint-free cloth. (e.g. glass cleaner) |

\*You must be sure that the cleaner does not damage the water-soluble, environmentally safe paint (test the product on an interior, hidden area).

Fig. 42: Cleaning products

Clean quickly to protect the surfaces.

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

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

See “Environmental Protection Regulations”.



**Note**

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

## 10 Malfunctions

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

Call your local electrician for malfunctions that you cannot localize.

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

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

In case of mechanical damage, send an email containing the above information and a digital photo of the damaged part and a photo of the complete furnace to the following address:

-> see "Nabertherm Service".

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

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

## 10.1 Error Messages of the Controller

The controller shows the error messages and warnings on the screen until they have been rectified and acknowledged. It may take up to one minute until these messages are transferred to the archive.

| ID+ Sub-ID                 | Text                      | Logic  | Remedy  |
|----------------------------|---------------------------|--|---|
| <b>Communication error</b> |                           |  |   |
| 01-01                      | Bus zone                  | Communication connection to a control module disrupted                         | Check that the control module is firmly attached<br>LEDs on the control modules red?<br>Check the cable between the control unit and the control module<br>Plug of the connection cable not plugged correctly into the control unit |
| 01-02                      | Bus communications module | Communication connection to the communications module (Ethernet/USB) disrupted | Check that the communications module is firmly attached<br>Check the cable between the control unit and the communications module   |
| <b>Sensor error</b>        |                           |  |   |
| 02-01                      | TC open                   |  | Check thermocouple, thermocouple terminals and cable<br>Check contacts of the thermocouple cable in plug X1 on the control module (contacts 1+2)  |
| 02-02                      | TC Connection             |  | Check the set thermocouple type<br>Check poles of thermocouple connection   |
| 02-03                      | Compare point error       |  | Control module defective  |
| 02-04                      | Compare point too hot     |  | Temperature in the switchgear too high (approx. 70 °C)<br>Control module defective  |
| 02-05                      | Compare point too cold    |  | Temperature in the switchgear too low (approx. - 10 °C)   |
| 02-06                      | Encoder separated         | Error at the 4-20 mA input of the controller (<2 mA)                           | Check 4-20 mA sensor<br>Check the connection cable to the sensor  |
| 02-07                      | Sensor element defective  | PT100 or PT1000 sensor defective   | Check PT sensor<br>Check connection cable to the sensor (cable break/short circuit)   |
| <b>System error</b>        |                           |  |   |
| 03-01                      | System memory             |  | Error after firmware updates <sup>1)</sup><br>Defective control unit <sup>1)</sup>  |
| 03-02                      | ADC error                 | Communication between AD converter and controller disrupted                    | Replace control module <sup>1)</sup>  |

| ID+ Sub-ID        | Text                   | Logic  | Remedy   |
|-------------------|------------------------|--|--|
| 03-03             | File system defective  | Communication between display and memory chip disrupted  | Replace control unit   |
| 03-04             | System monitoring      | Program execution on the control unit defective (Watchdog)   | Replace control unit<br>USB flash drive removed too soon or defective<br>Switch controller off and on again  |
| 03-05             | Zone system monitoring | Program execution on a control module defective (Watchdog)   | Replace control module <sup>1)</sup><br>Switch controller off and on again <sup>1)</sup>   |
| 03-06             | Self-test error        |  | Contact Nabertherm Service <sup>1)</sup>   |
| <b>Monitoring</b> |                        |  |  |
| 04-01             | No heater power        | No temperature increase in the ramps when heating output $\leq$ 100 % for 12 minutes and when the temperature setpoint is higher than the current furnace temperature  | Acknowledge the error (if necessary, disconnect from the power supply) and check safety contactor, door switch, heating controls and controller.<br>Check heating elements and heating element connections.<br>Lower D value of the control parameters.  |
| 04-02             | Excess temperature     | The temperature of the control zone exceeds the max. program setpoint or the maximum furnace temperature by 50 Kelvin (from 200 °C)<br>The equation for the switch off threshold is:<br>Maximum program setpoint + zone offset of the master zone + charge control offset [Max] (if charge control active) + excess temperature switch-off threshold (P0268, e.g., 50 K) | Check solid state relay<br>Check thermocouple<br>Check controller<br><br>(from V1.51 with 3 minute delay)  |
|                   |                        | A program was started at a furnace temperature higher than the maximum setpoint in the program   | Do not start the program until the furnace temperature is lower. If this is not possible, insert a hold time as a start segment and then a ramp with the desired temperature (STEP=0 minutes duration for both segments)<br>Example:<br>700 °C -> 700 °C, Time: 00:00<br>700 °C -> 300 °C, Time: 00:00<br>The normal program begins here<br>From Version 1.14, the actual temperature is also considered at the start.<br><br>(from V1.51 with 3 minute delay) |
| 04-03             | Power failure          | The set limit for restarting the furnace was exceeded  | If possible, use an uninterruptible power supply   |



| ID+ Sub-ID                | Text                | Logic   | Remedy   |
|---------------------------|---------------------|---|--|
|                           |                     | The furnace was switched off at the main switch during the program              | Stop the program on the controller before you switch off the main switch                 |
| 04-04                     | Alarm               | A configured alarm was triggered  |  |
| 04-05                     | Auto-tune failed    | The determined values are implausible   | Do not carry out auto-tune at the lower temperature range of the furnace working range   |
|                           | Battery weak        | Time is not shown correctly. A power failure may no longer be handled properly. | Export all parameters to a USB flash drive<br>Replace the battery (see “Specifications”) |
| <b>Other malfunctions</b> |                     |   |  |
| 05-00                     | General malfunction | Malfunction in the control module or Ethernet module                            | Contact Nabertherm Service<br>Provide the service export                                 |

