

Operating Instructions

Electrically Heated Chamber Furnaces

LH 15/12 - LH 216/14, LF 15/13 - LF 120/14

-> 01.2016 M01.0039 ENGLISCH

Original instructions

■ Made
■ in
■ Germany

www.nabertherm.com

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1 Introduction

Dear Customer,

Thank you for choosing a quality product from Nabertherm GmbH.

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

This product is characterized by

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

Your Nabertherm Team



Note

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

Protective Rights

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

Note

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

Note

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

1.1 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.

The chamber furnaces LH 15/12 - LF 120/14 have been very popular as professional laboratory furnaces for many years. The furnaces are available either with sturdy refractory insulation (LH models) or as a combination with refractory insulation in the corners and low heat storage, fast cooling fiber material (LF models). With an extensive range of accessories, these models can be designed optimally for the required process.

Depending on the model, chamber furnaces are heated from five or four sides (LH ...SW models).

Other Characteristics of this Product are:

- Tmax 1200 °C (only Model LH), 1300 °C or 1400 °C
- Double-walled housing with rear ventilation keeps the temperature of the outer walls low
- Heating on five sides for very good temperature uniformity
- Heating elements on carrier tubes ensure free heat radiation and a long service life
- Controller attached to the furnace door can be removed for convenient operation
- Protection for floor heating and level stacking surface through flush-mounted SiC floor plate
- LH models: Multi-layer, fiber-free refractory insulation and special back insulation
- LF models: High-quality, non-classified fiber insulation with corner bricks for shorter cooling and heating times
- Door with brick on brick seal, ground manually
- Short heating times because of high electrical connected load
- Self-supporting arched roof for high stability and best possible protection against dust
- Quick release door
- Motor-driven exhaust air flap. Opening and closing can be programmed for different segments via an extra function of the controller. (Drive fixed to the back wall, chimney bricked, exhaust air opening: inside diameter 75 mm)
- Infinitely adjustable fresh-air flap in furnace floor
- Base included
- NTLog Basic for Nabertherm controller: Recording process data with a USB flash drive

Additional Equipment

- Parallel swing door, swings away from operator, to be opened when furnace is hot
- Lift door with manual lifting device using a chain block
- Lift door with pneumatic drive (operated with a foot pedal)
- Lift door with electro-pneumatic drive (two-hand operation)
- Lift door with electro-mechanical linear drive (two-hand operation)
- Separate wall-mounted or standing cabinet for the switchgear
- Cooling fan to reduce cycle times

-
- Protective gas connection to purge the furnace with non-flammable protective or reaction gases
 - Manual or automatic gas supply system
 - Weighing device to determine loss on ignition (Model LH/LF .../...SW)
 - Debinding package with safety concept up to 60 liters
 - Process control and documentation via VCD software package or Nabertherm Control-Center NCC for monitoring, documentation, and control

1.2 Overview of the Complete Furnace

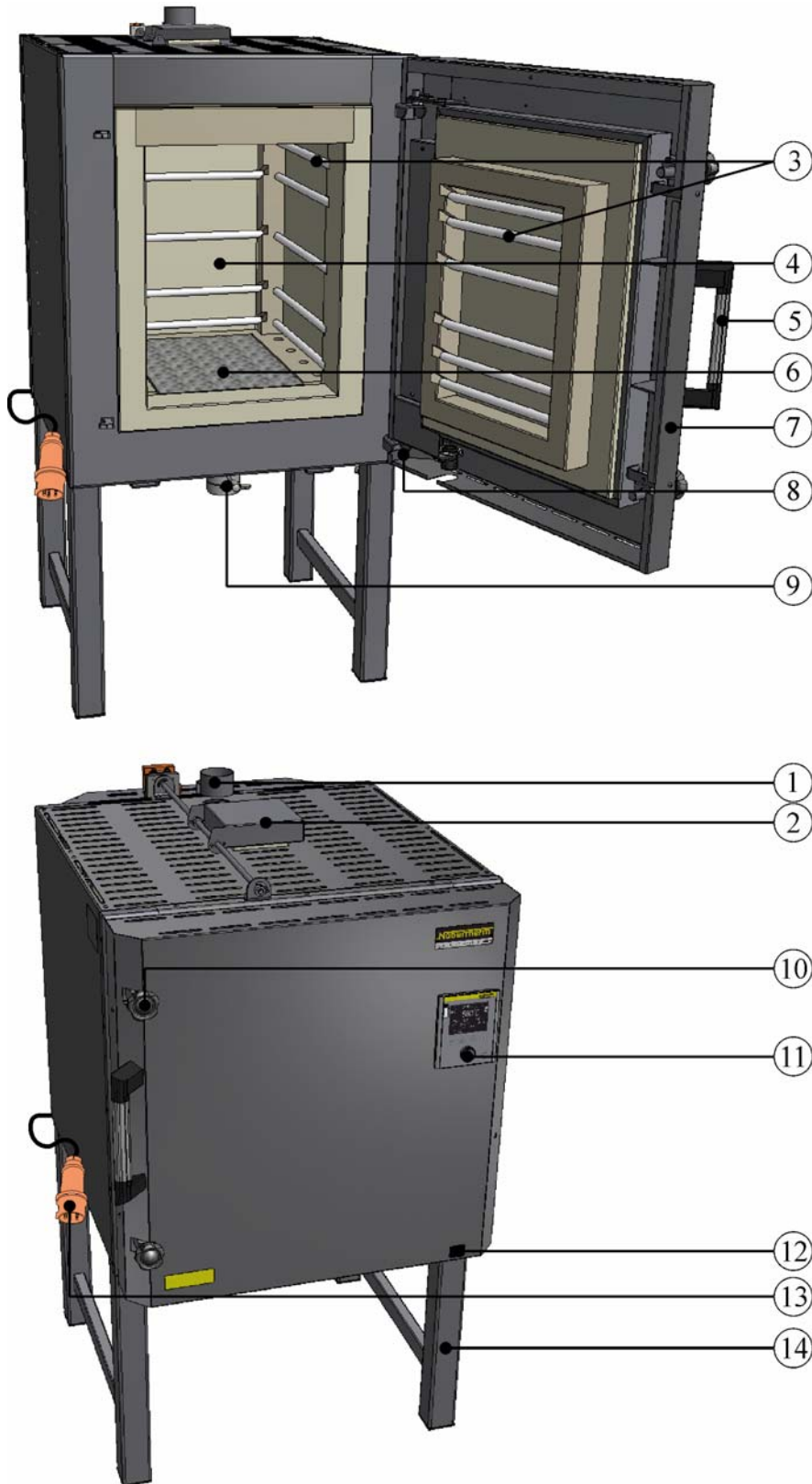


Fig. 1: Example: Chamber furnace LH 120/.. (similar to picture)

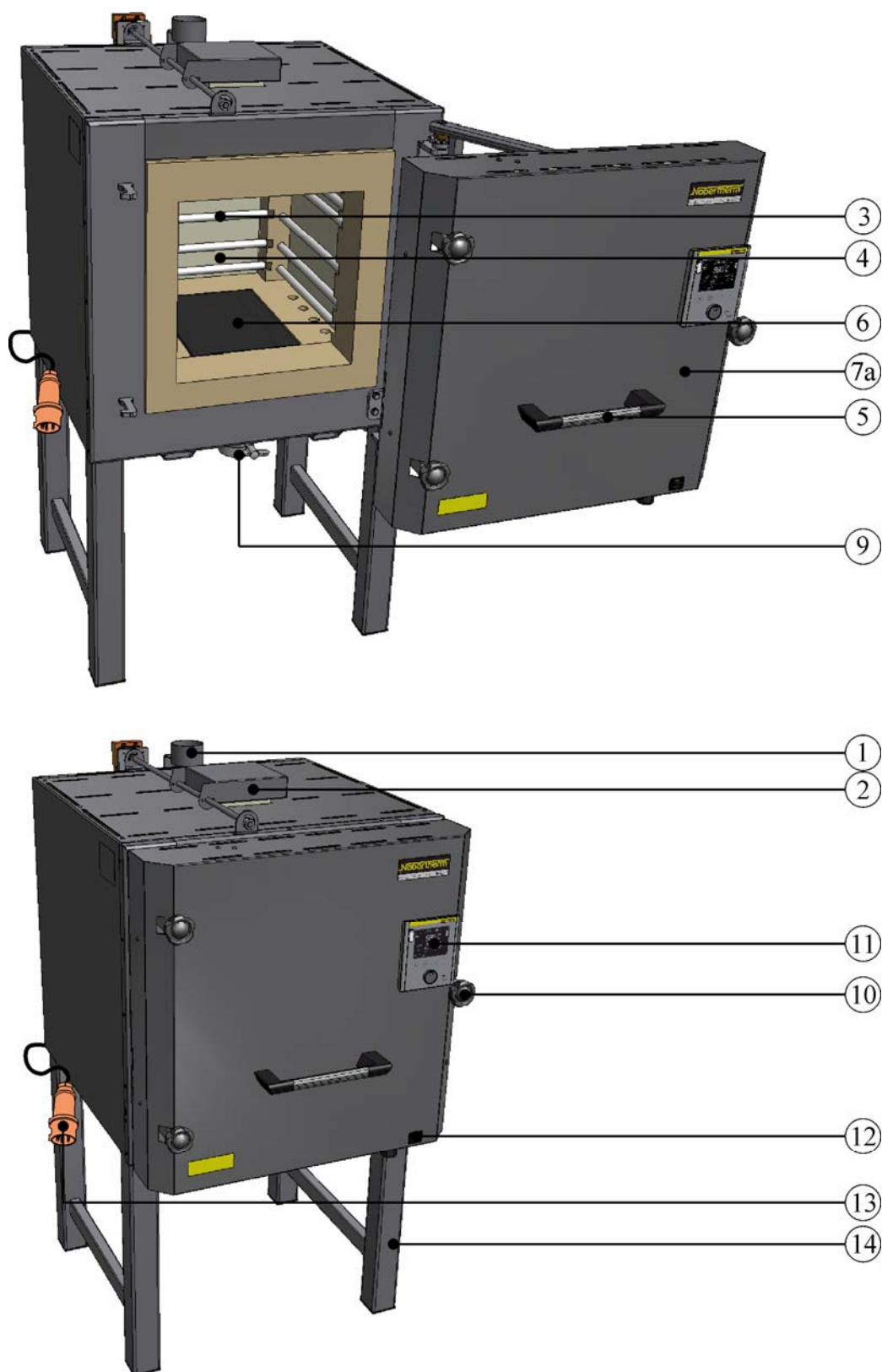


Fig. 2: Example: Chamber furnace LH 60/.. with parallel swing door as an accessory (similar to picture)

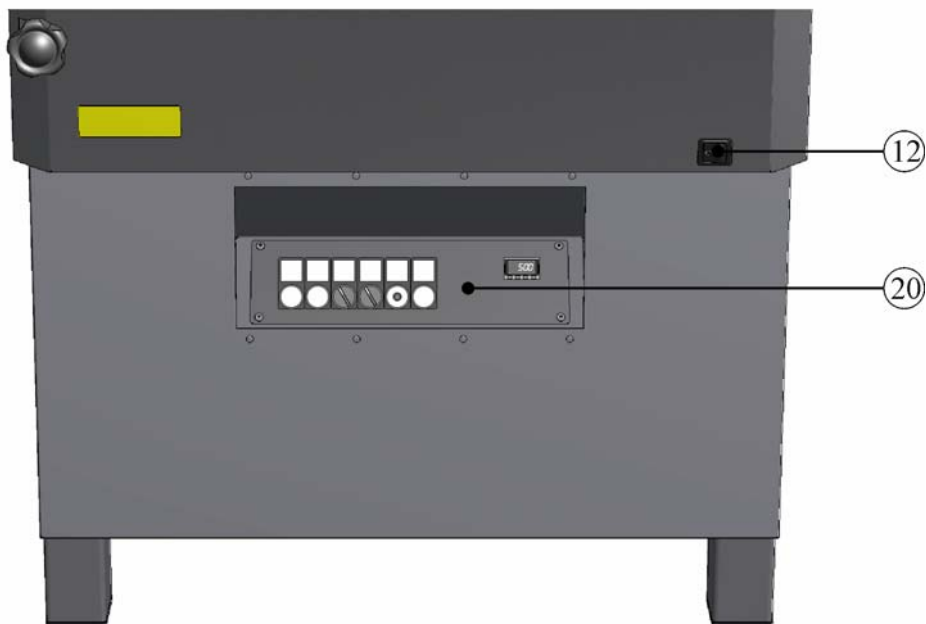
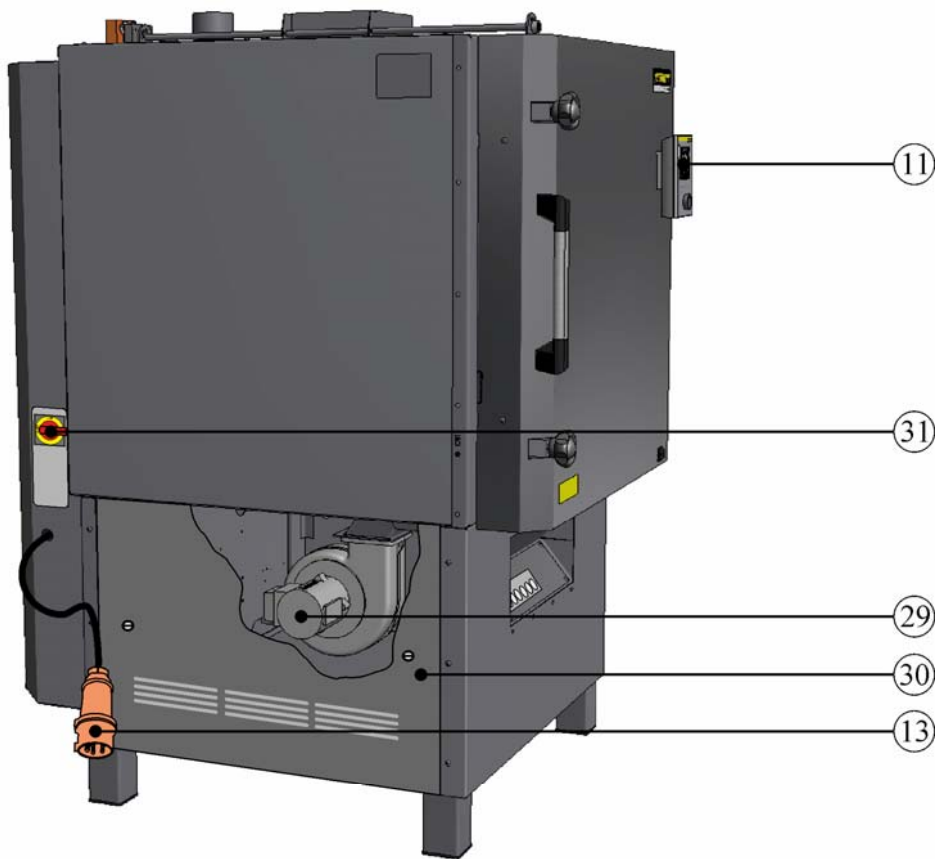
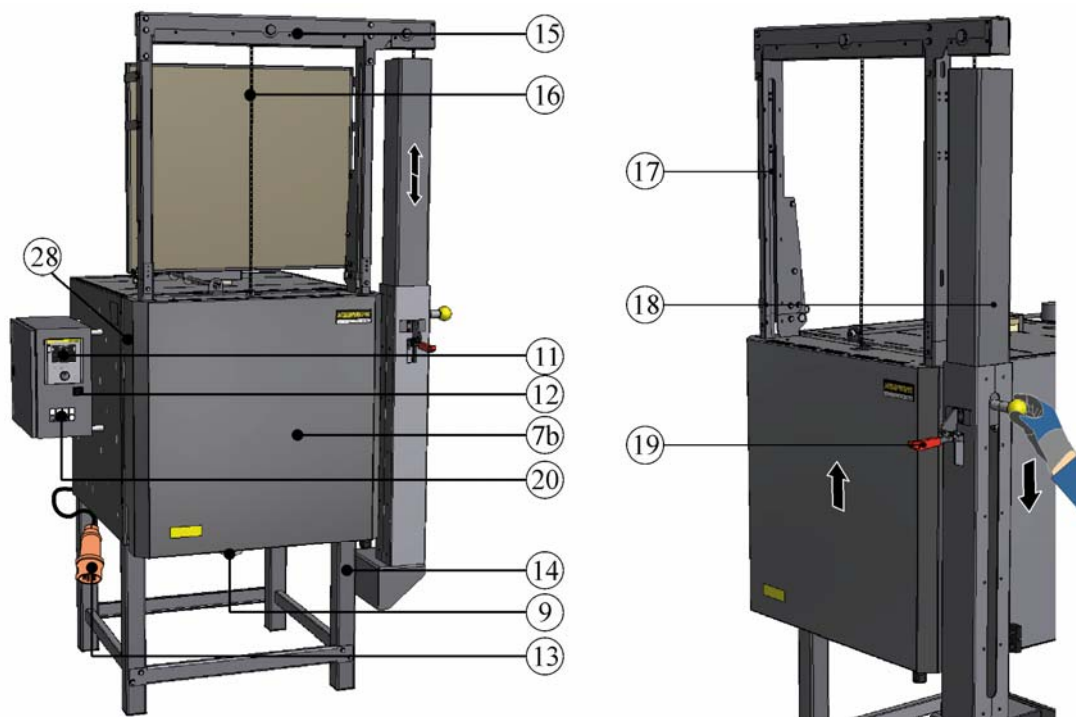
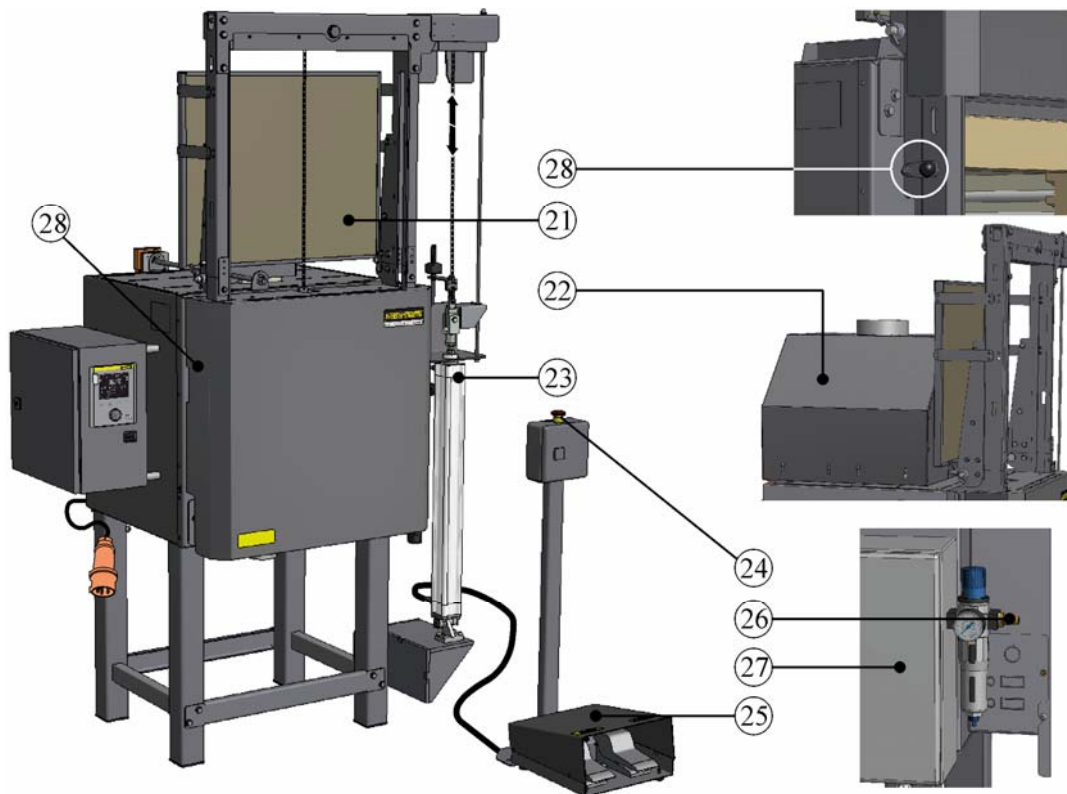


Fig. 3: Example: Chamber furnace LH 120/.. with cooling fan (accessory) including operating elements on the base which is closed all around (similar to picture)