## 10.2 Warnings of the Controller

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

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

| No. | Text   | Logic   | Remedy   |
|-----|--|---|--|
| 07  | Alarm 1 - Min  | The configured min. alarm 1 was triggered   | Optimize the control parameters<br>Alarm set too narrowly  |
| 08  | Alarm 1 - Max  | The configured max. alarm 1 was triggered   | Optimize the control parameters<br>Alarm set too narrowly  |
| 09  | Alarm 2 - Band   | The configured band alarm 2 was triggered   | Optimize the control parameters<br>Alarm set too narrowly  |
| 10  | Alarm 2 - Min  | The configured min. alarm 2 was triggered   | Optimize the control parameters<br>Alarm set too narrowly  |
| 11  | Alarm 2 - Max  | The configured max. alarm 2 was triggered   | Optimize the control parameters<br>Alarm set too narrowly  |
| 12  | Alarm - External   | The configured alarm 1 at input 1 was triggered   | Check the source of the external alarm   |
| 13  | Alarm - External   | The configured alarm 1 at input 2 was triggered   | Check the source of the external alarm   |
| 14  | Alarm - External   | The configured alarm 2 at input 1 was triggered   | Check the source of the external alarm   |
| 15  | Alarm - External   | The configured alarm 2 at input 2 was triggered   | Check the source of the external alarm   |
| 16  | No USB flash drive inserted                                      |   | When exporting data, insert a USB flash drive in the controller  |
| 17  | Import/export of data via the USB flash drive unsuccessful       | The file was edited with a PC (text editor) and saved in the wrong format or the USB flash drive was not detected.<br>You want to import data that is not in the import folder on the USB flash drive | Do not edit XML files with a text editor, only in the controller.<br>Format the USB flash drive (format: FAT32). No quick formatting<br>Use a different USB flash drive (to 2 TB/FAT32)<br>When importing, all data must be in the import folder on the USB flash drive.<br>The maximum storage capacity for USB flash drives is 2 TB/FAT32). If you experience problems with your USB flash drive, use a different USB flash drive with maximum 32 GB |
|     | Programs are rejected during the import of programs              | Temperature, time or rate are outside the limit values  | Import only programs that are suitable for the furnace. The controllers differ as regards the number of programs and segments and the maximum furnace temperature.   |
|     | While programs are being imported, "Error occurred" is displayed | The complete parameter set (at least the configuration files) was not stored in the "Import" folder on the USB flash drive  | If you deliberately left out files during import, ignore the message. Otherwise, check the completeness of the import files.   |
| 18  | "Heating blocked"  | This message is displayed if a door switch is connected to the controller and the door is open  | Close the door<br>Check the door switch  |

| No. | Text                                      | Logic   | Remedy   |
|-----|---|---|--|
| 19  | Open door                                 | The furnace door was opened while a program was running   | Close the door while a program is running.   |
| 20  | Alarm 3                                   | General message for this alarm number   | Check the cause of this alarm message  |
| 21  | Alarm 4                                   | General message for this alarm number   | Check the cause of this alarm message  |
| 22  | Alarm 5                                   | General message for this alarm number   | Check the cause of this alarm message  |
| 23  | Alarm 6                                   | General message for this alarm number   | Check the cause of this alarm message  |
| 24  | Alarm 1                                   | General message for this alarm number   | Check the cause of this alarm message  |
| 25  | Alarm 2                                   | General message for this alarm number   | Check the cause of this alarm message  |
| 26  | Multi-zone holdback temperature exceeded  | A thermocouple that was configured for multi-zone holdback has left the temperature band downward | Check whether the thermocouple is necessary for monitoring.<br>Check the heating elements and their activation |
| 27  | Multi-zone holdback temperature undershot | A thermocouple that was configured for multi-zone holdback has left the temperature band upward   | Check whether the thermocouple is necessary for monitoring.<br>Check the heating elements and their activation |
| 28  | Modbus connection interrupted             | The connection to the superordinate system was interrupted.                                       | Check if the Ethernet cables are damaged.<br>Check the configuration of the communication connection           |

### 10.3 Malfunctions of the Switchgear

| Error                               | Cause  | Remedy  |
|-------------------------------------|--|---|
| <b>Controller does not light up</b> | Controller is switched off   | Switch the power switch to “I”  |
|                                     | No power available   | Is the power cord plugged into the socket?<br>Check the building fuses.<br>Check the fuse of the controller (if present) and replace it if necessary. |
|                                     | Check the fuse of the controller (if present) and replace it if necessary. | Switch the power switch on. If the error occurs again, contact Nabertherm Service   |
| <b>Controller displays error</b>    | See the separate instructions of the controller                            | See the separate instructions of the controller   |
| <b>Furnace does not heat</b>        | Door / cover is open   | Close the door / cover  |

| <b>Error</b>   | <b>Cause</b>   | <b>Remedy</b>   |
|--|--|---|
|  | The door contact switch is faulty (if present)   | Check the door contact switch   |
|  | "Delayed Start" is displayed   | The program is waiting for the programmed start time.<br>Deselect delayed start above the start button.                             |
|  | Error in entering the program  | Check the heating program (see the separate instructions of the controller)   |
|  | Heating element defective  | Have this checked by Nabertherm Service or a qualified electrician.   |
| <b>Very slow heating of the heating space</b>                            | The fuse(s) of the connection is/are defective.  | Check the fuse(s) of the connection and replace if necessary.<br>Notify Nabertherm service if the new fuse fails again immediately. |
| <b>The program does not jump to the next segment</b>                     | In one TIME segment in the program input, the wait time is set to INFINITE<br>If charge control is activated, the temperature of the charge is higher than the zone temperatures.  | Do not set the wait time to INFINITE  |
|  | If charge control is activated, the temperature of the charge is higher than the zone temperatures.  | The parameter [LOWER BLOCK] must be set to [NO].  |
| <b>The controller module can not be registered on the operating unit</b> | Addressing error of the controller module  | Perform a bus reset and re-address the controller module  |
| <b>The controller is not heating in the optimization</b>                 | No optimization temperature has been set   | The temperature to be optimized must be entered (see the separate instructions of the controller)                                   |
| <b>The temperature rises faster than the controller setting allows</b>   | The switch element of the heating unit (semiconductor relay, thyristor or switch contactor) is defective.<br><br>Individual defective components inside a furnace cannot be completely ruled out in advance. That is why the controllers and the switchgear units must be equipped with safety facilities. For example, the furnace shuts down the heating unit in response to error message 04 - 02 via an independent contact element. | Have the switch element tested by a qualified electrician and replaced as necessary.  |

## 11 Spare Parts/Wearing Parts



### Ordering spare parts:

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

### Availability of spare parts and wearing parts:

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



#### Note

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



#### Note

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

### 11.1 Electrical Schematics/Pneumatic Schematics



#### Note

The documents included do not always contain the electrical schematics and pneumatic diagrams. If you need the respective diagrams, they can be ordered from Nabertherm Service.

### 11.2 Removing and Installing Heating Elements



#### Warning – Danger of Electric Shock

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



#### Note

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



### Note

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

Nabertherm expressly does not accept any responsibility for direct or indirect damage caused by incorrect assembly. This also applies in all cases where general installation steps are not described.

The furnace must be completely emptied prior to installation or removal.

We recommend that two people replace heating elements.

**Tip:** Because of the many different furnace models, we recommend that you take several photos of the cables on the heating elements and the switchgear. This simplifies subsequent installation and wiring of new heating elements.

### Exhaust air pipe

First slacken the screws (1) from the exhaust air pipe guard plate using the enclosed Allen key. Lift the guard plate (2) from the exhaust air pipe and then carefully pull the exhaust air pipe (3) out straight upwards. Store the exhaust air pipe in a safe place, as its material is very sensitive.