Example: Chamber furnace with manual lift door



Example: Chamber furnace with pneumatic lift door

Fig. 4: The example shows chamber furnace LH 30/.. as accessories with manual lifting device using a chain block or pneumatic drive (similar to picture)

| No. | Name |
|-----|---|
| 1 | Bypass connection |
| 2 | Motor-driven exhaust air flap |
| 3 | Heating elements on support tubes |
| 4 | Furnace chamber of LH models: Multi-layer, fiber-free refractory insulation and special back insulation Furnace chamber of LF models: High-quality non-classified fiber insulation with corner bricks. |
| 5 | Handle |
| 6 | Protection for floor heating and level stacking surface through flush-mounted SiC floor plate |
| 7 | Swing door |
| 7a | Parallel swing door (accessory) |
| 7b | Lift door (accessory) |
| 8 | Door contact switch |
| 9 | Infinitely adjustable fresh-air flap in furnace floor |
| 10 | Door lock |
| 11 | Controller B400/C440/P470 (depending on model) with USB interface |
| 12 | Power switch with integrated fuse (switching oven on/off) |
| 13 | CEE power plug |
| 14 | Base |
| 15 | Guillotine with chain |
| 16 | Chain |
| 17 | Lift-door guide track |
| 18 | Manual lifting device using a chain block to open and close the lift door (manual lift door) |
| 19 | Lever to lock/unlock the lift door (manual lift door) |
| 20 | Operating, display and switching elements (depending on model) |
| 21 | Heat protection shield for furnaces with lift doors (accessory) |
| 22 | Exhaust air hood (flue) (accessory) |
| 23 | Pneumatic cylinder (pneumatic lift door) |
| 24 | EMERGENCY STOP button (stops the lift door movement) (pneumatic lift door) |
| 25 | Foot switch to open and close the lift door (pneumatic lift door) |
| 26 | Compressed air connection, quick-action coupling with 3/8" hose nozzle (pneumatic lift door) |
| 27 | Compressed air maintenance unit (pneumatic lift door) |
| 28 | Furnace door protection (only when a lift door is used) |
| | Castors as an accessory (not shown) |

| No. | Name |
|-----|---|
| 29 | Large cooling fan (accessory) |
| 30 | Closed base with removable side panels (only in combination with a large cooling fan) |
| 31 | Device circuit breaker (depending on design) |

Additional Equipment

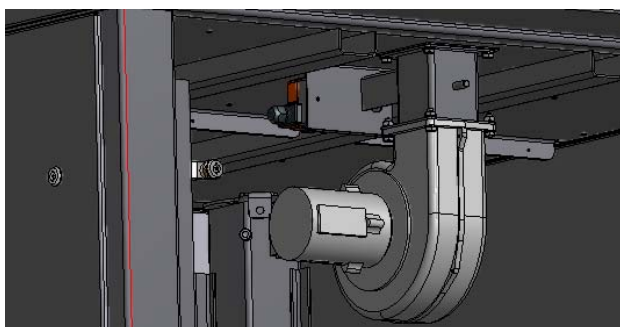


Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

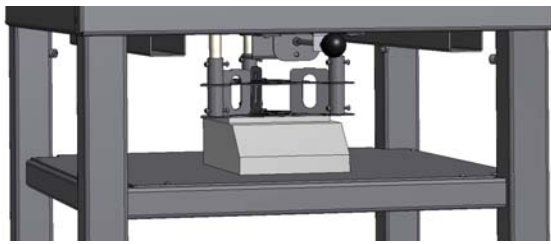
Fig. 5: Example (similar to picture)



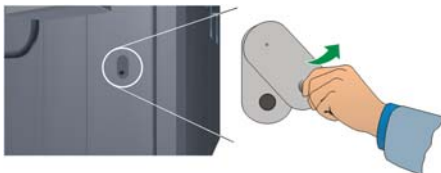
Gas supply system for non-flammable protective or reactive gas with shutoff valve and flow meter with regulator valve, piped and ready to connect (similar to picture)



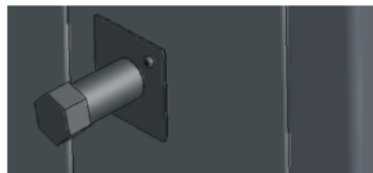
Controlled or uncontrolled cooling system with frequency-controlled cooling blower (similar to picture)



Weighing device to determine loss on ignition (similar to picture) (Model LH/LF .../..SW)



Variant A



Variant B

The hole is used, for example, for a thermocouple (similar to picture)

(depending on the design)

Accessories



Stainless steel exhaust hood (similar to picture)

Height adjustable via the screws on the bracket

1.3 Safeguarding against Dangers from Excess Temperatures

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

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

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

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

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



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

Fig. 6: Removing the sticker (similar to picture)

1.4 Key to the Model Names

| Example | Explanation |
|----------------------|---|
| LH 120/12SW | LH = Chamber furnace - fiber-free insulation of light refractory bricks LF = Chamber furnace – high-quality non-classified fiber insulation with corner bricks |
| LH 120 /12SW | 15 = 15-liter furnace chamber (volume in L) 216 = 216-liter furnace chamber (volume in L) |
| LH 120/ 12 SW | 12 = Tmax 1200 °C (2192 °F) 13 = Tmax 1300 °C (2372 °F) 14 = Tmax 1400 °C (2552 °F) |
| LH 120/12 SW | SW = Scale furnace with support frame and scale |













| Nabertherm <small>MORE THAN HEAT 30-3000 °C</small> Nabertherm GmbH Bahnhofstr. 20, 28865 Lilienthal/Bremen, Germany Tel +49 (04298) 922-0, Fax +49 (04298) 922-129 contact@nabertherm.de <small>www.nabertherm.com</small> Made in Germany | | |
|--|---------------------|-------|
| LH 120/12 | SN 123456 | 2017 |
| LH011H6SN | 1200 °C | 12 kW |
| – | 400 V 3/PE~ | – |
| – | 10, 1/10, 1/10, 1 A | – |

Fig. 7: Example: Model name (type plate)

1.5 Scope of Delivery

The scope of delivery includes:

| | Furnace components | Quantity | Comment |
|---|---|------------------|-----------------------------|
| | Chamber furnace N ... | 1 x | Nabertherm GmbH |
|  | Bypass connecting piece ¹⁾ | 1 x | Nabertherm GmbH |
|  | SiC floor board ¹⁾ | 3) | Nabertherm GmbH |
|  | Allen key | 1 x | Nabertherm GmbH |
|  | Ceramic underlayers ¹⁾ | 3 x | Nabertherm GmbH |
|  | Installation connecting piece ¹⁾ | 3 x | Nabertherm GmbH |
|  | Charging frame ²⁾ | 1x ²⁾ | Nabertherm GmbH |
|  | Forklift truck ²⁾ | 1x ²⁾ | Nabertherm GmbH |
|  | Gas supply system ¹⁾ | 4) | Nabertherm GmbH |
|  | Process documentation VCD software package ²⁾ | 1 x | Nabertherm GmbH |
| | Other components, variable depending on the particular furnace | - - - | Consult the shipping papers |
| | Document type | Quantity | Comment |
|  | Furnace Operating Instructions | 1 x | Nabertherm GmbH |
| | Controller Operating Instructions | 1 x | Nabertherm GmbH |
| | Operating instructions, over-temperature limit controller ¹⁾ | 1 x | Nabertherm GmbH |

| | | |
|---|-------|-----------------|
| Operating instructions for gas injection pane ²⁾ | 1 x | Nabertherm GmbH |
| Operating Instructions VCD software package ²⁾ | 1 x | Nabertherm GmbH |
| Other documents, variable dependent on the particular furnace | - - - | |

¹ in scope of delivery depends on design/furnace model

² in scope of delivery depend on need, see shipping papers

³ quantity depends on furnace model

⁴ quantity depends on on need, see shipping papers



Note

Make sure that all documents are carefully stored. All the functions of this furnace were tested during manufacturing and prior to shipping.



Note

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

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

2 Specifications



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

| Model | Tmax °C | Inner dimensions in mm | | | Volume in L | Outer dimensions in mm | | | Heating power in kW | Electrical connection | Weight in kg |
|------------------|------------|------------------------|-----|-----|----------------|------------------------|------|------|------------------------|-----------------------|-----------------|
| | | w | d | h | | W | D | H | | | |
| LH 15/12 | 1200 | 250 | 250 | 250 | 15 | 680 | 860 | 1230 | 5.0 | 3-phase ¹ | 170 |
| LH 30/12 | 1200 | 320 | 320 | 320 | 30 | 710 | 930 | 1290 | 7.0 | 3-phase ¹ | 200 |
| LH 60/12 | 1200 | 400 | 400 | 400 | 60 | 790 | 1080 | 1370 | 8.0 | 3-phase | 300 |
| LH 120/12 | 1200 | 500 | 500 | 500 | 120 | 890 | 1180 | 1470 | 12.0 | 3-phase | 410 |
| LH 216/12 | 1200 | 600 | 600 | 600 | 216 | 990 | 1280 | 1590 | 20.0 | 3-phase | 450 |
| LH 15/13 | 1300 | 250 | 250 | 250 | 15 | 680 | 860 | 1230 | 7.0 | 3-phase ¹ | 170 |
| LH 30/13 | 1300 | 320 | 320 | 320 | 30 | 710 | 930 | 1290 | 8.0 | 3-phase ¹ | 200 |
| LH 60/13 | 1300 | 400 | 400 | 400 | 60 | 790 | 1080 | 1370 | 11.0 | 3-phase | 300 |
| LH 120/13 | 1300 | 500 | 500 | 500 | 120 | 890 | 1180 | 1470 | 15.0 | 3-phase | 410 |
| LH 216/13 | 1300 | 600 | 600 | 600 | 216 | 990 | 1280 | 1590 | 22.0 | 3-phase | 460 |
| LH 15/14 | 1400 | 250 | 250 | 250 | 15 | 680 | 860 | 1230 | 8.0 | 3-phase ¹ | 170 |
| LH 30/14 | 1400 | 320 | 320 | 320 | 30 | 710 | 930 | 1290 | 10.0 | 3-phase ¹ | 200 |
| LH 60/14 | 1400 | 400 | 400 | 400 | 60 | 790 | 1080 | 1370 | 12.0 | 3-phase | 300 |
| LH 120/14 | 1400 | 500 | 500 | 500 | 120 | 890 | 1180 | 1470 | 18.0 | 3-phase | 410 |
| LH 216/14 | 1400 | 600 | 600 | 600 | 216 | 990 | 1280 | 1590 | 26.0 | 3-phase | 470 |
| LF 15/13 | 1300 | 250 | 250 | 250 | 15 | 680 | 860 | 1230 | 7.0 | 3-phase ¹ | 150 |

| | | | | | | | | | | | |
|-----------|------|-----|-----|-----|-----|-----|------|------|------|----------------------|-----|
| LF 30/13 | 1300 | 320 | 320 | 320 | 30 | 710 | 930 | 1290 | 8.0 | 3phasig ¹ | 180 |
| LF 60/13 | 1300 | 400 | 400 | 400 | 60 | 790 | 1080 | 1370 | 11.0 | 3-phase | 270 |
| LF 120/13 | 1300 | 500 | 500 | 500 | 120 | 890 | 1180 | 1470 | 15.0 | 3-phase | 370 |
| LF 15/14 | 1400 | 250 | 250 | 250 | 15 | 680 | 860 | 1230 | 8.0 | 3-phase ¹ | 150 |
| LF 30/14 | 1400 | 320 | 320 | 320 | 30 | 710 | 930 | 1290 | 10.0 | 3-phase ¹ | 180 |
| LF 60/14 | 1400 | 400 | 400 | 400 | 60 | 790 | 1080 | 1370 | 12.0 | 3-phase | 270 |
| LF 120/14 | 1400 | 500 | 500 | 500 | 120 | 890 | 1180 | 1470 | 18.0 | 3-phase | 970 |

¹Heating only between two phases

²Depending on furnace design connected load might be higher

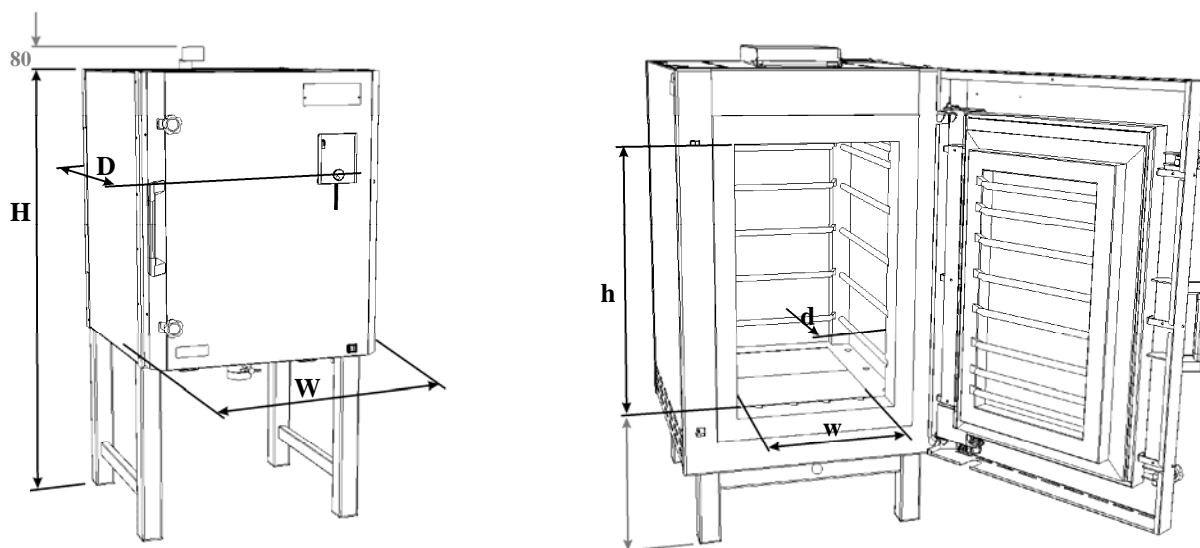


Fig. 8: Dimensions

| | | |
|--|----------------------------------|--|
| Electrical Connection | Voltage (V): | Consult type plate |
| | Frequency (Hz): | Consult type plate |
| | Electric current (A) | Consult type plate |
| Thermal Protection Class | Furnaces: | as specified in DIN EN 60519-2 without safety controller: Class 0 with safety controller: Class 2 |
| Protective Type | Furnaces: | IP20 |
| | Switch cabinet | IP40 |
| Ambient Conditions for Electrical Equipment | Temperature: Humidity: | +5 °C to + 40 °C max. 80 % not condensing |
| Weights | Furnace with accessories | Varies (consult the shipping papers) |
| Emissions | Continuous sound pressure level: | < 80 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.

Furnaces in this series are electrically heated furnaces suitable for sintering, hardening, or for the heat treatment of technical ceramics, metals, glass and also for use in laboratories.

- 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 and such uses must be approved in writing by Nabertherm.
- 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.



This furnace was designed for **private and commercial** use. The furnace is **NOT** to be used for heating food, animals, wood, grains, 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.



Note

See safety instructions in the individual sections.

The operator is liable for any resulting damages.



Note

The furnace must not be operated with explosive gases or mixtures or with explosive gases or mixtures that form during the process.

This furnace has **no** safety technology for processes in which combustible mixtures can form, such as debinding.

If the furnace is to be used for such processes, the concentration of organic gases must never exceed 3% of the lower explosive limit (LEL) in the furnace. This requirement not only applies to normal operation, but also especially to exceptions, such as process malfunctions (e.g. due to the breakdown of a unit, etc.). Ensure adequate extraction and ventilation of the furnace.

Nabertherm offers a wide range of furnaces that were especially developed for processes with flammable gases.



Note

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

4.2 Requirements for the Furnace Operator



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

This level of safety 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

- **This furnace is NOT used by certain persons (including children) with restricted physical, sensorial or mental capabilities or who have insufficient experience and/or insufficient knowledge, unless they are supervised by a person who is responsible for their safety or are instructed in how to use the furnace. Children should be supervised to make sure that they do not play with the furnace.**
- When ceramics, clay, or glaze are fired, they can emit gases and vapors that are harmful to your health. It is therefore necessary to make sure that the "exhaust gases" emitted from the exhaust air opening are directed outdoors in a suitable manner (ventilate the working area). If adequate ventilation cannot be ensured at the working area, the "exhaust gases" must be removed via a pipe (see "venting exhaust fumes").
- 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. **If applicable, read the labels and instructions on the packaging of materials that you use.**
- The furnace is operated only in a perfect operating condition and, in particular, that the functions of the safety components are checked regularly.
- Necessary personal protective equipment is available. Example: protective gloves, suitable apron, etc.
- This instruction manual is to be kept beside 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,
- 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,
- If the furnace is used commercially:
Observe the safety regulations applicable in your country. In Germany, the furnace must be checked by a qualified electrician at defined intervals in accordance with a regulation issued by the employers' accident insurance fund.

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 Protective Clothing



Wear heat-resistant gloves to protect your hands.



Wear safety boots to protect your feet.

4.4 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).

4.5 Basic Measures in Case of Emergency

4.5.1 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.

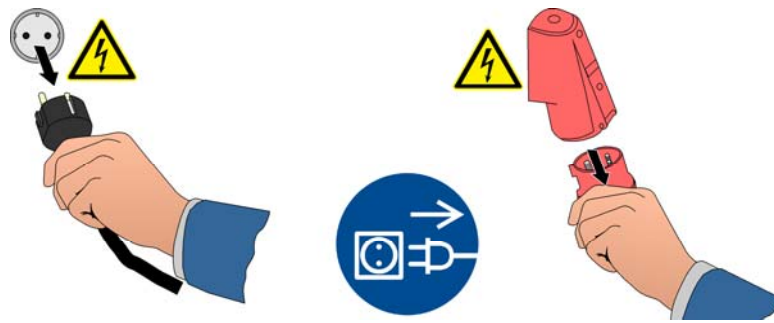


Fig. 9: Pull the power plug (similar to picture)



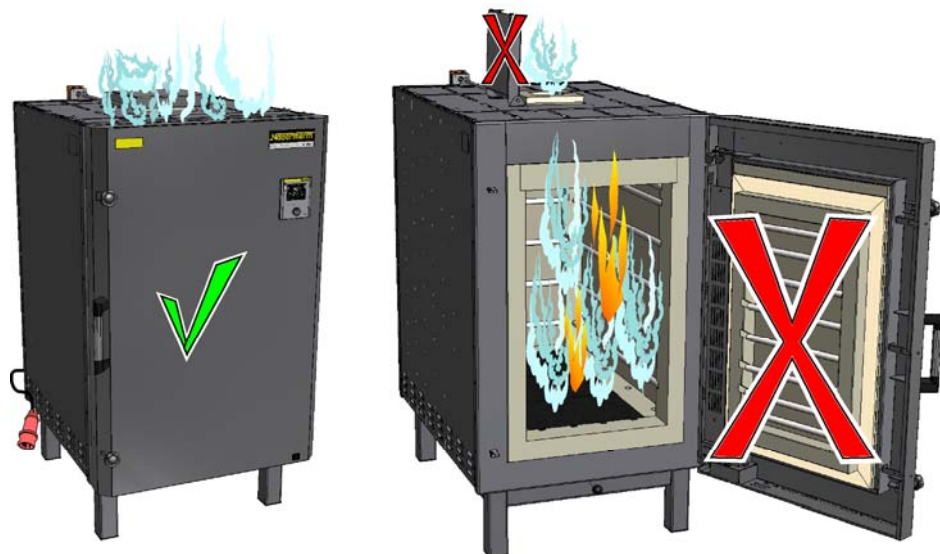
Risks during Normal Operation!

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 the door and exhaust-air flap (in included) closed. This will allow you to prevent the spread of smoke and keep out a supply of oxygen. Pull the power plug immediately.

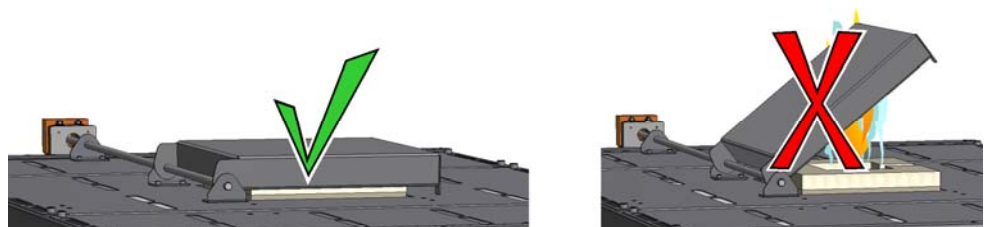
Keep doors and windows closed! This prevents the spread of smoke.

No matter how serious the fire is, contact the fire department without delay. When you call, speak calmly and clearly.