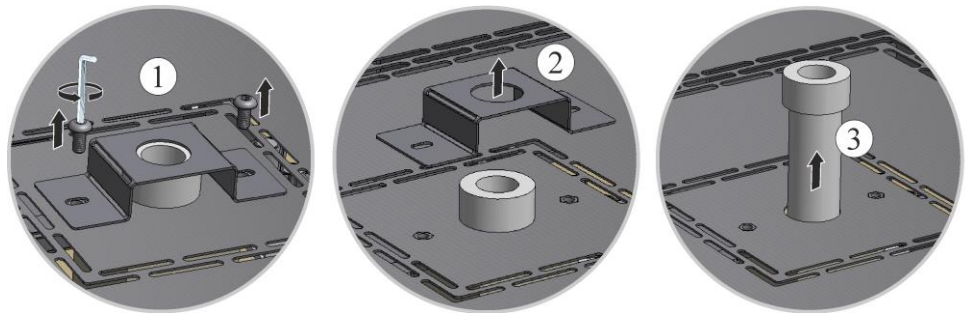


Fig. 43: Removing the exhaust air pipe (similar to picture)

### Removing the top cover from the furnace housing

Unscrew all the screws of the panel with a suitable tool and keep them in a safe place for future use.

The number and position of the screws may differ from one furnace model to the next. The furnace may look different than the picture depending on the furnace model and features.

The cover must be lowered onto a soft material (such as foam rubber).

If present, pay attention to the protective ground cable of the back wall to the clamp. If necessary, disconnect the cable from the clamp.



Fig. 44: Removing the cover on model LHT 01/17 D (similar to picture)



Fig. 45: Removing the cover on model LHT 03/17 D (similar to picture)

**Clamps and connection contact/connection bridge**

Carefully open the clamps (1) with the heating element pliers (2) and lift upward. Remove the connection contact or contact bridge (3) upward from the heating element.

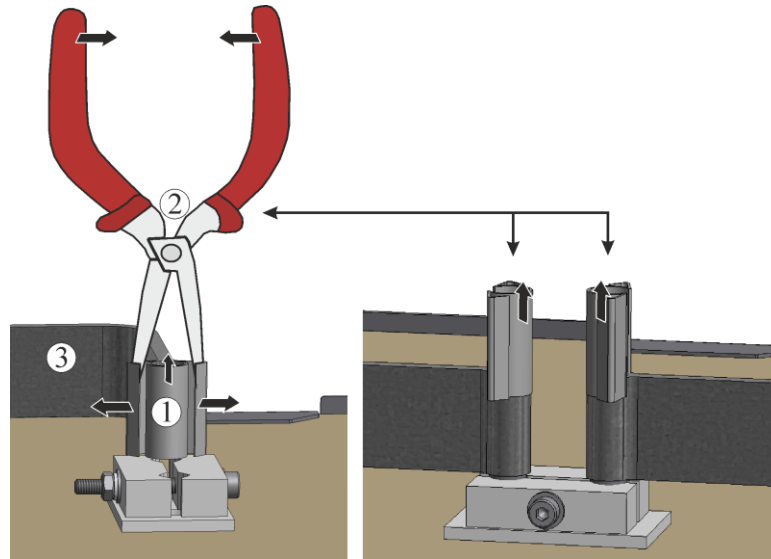


Fig. 46: Clamps and connection contact (similar to picture)

**Element holder and insulation**

Carefully undo the screw on the element holder (1) with a suitable tool. Remove the element holder from the heating element. Remove the fiber paper and fiber wool underneath from the gap between the sides of the heating elements.

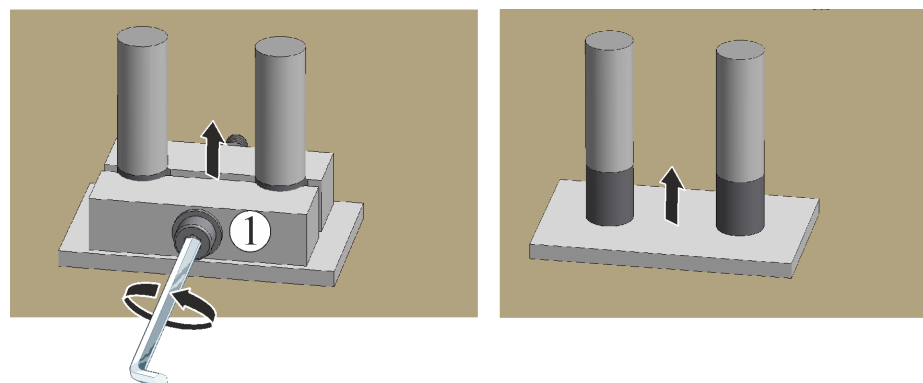
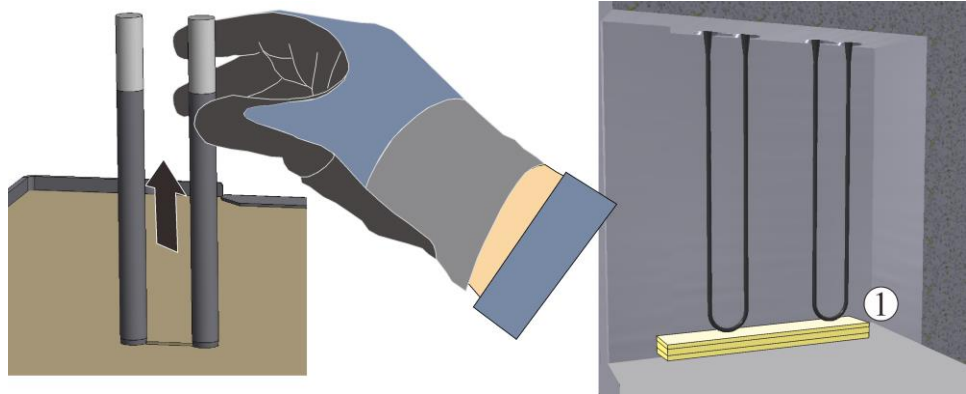


Fig. 47: Removing the element holder and insulation (similar to picture)

## Replacing heating elements

Carefully pull heating elements out upwards; do **not** press heating element legs together whilst doing so. Clean heating chamber and passage holes (vacuum out). Carefully insert new heating elements from above. Attention: Pay attention to the correct installation height! See sketch. An assembly support (e.g. foam) between the heating elements and the base of the furnace is helpful.



1 = Assembly support (e.g. foam)

Fig. 48: Heating elements (similar to picture)

Check the supplied heating elements for damage before installation.

Compare the delivered items with the delivery note and the purchase order documents.

**Immediately** notify the carrier and Nabertherm GmbH of any missing or damaged parts, as complaints received at a later date cannot be acknowledged.