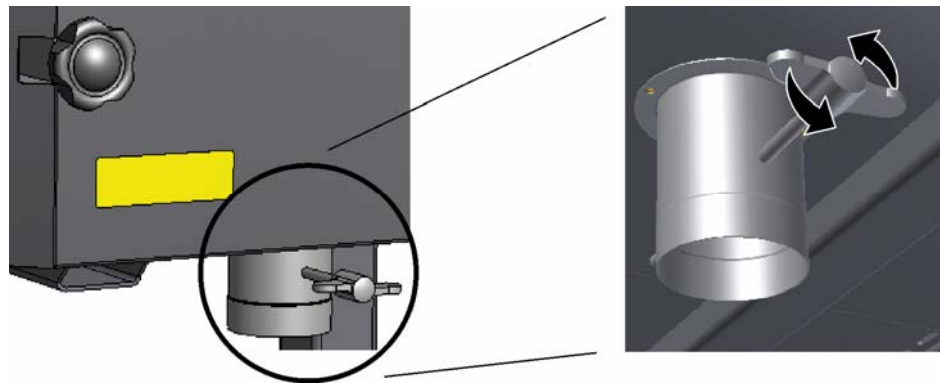





Similar to picture

The exhaust-air flaps must remain closed.



Close the fresh-air
Similar to picture



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

4.6 Basic Measures for Servicing and Maintenance

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

Switch the furnace off at the power supply **and pull out the plug.**

The furnace must be completely empty.

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/tensioning straps have been re-tightened,
- Reinstall protective equipment, screens, and filters If applicable),
- Remove all material, tools, and other equipment used for the maintenance or repair work from the working area of the furnace,
- Power cables may be replaced only with similar, approved cables.

4.7 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.

NOTICE

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

CAUTION

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

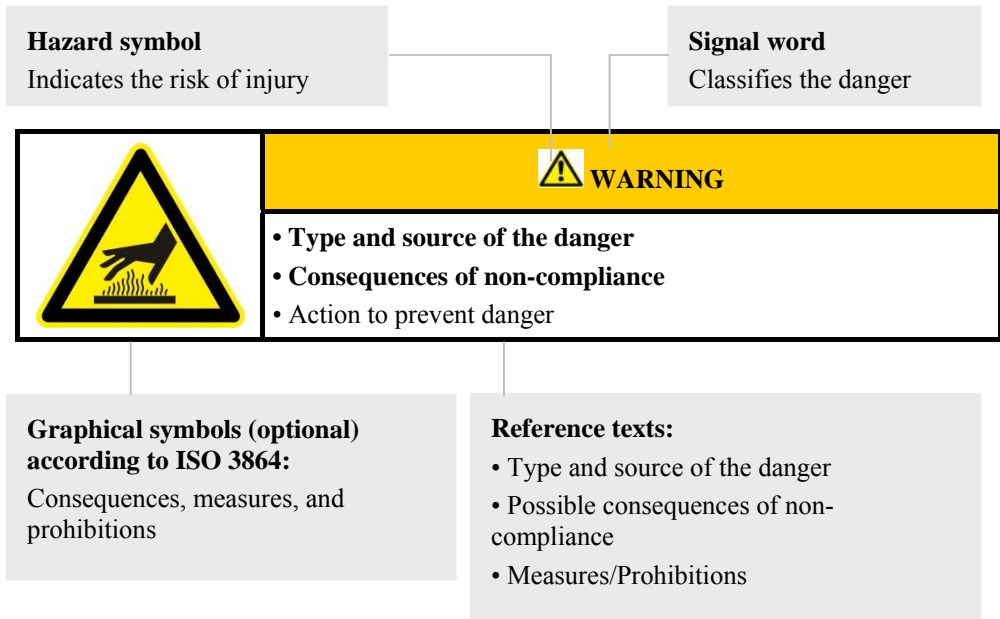
WARNING

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

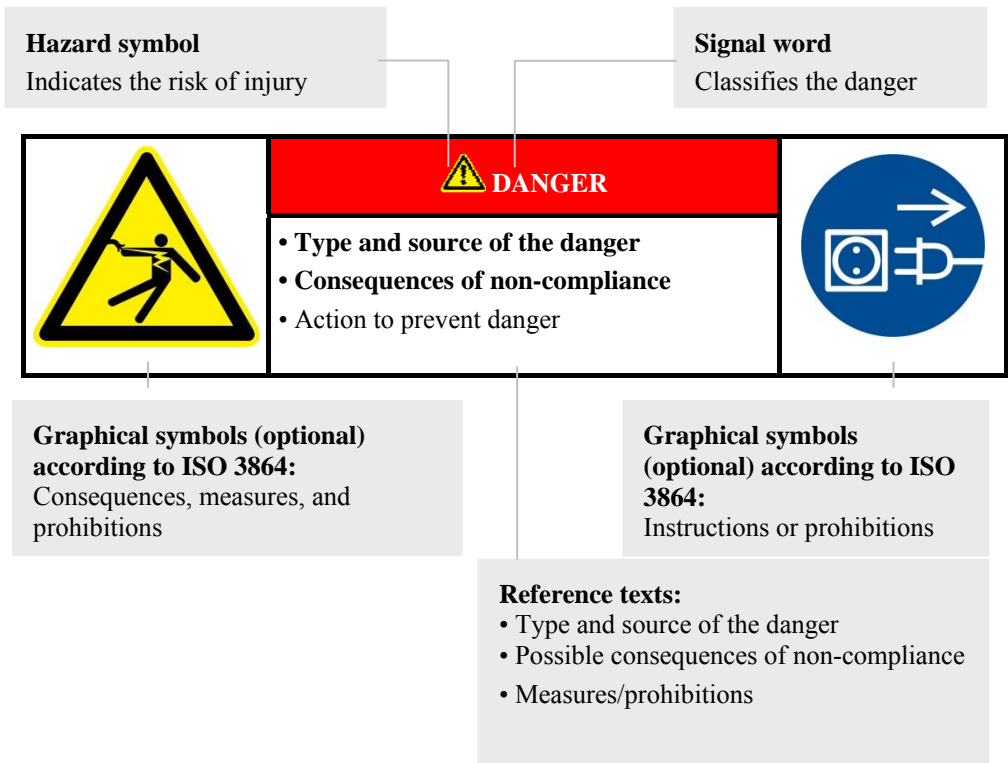
DANGER

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

Structure of the Warning: All Warnings are Structured as Follows



or



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 – 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.

**Caution – Danger of falling**

Ignoring this can lead to fatal injury. Danger of falling exists at a height less than 1.00 m above the ground or another sufficiently broad bearing surface (for example, on elevated operating positions and workplaces, working platforms, galleries, platforms, footbridges, flying bridges, ramps and stairways).

Openings and recesses through which people can fall (for example in floors, platforms, installation openings, hatchways and pits, non-bearing roofs).

**Warning - Fire Danger**

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

**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

4.8 General Risks with the Furnace



Warning! General Hazards!

Risk of burning on the furnace housing

The door handle/grip can become very hot during operation; wear gloves.

Risk of crushing on moving parts (door hinge)

The switchgear cabinet (if present) and the terminal boxes on the system contain dangerous electrical voltages.

Do not insert any objects into the openings on the furnace housing, exhaust air holes, or cooling slots on the switchgear or furnace (if present). This poses a risk of electric shock.

Fire hazard if an extension cable is used:

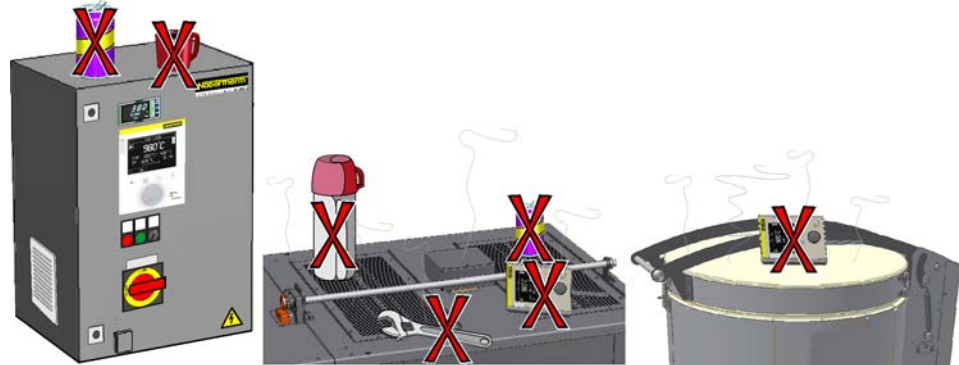
With 230 V furnace models make sure that:

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.






Warning – General hazards

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



DANGER

- **Danger 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.

| | | |
|---|--|---|
|  |  DANGER |  |
| | <p>• Danger from electrocution</p> <p>• If there is no earth connection, or the earth connection is poorly connected, the result may be a deadly electrical shock.</p> <p>• 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.</p> | |

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.

Appropriate protective gloves must be worn.

Safety Instructions

- Industrial trucks (e.g.: crane/pallet truck) must be operated only by authorized personnel. The operator bears sole responsibility for safe operation and the load.
- Use only lifting equipment with sufficient load-bearing capacity.
- 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.
- 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.
- Attach transportation equipment only to positions intended for this purpose.



Note

Wear protective gloves when installing the furnace.



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.

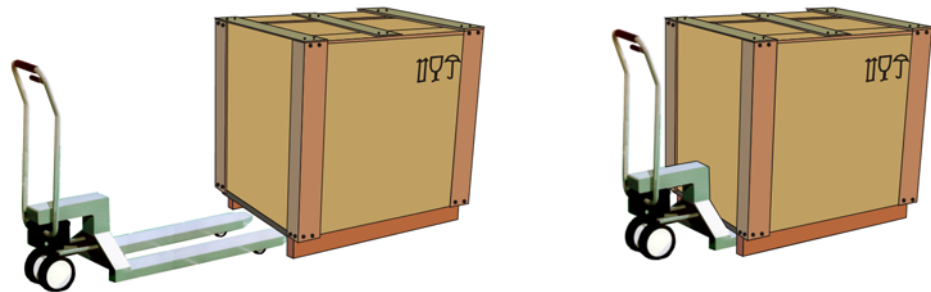




Fig. 10: Pallet truck is pushed **completely** beneath the transportation frame





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

Symbols:

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

| Description | Symbol | Explanation |
|--------------|--------|---|
| Fragile | | This symbol is to be attached to fragile goods. Goods marked like this are to be handled carefully and must not be thrown or tied up. |
| This side up | | The freight must be transported, transshipped, and stored in such a way that the arrows point upward. The freight must not be rolled, folded, or stored on edge. However, the package does not have to be packed on top of other freight. |

| Description | Symbol | Explanation |
|-------------|---|--|
| 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. |