Fill the gap between the element connection ends with fiber wadding\*. Then place fiber paper\* (approx. 2 mm) on the insulation. If the holes are not filled out, this causes the clamps to overheat with the result that the heating elements break down prematurely.

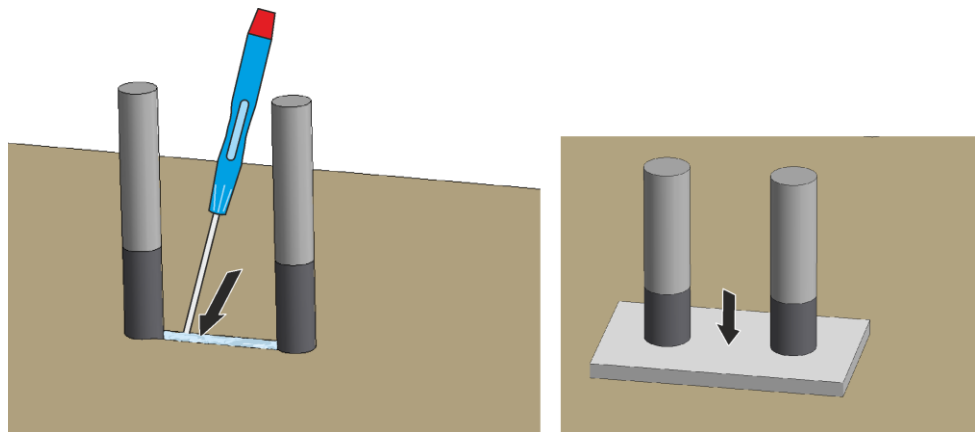


Fig. 49: Fiber wool

Fiber paper

## Assembling the heating elements

Plug the heating element ends on to the element holders (1). **Carefully** tighten the element holders with a suitable tool (see Torque for Heating Element Screws). The screw heads must face outwards. Avoid any stress or distortion of the heating elements. Make sure that the element holders do not twist when tightening the screws. Place the connection contact or connection bridge (2) on to the ends of the heating elements and hold in place with new clamps (3), pay attention that they are correctly positioned to each other. Check the element holders, screws, spring clips and cables.



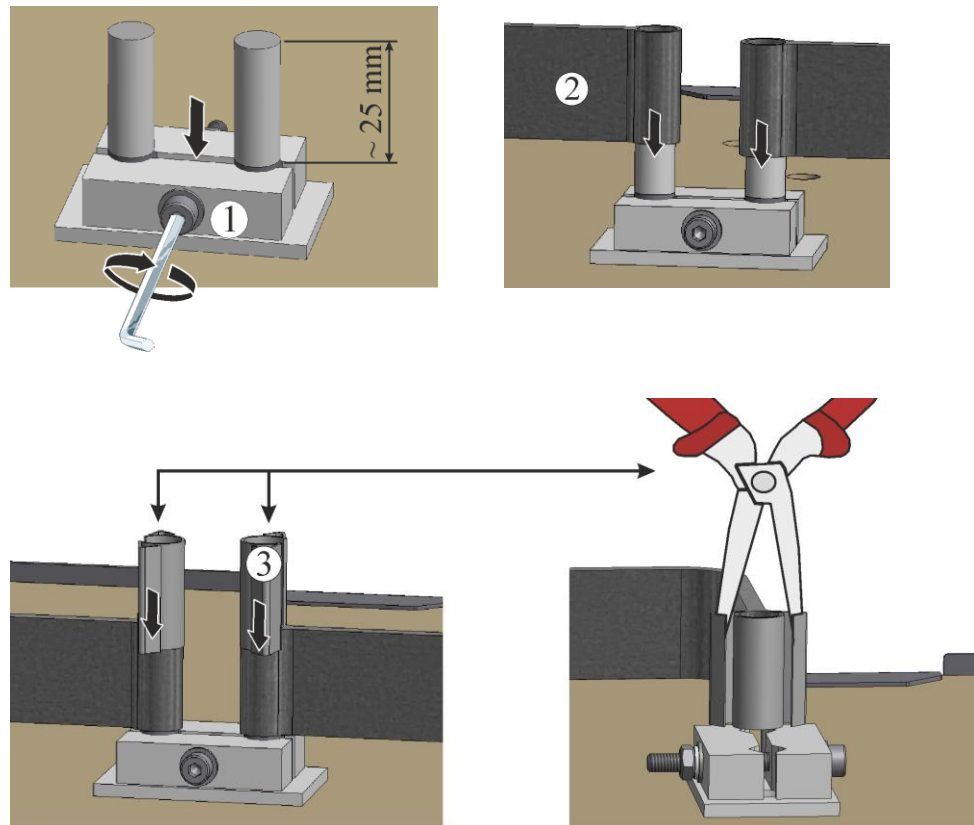


Fig. 50: Assembling the heating elements (similar to picture)  
 The switchgear cover is assembled in the reverse order.

### Positioning and installing the cover

Place the cover on the furnace housing and fix it in place with the screws that were previously removed.



Fig. 51: Installing the cover on model LHT 01/17 D (similar to picture)



Fig. 52: Installing the cover on model LHT 03/17 D (similar to picture)

### Assembling the exhaust air pipe

Carefully push the exhaust air pipe (1) into the intended opening. The head of the exhaust air pipe must lie on the furnace lid. Reassemble the exhaust air pipe guard plate (2) using the previously slackened screws (3).

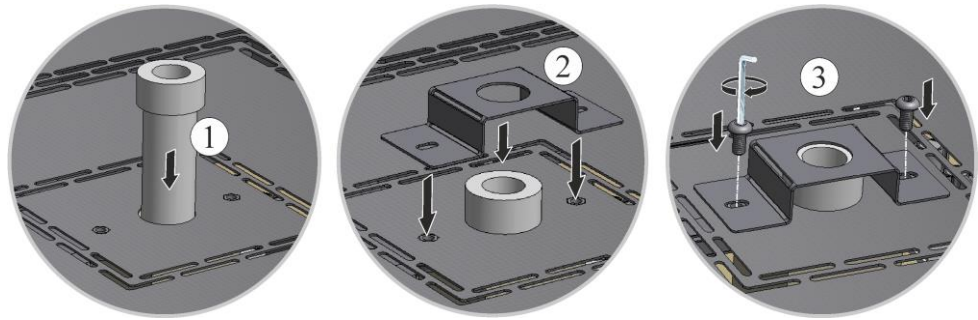


Fig. 53: Assembling the exhaust air pipe (similar to picture)



**Note**

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



**Caution**

Make sure that no cables poke out or are caught. Beware of sharp edges.



**Warning – General Hazards!**

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

**Commissioning**

Insert the mains power connector (see chapter "Connection to the Mains Electricity"), then switch on the power switch and check the function of the furnace (see chapter "Operation").