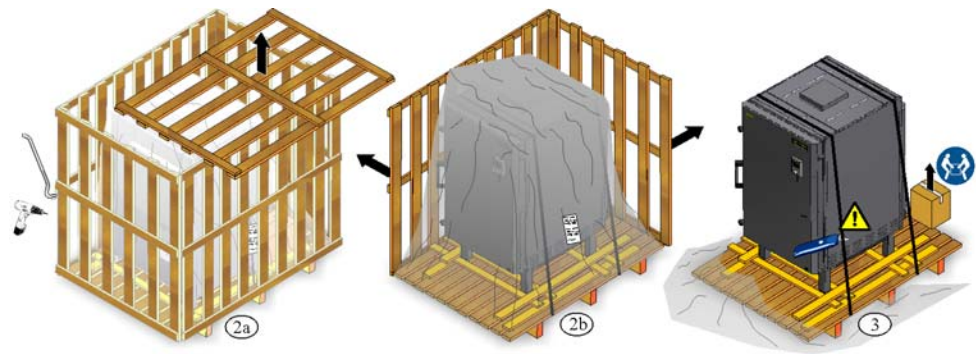
| | | |
|---|---|---|
|   |  CAUTION |  |
| | <ul style="list-style-type: none"> • Device may slip or topple over. • Damage to the device. • Risk of injury from lifting heavy loads. • Transport device only in original packaging. • Several people must carry the device. | |



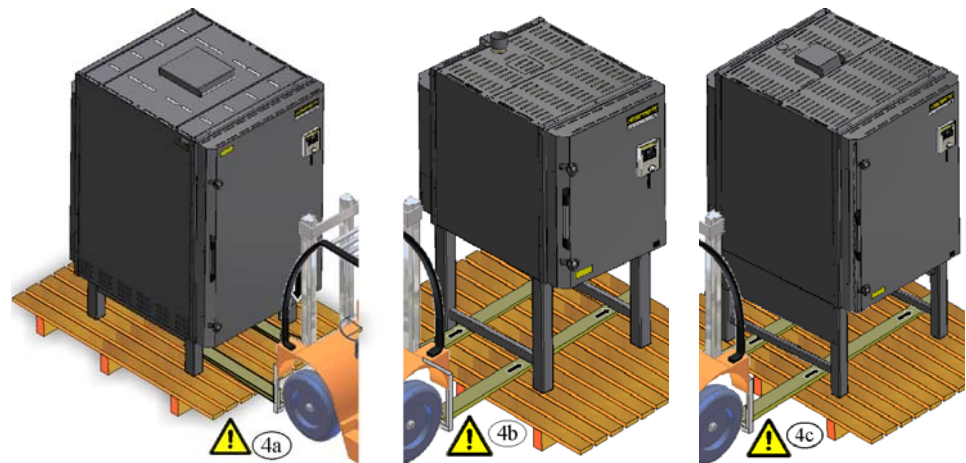
Wear protective gloves



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



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



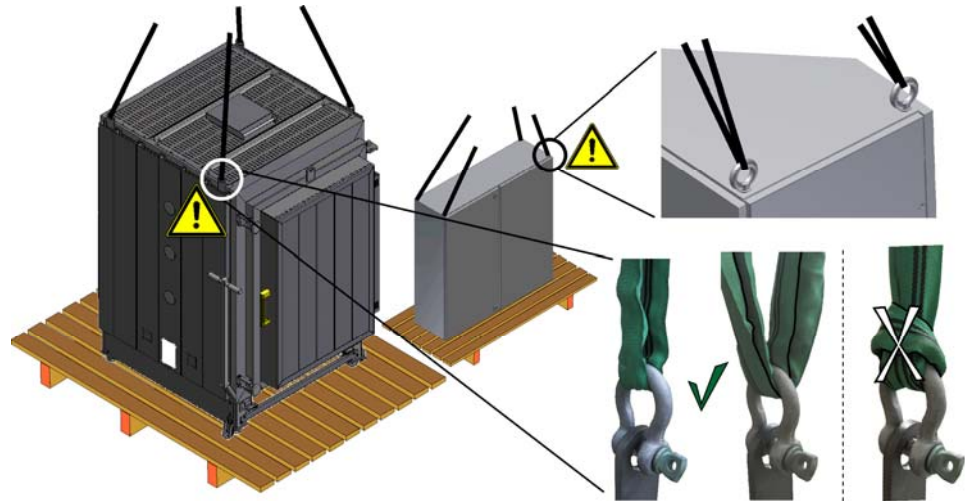
4. The furnace frame is made of thick steel sections. Move the forklift forks into position under the furnace (4a) or, if the furnace has a base, under the base, as shown in the picture (4b-4c), carefully avoiding any attachments and lines, which, if necessary, should be removed first. Make sure that the forks of the forklift are **completely** under the frame. Mind the nearby transported goods.

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

Caution

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

5.1.1 Furnace or Switchgear with Transportation Rings (if included)



The inner diameter of the lifting rings is roughly 35 mm. Attach an appropriate shackle to all the lifting rings.

Only use a suitable transportation strap on the shackle. The furnace/switchgear must not be lifted by its attachments, pipes or cable conduits. Lifting belts must not be tied together.

Avoid any sudden upward jerks. Working beneath a suspended load is prohibited. The risk of death is imminent. Lift and lower the furnace/switchgear carefully.

Note

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

5.2 Transport Securing Device/Packaging

The furnace packaging prevents damage during transportation. Make sure that you remove all packaging material. All packaging material can be recycled. The packaging was designed so that no special description is necessary.

Note

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



Safety information

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

Note

No special transportation securing equipment is available for this furnace

During transportation, the furnace collar and door insulation are protected against mechanical effects all round with foil or cardboard strips (depending on the model). We recommend that you remove this protection only when the furnace is installed and set up.



Fig. 11: Example: Removing the transportation protection (similar to picture)

5.3 Constructional and Connection Requirements

5.3.1 Installation (Furnace Location)

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

Floor Characteristics

- The furnace must be positioned in a dry room as stated in the safety instructions.
- The floor must be level to permit the furnace to stand upright.
- The load-bearing capacity of the floor must be rated to take the weight of the furnace plus the operating personnel.
- 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.

Installation Location

- The operator is responsible for adequate ventilation by installing the appropriate systems to supply fresh air and to vent exhaust air. If a batch emits gases or vapors, adequate ventilation of the installation site must be provided as well as a suitable exhaust air venting system. A suitable vent for combustion exhaust must be supplied by the customer
- Make sure that the heat radiated by the furnace is vented (consult a ventilation expert, if necessary)
- Although the furnace is well-insulated, the exterior surfaces of the furnace radiate heat. If necessary, this heat must be dissipated (**a ventilation technician may need to be consulted**). In addition, a minimum clearance (**S**) of 0.5 m on all sides and 1 m above the furnace must be maintained to flammable materials. In individual cases, more space must be chosen in order to match the local conditions. For **nonflammable materials**, the minimum **side** clearance can be reduced to 0.2 m.


- The furnace must be protected against weather and caustic atmospheres. Nabertherm accepts no liability or warranty claim for any corrosion damage as a result of installation in damp surroundings or for similar reasons.
- The furnace and switchgear are not designed to be operated outdoors.




Requirements related to the ambient conditions of the switchgear

- The switchgear x must be readily accessible.
- The floor must be level to permit the switchgear to stand upright.
- The furnace's electrical equipment is designed to operate in temperatures from + 5 °C to 40 °C (104 °F). At a temperature of 40 °C (104 °F) the humidity must not exceed 50 %. At lower temperatures the humidity can be higher (max. 80 %), but there must be no condensation.
- At higher temperatures the switch-cabinet coolers must be used. In case of higher humidity and very low temperatures, heaters must be used.
- The switchgear must be protected against heat, dust and moisture.
- The location must be sufficiently ventilated.

Connecting the switchgear

- When the switchgear is connected to the power source and, as necessary, to the furnace, a **clockwise rotating** field must be executed.
- Both connections must be made by specialized electricians. All applicable rules and legal regulations must be followed.
- Before connecting the furnace, the available supply voltage and frequency must be checked against the values stated on the type plate to ensure that they are identical.
- Check the protective conductor
- Select the cross sections of the feed line as specified in the schematic circuit.

| | |
|---|---|
|  |  DANGER |
| | <ul style="list-style-type: none"> • Risk of fire, danger to health. • Risk of fatal injury. • Adequate ventilation must be ensured at the installation location to remove exhaust heat and exhaust gases. |

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

Assembling the base if not assembled

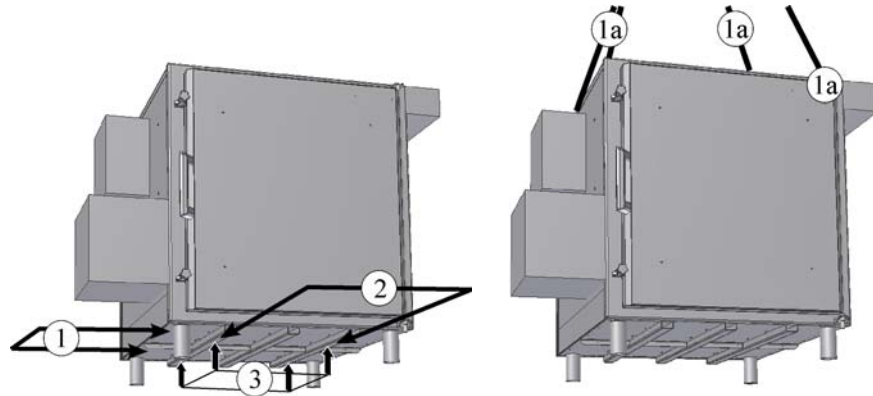


Fig. 12: Lifting the furnace with an industrial truck or crane (similar to picture)

Lifting the Furnace with a Suitable Industrial Truck

The forks of the industrial truck should be completely inserted under the furnace floor either from the side (1) or from the front (2). Only the floor profiles (3) of the furnace floor may rest on the forks of the industrial truck. Make sure the forks are clear of attachments, pipework or cable conduits. Lift the furnace gently; avoid any sudden movements.

Lifting the Furnace with a Suitable Crane

There are 4 lifting rings (1a) on the furnace for attaching shackles. The inner diameter of the lifting rings is roughly 35 mm. Attach an appropriate shackle to each of the 4 lifting rings. The lifting belts attached to the shackles must be adequate for the task (see the illustration "Lifting the furnace" in the section entitled "Unpacking"). The furnace must not be lifted by its attachments, pipes or cable conduits. Lifting belts must not be tied together. Lift the furnace gently; avoid any sudden movements.