**Note**

Do not forget to remove the assembly support/assembly aid from the furnace chamber.



**Note**

Use the pre-set program to create a protective oxide coating on the heating elements (see "Pre-Set Programs").



**Note**

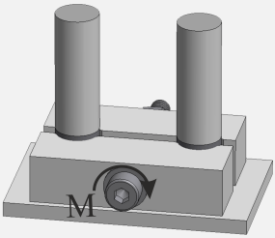
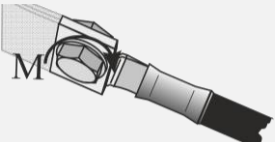
\*) = Enclosed with spare part delivery.

### 11.2.1 Tightening Torque for Screw Connections on Heating Elements

**Screw tightening torque**

Tighten screws on the heating elements with a defined torque. If this advice is not followed, the heating elements may be damaged.

| Figure | Screw/type of fixing | Thread diameter of metric thread | Torque (M) in Nm |
|--------|----------------------|----------------------------------|------------------|
|--------|----------------------|----------------------------------|------------------|

|   |  |                            |      |
|---|--|----------------------------|------|
|  | Fixing molybdenum disilicide (MoSi2) heating element<br>Ceramic element holder | All sizes<br>(3/6 and 4/9) | 1 Nm |
|  | Fixing aluminum wires to cable lug   | All screw connections      | 6 Nm |

**Commissioning**

Insert the mains power connector (see chapter "Connection to the Mains Electricity"), then switch on the power switch and check the function of the furnace (see chapter "Operation").



**Note**

Do not forget to remove the assembly support/assembly aid from the furnace chamber.



**Note**

\*) = Enclosed with spare part delivery.

**11.3 Replacing a Thermocouple**



**Warning – Danger of Electric Shock**

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



**Warning – General Hazards!**

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



**Caution - damage to components!**

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

**Furnace model LHT 01/17 D**

**Removing the base plate**

CAREFULLY place the furnace on its side. To protect the surface and prevent vibration when the furnace is placed down, we recommend that you place it on a soft surface. Use a

suitable tool to undo the screws from the feet of the furnace. Remove the base plate and place it on a soft surface.



1 = Soft surface (e.g. foam)

Fig. 54: Removing the base plate - model LHT 01/17 D (similar to picture)

### Furnace model LHT 03/17 D

#### Exhaust air pipe

First slacken the screws (1) from the exhaust air pipe guard plate using the enclosed Allen key. Lift the guard plate (2) from the exhaust air pipe and then carefully pull the exhaust air pipe (3) out straight upwards. Store the exhaust air pipe in a safe place, as its material is very sensitive.

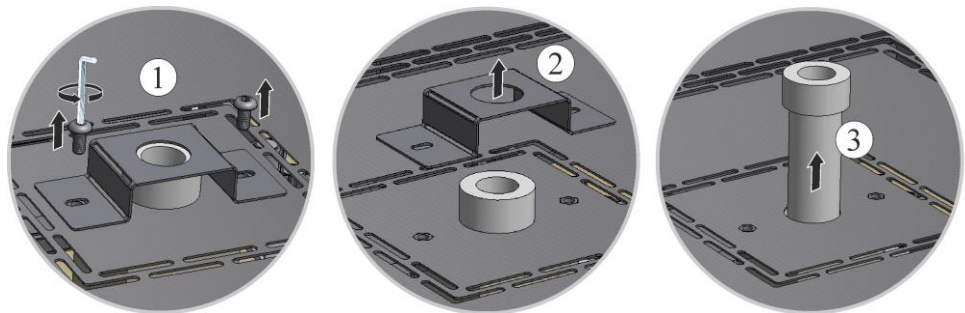


Fig. 55: Removing the exhaust air pipe (similar to picture)

#### Removing the top cover from the furnace housing

Unscrew all the screws of the panel with a suitable tool and keep them in a safe place for future use.

The number and position of the screws may differ from one furnace model to the next. The furnace may look different than the picture depending on the furnace model and features.

The cover must be lowered onto a soft material (such as foam rubber).

Place the cover on the furnace housing and fix it in place with the screws that were previously removed.



Fig. 56: Removing the cover on model LHT 03/17 D (similar to picture)

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

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

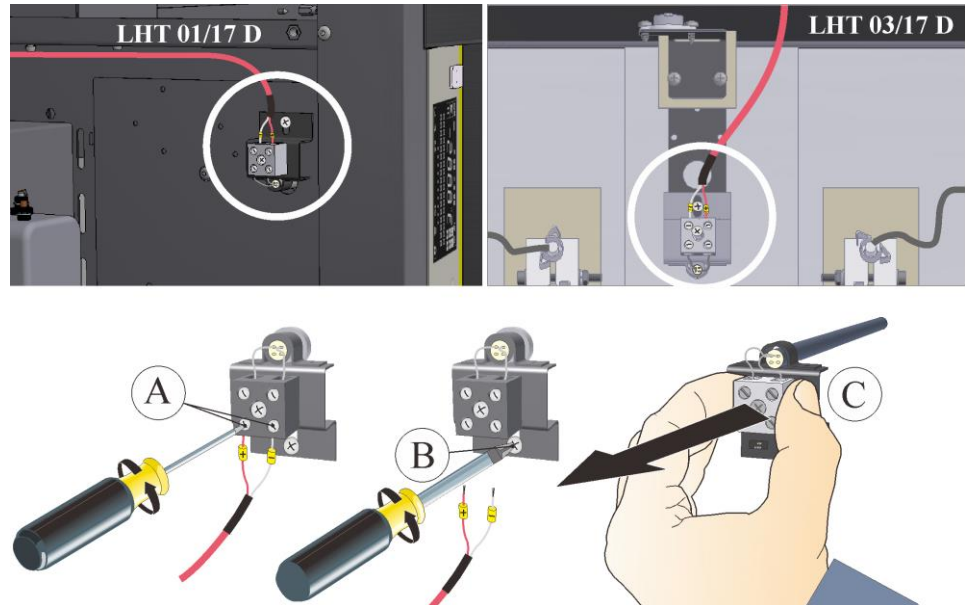


Fig. 57: Dismantling the thermocouple/s for the furnace chamber (similar to picture)



**Note**

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

$\oplus$  to  $\oplus$        $\ominus$  to  $\ominus$



**Note**

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



**Warning – General Hazards!**

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

The assembly of the cover(s) is carried out in reverse order. If necessary, have an expert connect the grounding cable (which was previously disconnected) between the terminal and the cover. The cables behind the cover must be able to move freely and may not be placed on or come into contact with heat-contacting components.



**Caution**

Make sure that no cables poke out or are caught. Beware of sharp edges.

**Commissioning**

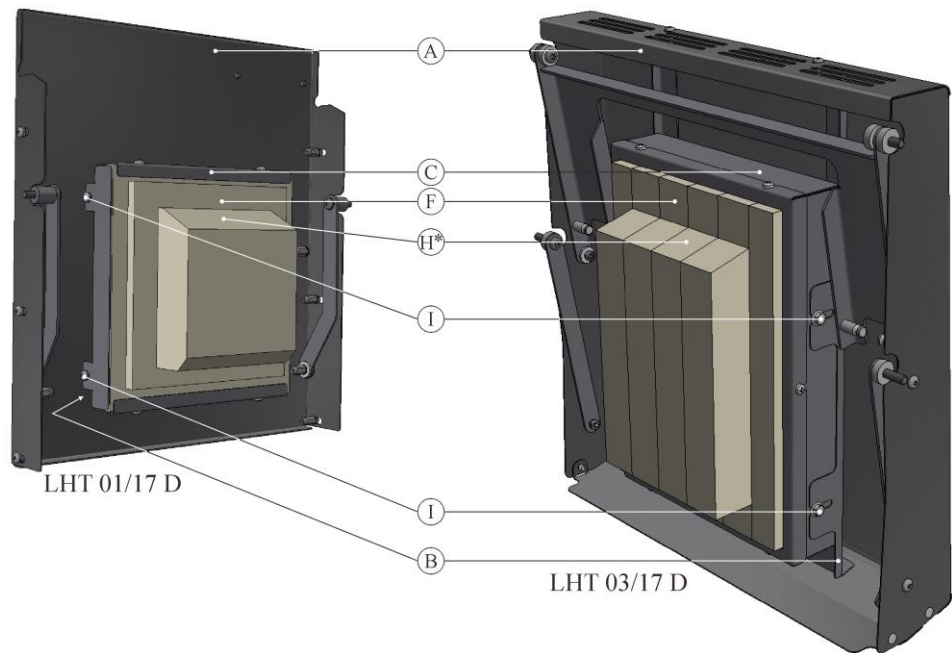
Insert the mains power connector (see chapter "Connection to the Mains Electricity"), then switch on the power switch and check the function of the furnace (see chapter "Operation").

## 11.4 Replacement/Readjustment of the Door Insulation Structure



### Warning! General hazards!

Work on the equipment may only be performed by qualified, authorized specialists. During work, the voltage supply to the furnace/switching system must be switched off to prevent unintentional commissioning (disconnect mains power connector) and all moving parts of the furnace must be secured. Observe DGUV V3 or corresponding national guidelines of the country of use. Wait until the furnace chamber and attaching parts have cooled to room temperature.



\*Inclined surface of door insulation points upwards

Fig. 58: Replacement/readjustment of the door insulation structure (similar to picture)

| Item | Quantity | Name                               | Comment                           |
|------|----------|------------------------------------|-----------------------------------|
| A    | 1        | Furnace lift-door                  |                                   |
| B    | 1        | Door spacer plate                  |                                   |
| C    | 1        | Complete door insulation structure | See chapter "Spare/Wearing Parts" |
| F    | 1        | Door collar insulation             |                                   |
| H    | 1        | Door insulation                    |                                   |
| I    | 4        | Screw                              |                                   |

Swivel the furnace lift-door carefully away upwards. Loosen all 4 screws (I) and complete door insulation structure (C) from the door spacer plate (B). Pull complete door insulation structure towards the furnace and remove upwards (see sketch on left). Carefully assemble door insulation structure in reverse order. Inclined surface of door insulation points upwards.

Secure new complete door insulation structure to the door spacer plate with the enclosed screws and align. The insulation is very sensitive; pay attention to adjacent components.



Door collar insulation must lie on the furnace collar insulation all around. If the door insulation does not lie on the furnace collar all around, the complete door insulation structure must be readjusted using the hexagonal screws (I).



**Note**

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

### 11.5 Separate the Snap-In Coupling (Plug) from the Furnace Housing

With a small flat blade screwdriver carefully push the locking latch (2) upward while pulling the plug (3) out of the coupling (4).

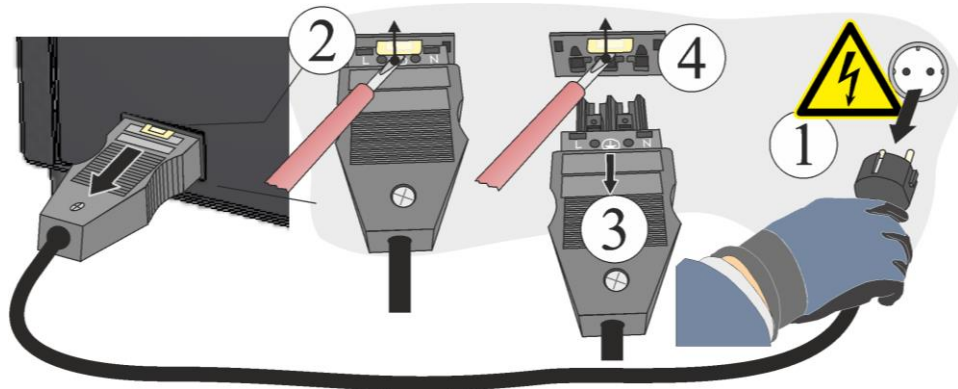



Fig. 59: Separate the snap-in coupling (plug) from the furnace housing (similar to picture)

### 11.6 Replacing a Fuse

A Fuse is located inside the switchgear cabinet. The fuse is an important component of the power supply system and protects the furnace and its components against damage and fire. When you insert a new fuse, make sure that the fuse rating is suitable for the voltage used by your furnace.

|   |   |
|---|---|
|  | NOTICE  |
|   | <ul style="list-style-type: none"> <li>• <b>Damage to the furnace and its components</b></li> <li>• <b>Use of a fuse that is NOT suitable for the respective voltage may damage the furnace and its components and is a fire hazard.</b></li> <li>• Use only a suitable fuse type. Check that the fuse type has the correct nominal current value.</li> </ul> |



Carry out the procedure to switch off the furnace (see "Operation"). Then pull the power plug out of the socket. Allow the furnace to cool naturally.

## Removing the switchgear cover

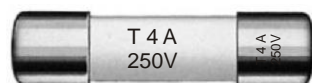


The number and position of the screws may differ from one furnace model to the next.

Fig. 60: Removing the switchgear cover (figure similar)

Remove the screws from the rear wall and keep them in a secure place for later use.

- Remove the fuse from the fuse holder.
- Replace the defective fuse with a similar fuse.
- Before you replace the fuse, make sure that it has the correct nominal current.



Nominal current (Example)

Fig. 61: Fuse (fuse link)

### Note

The nominal current is engraved into the metal cap of the fuse or can be found imprinted directly on the fuse.