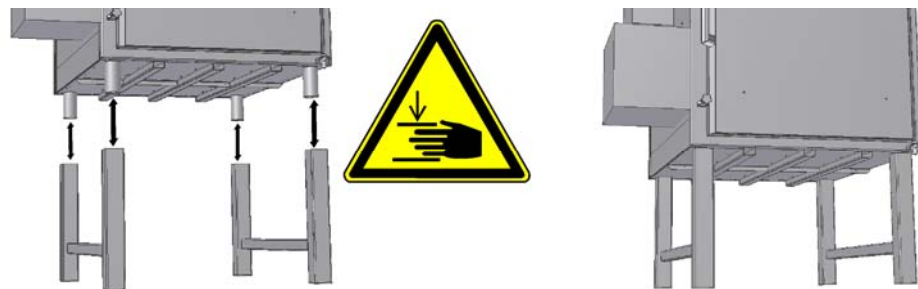
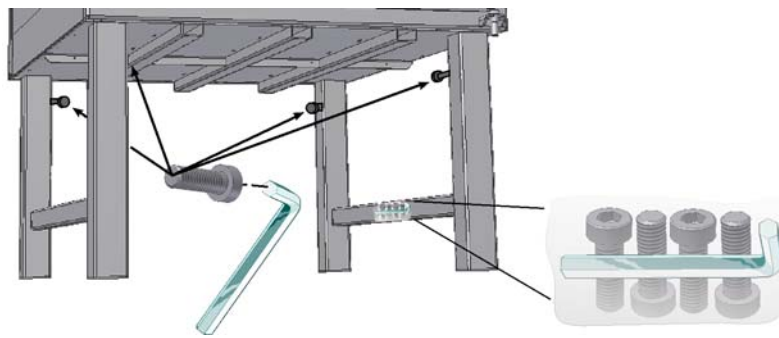


Fig. 13: Lowering onto the base frame (similar to picture)

Lower the furnace carefully onto the base frame and make sure that it rests securely in place.



Scope of delivery: 4x screws M10x30 mm / 1x Allen key 8 mm

Secure the base frame by attaching the screws included in the scope of delivery.

Fig. 14: Secure attachment of the base frame (similar to picture)



Caution

Nabertherm assumes no liability for damages caused by improper installation.

Installation of a Wall Cabinet System (in scope of delivery depending on design/furnace model)

The wall must provide a safe and secure mounting surface. The top of the box should not be higher than 2.00 m so that all the operating elements are easy to reach. (Hardware for the attachment is not included in the scope of delivery).

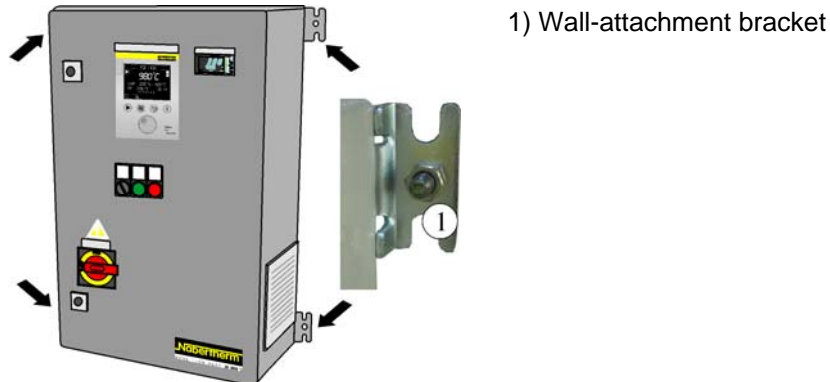


Fig. 15: Wall cabinet system (similar to picture)

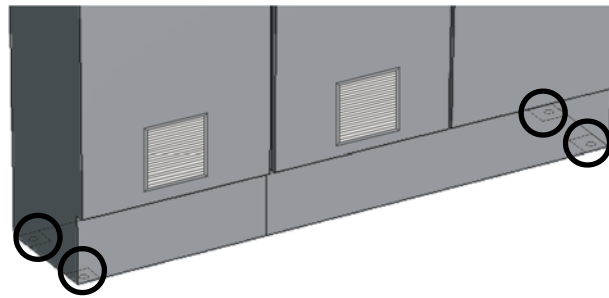


Note

Make sure you know where the power and water lines are located before you drill any holes. Nabertherm does not assume any liability for possible damage or injuries.

Installation of a Free-Standing System (in scope of delivery depending on design/furnace model)

- Secure the switchgear using the screws included in the delivery (The quantity of materials included in the scope of delivery can vary from one model to another).
- The number and position of the screws may differ from one furnace model to the next.



Scope of delivery:
-Height adjustment disks
-Threaded anchors

Fig. 16: Installing the switchgear



Note

To ensure that the floor switchgear cabinets are safely and securely installed we recommend that they be bolted to the floor. The switchgear cabinets supplied by Nabertherm are provided with bores in the base for this purpose.


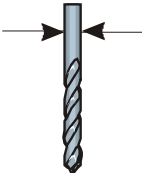
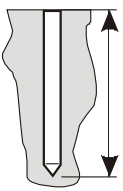


5.3.2 Installation Package for Installing the Furnace Framework

The safe and secure installation of the furnace requires that these safety instructions be followed:

- The floor must be level to permit the furnace to stand upright. Level the furnace with a water level. Use the height adjustment disks from the installation package to compensate for any unevenness in the floor.
- The bearing capacity of the floor must be dimensioned to hold the weight of the furnace and the operators.
- Installation of the compound anchor cartridges and anchor rod see "Chemical Anchor Capsule/Anchor Rod Installation Instructions".

5.3.3 Chemical Anchor Capsule/Anchor Rod Installation Instructions

The chemical anchor capsule contains a number of components (synthetic resin, quartz sand) and a special hardener encapsulated in a glass tube. When the anchor rod is vibrated into the cleaned drill hole using a hammer drill or impact drill, the glass is broken up by the chiseled end of the anchor rod and the hardener is mixed with the other components. A fast-setting synthetic resin mortar forms in a reaction, producing a stronger bond between the anchor rod and the drill hole than embedding in concrete would achieve. The absolutely stress-free anchor makes this system far superior to expansion dowels and results in a high load capacity (up to 60 kN) even with small edge distances and axial spacings.

| | | | | |
|---|---|--|---|---|
|  |  |  |  |  |
| Chemical Anchor Capsule | Ø in mm | mm | Nm | Anchor Rod |
| M10 | 12 | 90 | 20 | M10 |
| M12 | 14 | 110 | 40 | M12 |
| M14 | 16 | 120 | 50 | M14 |
| M16 | 18 | 125 | 60 | M16 |
| M20 | 25 | 170 | 150 | M20 |



Suitable Building Materials:

Allowed for uncracked concrete grades B15 to B55. Also suitable for dense natural stone.

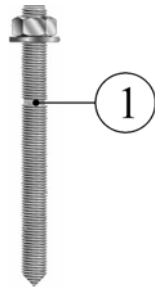
Allowable Loads:

Allowed for loads of 3 kN to 60 kN in the compression zone.


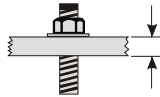

The anchor can be fully loaded after the specified cure time.

| | |
|---|---|
|  |  |
| > 20° | 10 min |
| 10°–20° | 20 min |
| 0°–9° | 45 min |
| -5°–1° | 4 h |

Anchor Rod



1) Embedment depth mark

| | | |
|--|---|---|
|  |  |  |
| Anchor Rod | mm | mm |
| M10 | 20 | 130 |
| M12 | 25 | 160 |
| M14 | 38 | 170 |
| M16 | 35 | 190 |
| M20 | 70 | 260 |

Installation Type:

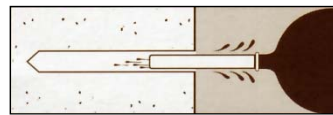
- Threaded rod

Installation Instructions:

- Insert the anchor rod with a rotary-impact electric tool (impact drill, hammer drill).
- Can also be used in wet concrete and under water.



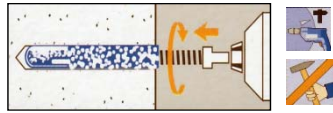
Drill hole with depth and diameter according to specifications given in the above table.



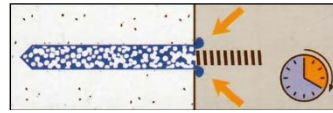
Thoroughly clean (blow out) drill hole.



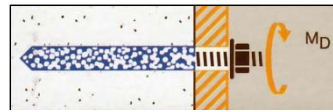
Insert chemical anchor capsule completely into drill hole.



To facilitate installation, the anchor rod has a hexagonal head. Vibrate anchor rod down to embedment depth mark. Then immediately shut off drill and remove from anchor rod.




The synthetic resin bonds the entire inserted surface of the anchor rod to the wall of the drill hole and largely seals the hole. Do not remove excess resin.



The anchor can be fully loaded after the specified cure time (see above table).

Hazard Information:

| | |
|---|---|
|  Xi – Irritant | R 43: May cause skin sensitization on contact. |
| | S36/37: Wear suitable gloves and protective clothing when |
| | S60: This product and its container must be disposed of as hazardous waste. |
| General Information | Change clothes if contaminated with product. |
| Following inhalation | Ensure adequate ventilation. Consult a doctor in case of symptoms. |
| Following contact with skin | In case of contact with skin, immediately wash off with plenty of soap and water. Consult a doctor if skin irritation persists. |
| Following contact with eyes | In case of contact with eyes, rinse thoroughly with plenty of water and consult a doctor. |
| Following ingestion | Not applicable |
| Instructions for physicians | Treat symptoms. |
| Safety data sheet | 1907/2006/EC |

5.4 Assembly, Installation, and Connection

5.4.1 Installation and Mounting of the Lift-Gate Guide Tracks

Set-Up and Assembly of Lift-Gate and Guillotine Guide Tracks

Danger of Injury



When lifting the furnace, parts of the guillotine or the guillotine itself could fall over or drop. Before assembly work begins, anyone not involved with this task must leave the work area. Safety shoes and hardhats must be worn.

Safety Instructions

- Only authorized personnel may operate industrial trucks. The operator bears sole responsibility for safe operation and the load.
- Only use lifting equipment with sufficient load-bearing capacity.
- Suitable lifting straps must be attached only to those positions which have been designated for this purpose.
- At no time should attachments, pipework or cable conduits be used for attaching the lifting equipment.
- Unpackaged parts should only be lifted using hoisting or belt slings.
- Lifting and slinging equipment must conform to the provisions contained in accident-prevention regulations.
- Parts made of special steel (including hardware elements) must always be kept separate from those made of unalloyed steel.
- Do not remove corrosion protection until immediately prior to assembly.