- Insert the new fuse into the fuse holder. Make sure that the fuse is pushed fully into the holder.
- Check that the power cable is not damaged. The power cable must not be damaged. Power cables may be replaced only with similar, approved cables.

### Note

Assemble the loosened parts in the reverse sequence.

## 11.7 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 effect on the function or quality of the furnace. However, if entire "sections" of the insulation come loose, Nabertherm Service must be notified.

It is quite normal that cracks appear in ceramic fiber insulation after the first firing. These cracks are usually not very deep (a few mm) and also have no effect on the function of the insulation.



Cracks generally occur due to thermal stresses that occur when the furnace is heating or cooling or because of rapid changes in temperature, such as when the door is opened at a high temperature. The temperature itself and chemical substances that may be in the material to be fired can also cause cracks.

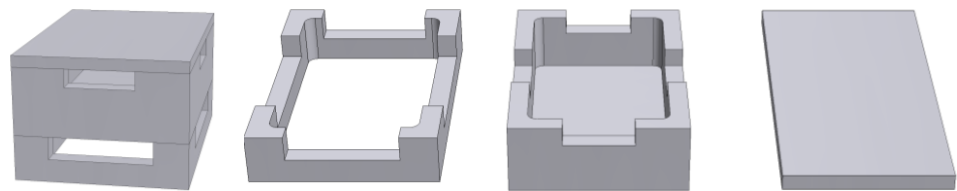
If cracks larger than 5 mm appear in the fiber insulation or material breaks off the furnace collar or refractory door material due to mechanical damage, these cracks or missing material can be filled with a repair material. Use a small spatula or a small piece of metal plate to press the repair material into the cracks. If larger areas of material break off, the entire insulation has to be replaced. Allow the repair material to dry for 24 hours before heating the furnace.

## 12 Accessories (Options)

Nabertherm offers special-purpose saggars for charging the furnace.

### Saggar for sintering furnaces LHT 01/17 D

For optimum utilization of the furnace chamber, the material is placed in ceramic saggars. The saggars have slits to allow the air to circulate. The container can be closed with a ceramic lid.



Starter kit

Spacer for saggars

Saggars

Lids for saggars

Article number:  
699001124

Article number:  
699000529

Article number:  
699000279

Article number:  
699000985

Fig. 62: Saggar with lid

### Saggar for sintering furnaces LHT 03/17 D

A saggar basically consists of the sintering dish as base and the spacer ring with ventilation openings. The material is highly resistant to temperature fluctuations and can be used for processes with short heat-up and cool-down times.



Starter-Set

Sintering Dish

Spacer Ring with  
Ventilation Openings

Article No.: 699001066

Article No.: 699001054

Article No.: 699001055

Fig. 63: Charge Saggar

## 12.1 Gas Supply System (Accessories)

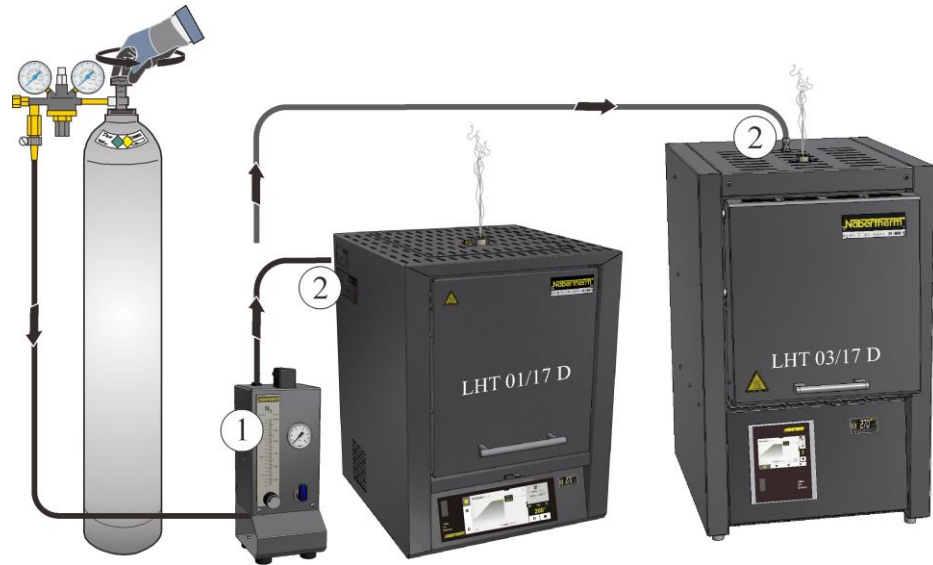


Fig. 64: Connection to the gas supply system (similar to picture)

|   |  |
|---|--|
| 1 | <b>Gas Supply System 1</b> for simple protective gas applications (no vacuum operation) This package represents a basic version sufficient for many applications, for operation with non flammable protective gases. |
| 2 | The customer is responsible for providing the exhaust system   |

### Function Description

The gas supply system permits you to feed **non**-combustible protective and reactive gases (such as: helium (He), argon (Ar), forming gas, carbon dioxide (CO<sub>2</sub>) or nitrogen (N<sub>2</sub>)) into a furnace in a quantity for a defined period.

### Safety

The gas supply system must be inspected to ensure it is in perfect condition before each use. If a defect is discovered the furnace must be shut down immediately.

During operation toxic gases and vapors can be released. They must be appropriately vented out of the building. Ignoring this warning can be dangerous to your health.

Only use gases whose characteristics are known. If something unexpected happens in the furnace (for example, build up of dense smoke or noxious smells) it must be shut down immediately and you must wait until the furnace has cooled down naturally.

The use of the gas supply system in connection with combustible gases is only permissible with additional "safety devices".

- You must ensure that the installation room is well ventilated and that protective gas emissions do not present any danger.
- It is the user's responsibility to ensure compatibility with local safety and installation regulations.
- The use of the furnace for the purposes for which it was designed also requires observing the instructions contained in this operating manual for installation, start-up and maintenance.
- You must be aware of the real or potential combustibility and explosiveness of gases when they are when operating the furnace. Make sure in particular that no corrosive or health endangering substances are generated and escape into the surrounding air.

- Operating the system is prohibited with power sources, products, operating equipment, auxiliary materials, etc., which are listed as hazardous or which may in any way harm the health of the personnel operating the furnace.
- Make sure the hose connection is perfectly tight before each use.
- The gas supply system must be checked for leaks and deposits in the flow meter (use a leak detection spray if necessary).
- The functionality of the ball valve and the solenoid valve must be checked at regular intervals.



**Note**

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



**Note**

See additional operating instructions for description and function.



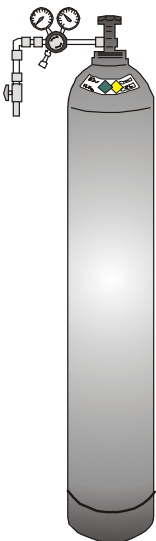
**Warning – Danger of Suffocation**

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

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

Measures: Switch on the extraction system.

## 12.2 Operation of Compressed Gas Containers



Pressurized gas tanks may be operated only by persons familiar with their handling. Before commencing work, employees must be instructed

in the operation of pressurized gas tanks,  
about the special hazards of handling pressurized gas tanks, and

- what to do in case of accidents or malfunctions. These instructions must be repeated at appropriate intervals.

Pressurized gas cylinders may be placed in work rooms only in the absolutely necessary quantities and in the smallest possible sizes, and only for immediate use.

Pressurized gas cylinders must not be stored in work rooms.

If possible, gas cylinders should be kept in gas cylinder cabinets with an extraction system.

When no gas is being withdrawn, always keep the main valve on the gas cylinder closed. Gas cylinders without attached pressure regulators must not be used without protective caps. Gas hoses must be checked regularly for brittle or porous areas and, if necessary, be replaced immediately.

**Safety measures and appropriate conduct**

- Secure pressurized gas tanks against toppling over, impact and heating (e.g. from heater or furnace system).
- At the workplace only have the number of pressurized gas cylinders required to continue working.
- Transport only with cylinder transport trolleys and with protective caps firmly screwed on.
- Wear suitable gloves and if necessary goggles.



- When changing cylinders, always check for leaks at the valves of full and empty cylinders.
- Refilling cylinders is prohibited.
- Do not use force to open valves.
- Sufficiently ventilate areas.
- Smoking and open flames are prohibited.
- Keep fire extinguisher ready.

The operator must prepare operating instructions specifying the hazards occurring in the work room for people and the environment and also specifying the generally required protective measures and codes of conduct. The operating instructions must be written in an understandable form and be available in the work room. The operating instructions must also contain instructions on what to do in case of danger and about first-aid measures.



**Note**

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



**Warning – General Hazards!**

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

### 12.3 Separate the Snap-In Coupling (Plug) from the Furnace Housing

With a small flat blade screwdriver carefully push the locking latch (2) upward while pulling the plug (3) out of the coupling (4).

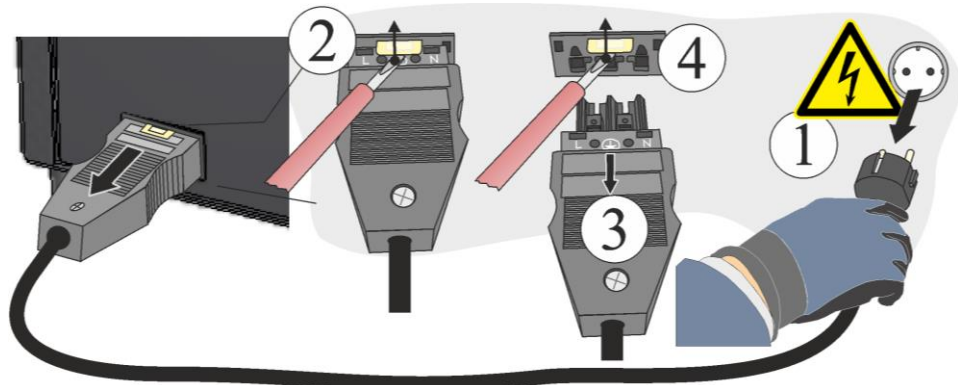


Fig. 65: Separate the snap-in coupling (plug) from the furnace housing (similar to picture)

### 12.4 Electrical Schematics/Pneumatic Schematics



**Note**

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

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

## 13 Nabertherm Service



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

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

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

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

Provide the following details from the type plate:

|   |   |   |
|---|---|---|
| <br><small>MORE THAN HEAT 30-3000 °C</small>   |   |   |
| <small>Nabertherm GmbH<br/>                 Bahnhofstr. 20, 28865 Lilienthal/Bremen, Germany<br/>                 Tel +49 (04298) 922-0, Fax +49 (04298) 922-129<br/>                 contact@nabertherm.de</small> |   |   |
| <small>Made in Germany</small>  |   |   |
| <small>www.nabertherm.com</small>   |   |   |
| ①   | ② | ④   |
| ③   |   |  |
|   |   |   |
|   |   |   |

- ① Furnace model
- ② Serial number
- ③ Article number
- ④ Year of construction

Fig. 66: Example (type plate)

## 14 Shut-Down, Dismantling, and Storage

### To be Completed by the Operator

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

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



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

---

---

---

---

Oils and other substances that are hazardous to water must be completely removed before the furnace is dismantled for recycling or scrap.

Ensure that operating materials, lubricants, and consumables are disposed of in an environmentally compliant manner. Regulations relating to proper waste recycling and disposal must be observed.

The furnace may be lifted only at the intended points.

Use only the specified lifting and securing equipment to lift the furnace/parts.

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

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



Before transporting the furnace, attach the following securing equipment:

---

---

---

---



#### Note

See "Safety" and "Transportation".

## 14.1 Transportation/Return Transportation



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

Otherwise:

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

+45°C  
-5 °C



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

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

Otherwise, in general:

“Fix” and “secure” (adhesive tape) all moving parts and cushion and protect any projecting parts against breakage.

Protect your electronic equipment against moisture and make sure that no loose packaging material can get inside it.

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

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

As a rule:

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

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

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



### Note

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



### Note

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

## 15 Declaration of Conformity



## EU Declaration of Conformity

### High-Temperature Furnaces

for the industrial use

|              |             |             |
|--------------|-------------|-------------|
| <b>Model</b> | LHT 01/17 D | LHT 03/17 D |
|--------------|-------------|-------------|

Name and address of the manufacturer

Nabertherm GmbH  
Bahnhofstr. 20  
28865 Lilienthal, Germany

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

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

The following harmonized standards were applied:

- DIN EN 61010-1 (03.2020)
- DIN EN IEC 61000-6-1 (11.2019), DIN EN IEC 61000-6-3 (06.2022)

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

Lilienthal, 13.09.2022

Dr. Henning Dahl  
Vice President R & D

Malte Pirngruber-Spanier  
Department Manager R & D



**16 For Your Notes**

---

## For Your Notes

**For Your Notes**



MORE THAN HEAT 30-3000 °C

**Headquarters:**

Nabertherm GmbH · Bahnhofstr. 20 · 28865 Lilienthal/Bremen, Germany · Tel +49 (4298) 922-0, Fax -129 · [contact@nabertherm.de](mailto:contact@nabertherm.de) · [www.nabertherm.com](http://www.nabertherm.com)

Reg: M01.1068 ENGLISCH