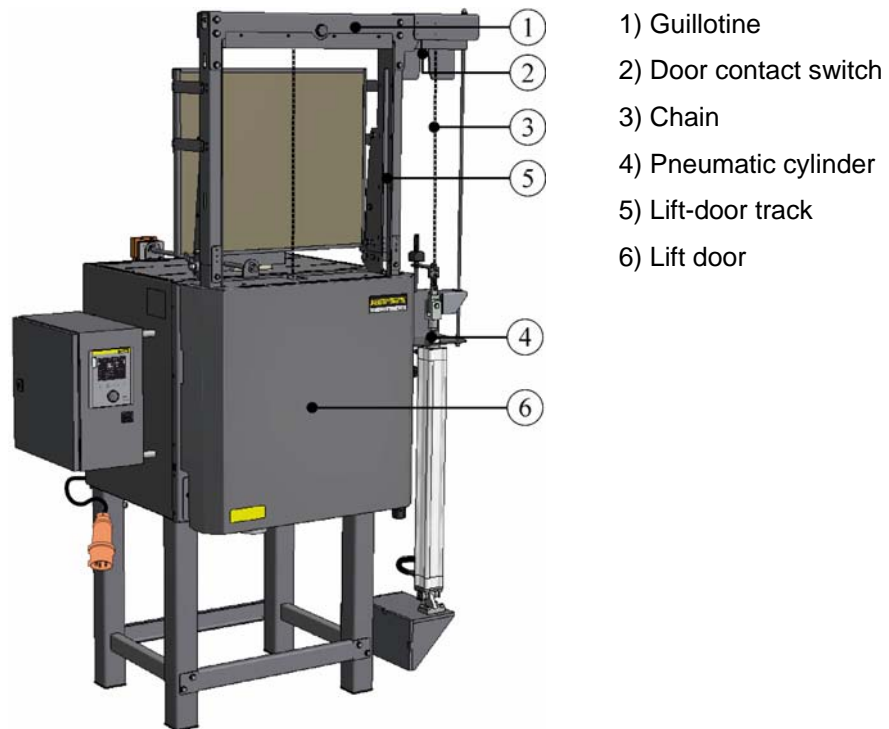


Fig. 17: Lift-door guide track and guillotine (similar to picture)



Warning - Dangers During Normal Operation!

Swinging or suspended loads are dangerous. Working beneath a suspended load is prohibited. The risk of death is imminent.



Caution

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

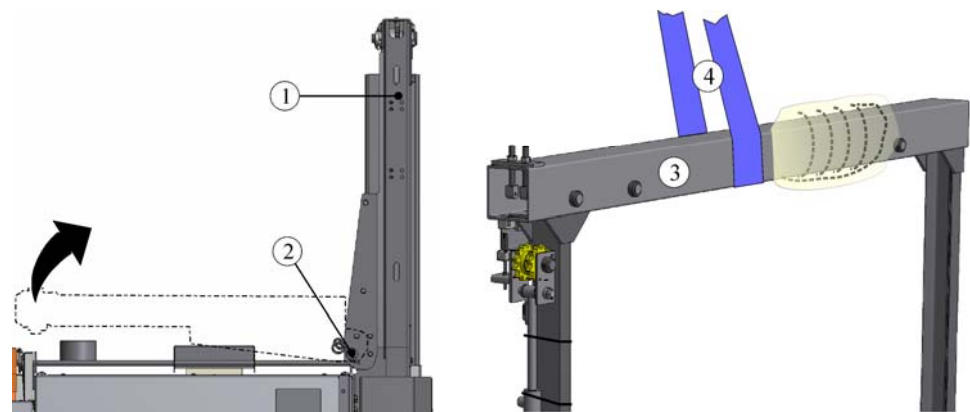


Warning - Danger of Electric Shock!

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

Erecting the Guillotine

Remove all packaging material (We recommend leaving the packaged chain on the guillotine until it has been erected.). Remove the requisite hexagon bolts and washers at the joint of the lift door guide track with a suitable tool and keep them for installing the lift-door guide track later. Raise the lift door guide track slowly and carefully on the guillotine using a suitable transportation strap. The furnace must not be lifted by its attachments, pipes or cable conduits. Avoid any sudden upward jerks. For safety reasons the transportation strap must **not** be removed after the lift door track has been raised.



1) Lift-door track 2) Joint 3) Guillotine 4) Transportation strap

Fig. 18: Erecting the guillotine (similar to picture)

Installing the Lift Door Track

Fasten the lift-door track with the previously removed hexagon bolts incl. washers with suitable tool to the furnace frame, turning clockwise, ensure that they are firmly secured and tighten as necessarily.

After a check, the transport strap can be removed from the guillotine

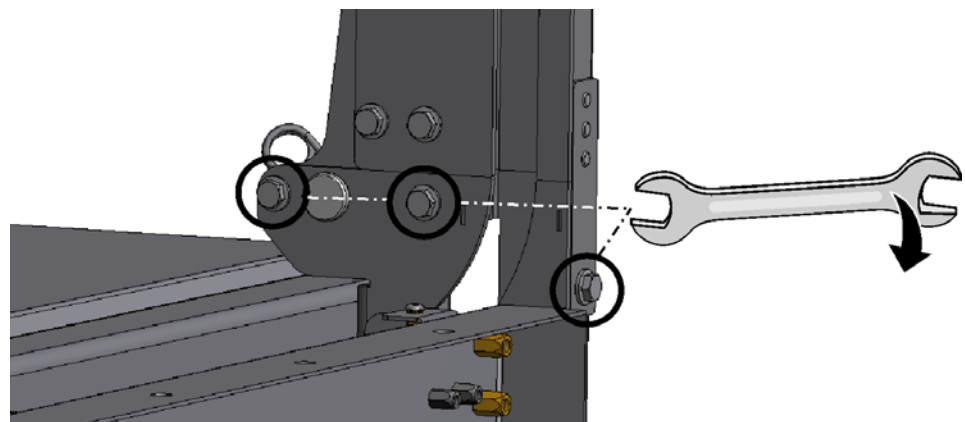


Fig. 19: Installing the Lift Door Track (similar to picture)

Remove Fastening Material

Carefully remove any fastening material attached to the lift door track and the guillotine. These are generally on the chain or the pneumatic cylinder.

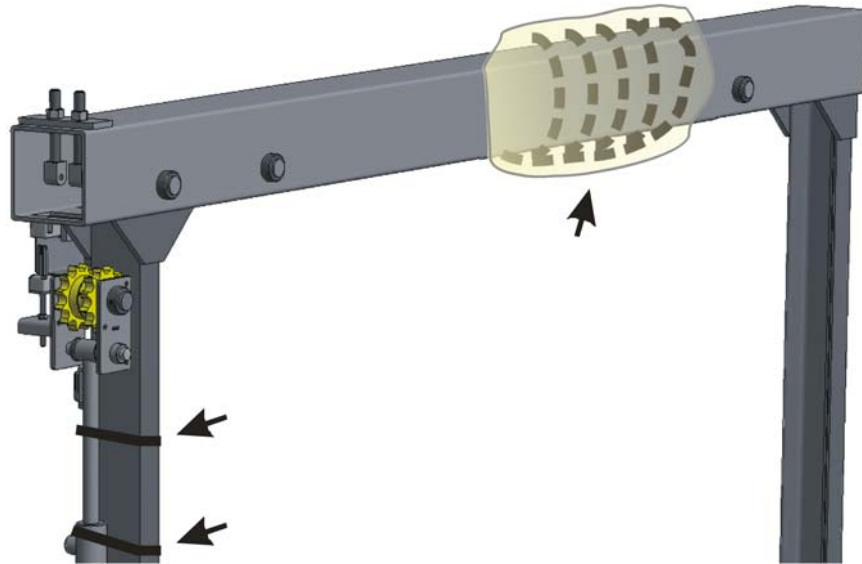


Fig. 20: Removing the Fastening Material (similar to picture)

Installing the guide rod

The guide rod (1) included with the delivery was removed for transportation and must be installed again between the cylinder guide (2) and the bracket for the door contact switch (3) (on the guillotine) once the guillotine has been aligned and installed. Undo the fixing material from one side of the guide rod (dome nut/washer) and slide this end (1) through the cylinder guide (2) from below until it touches the bracket (3) on the guillotine. Fix the rod with the previously removed washer and dome nut (A/B) and make sure that both sides sit firmly. Before installing the guide rod, make sure that it is not bent.

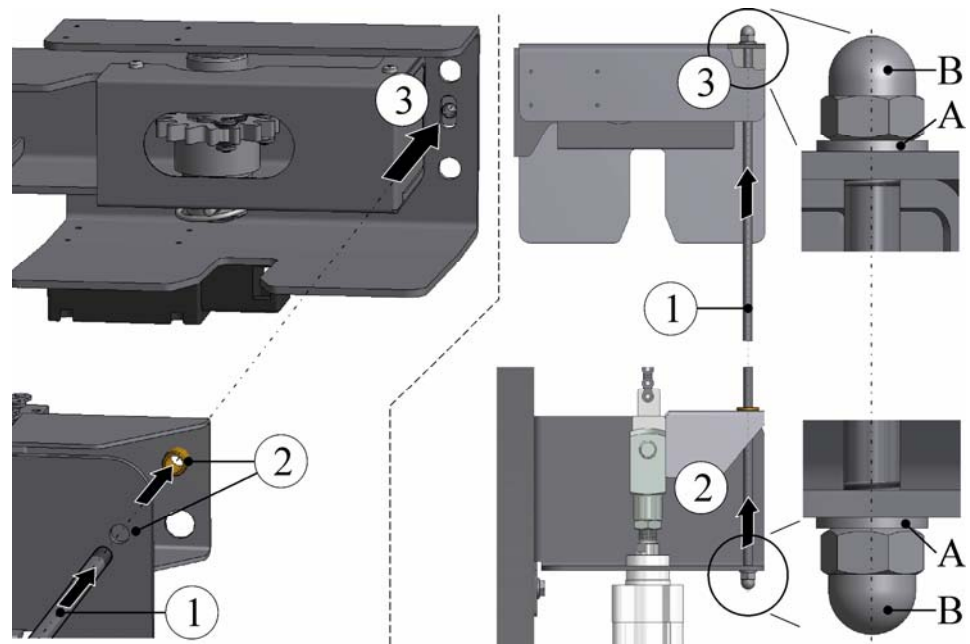


Fig. 21: Example: Installing the guide rod (similar to picture)

Installing the door contact switch

Attach the door contact switch to the lift door track with a suitable tool. When connecting the door contact switch check for any signs of damage. A damaged door contact switch must **not** be used. It must be replaced with an equivalent. Ensure that the cable to the door contact switch is run correctly and safely.



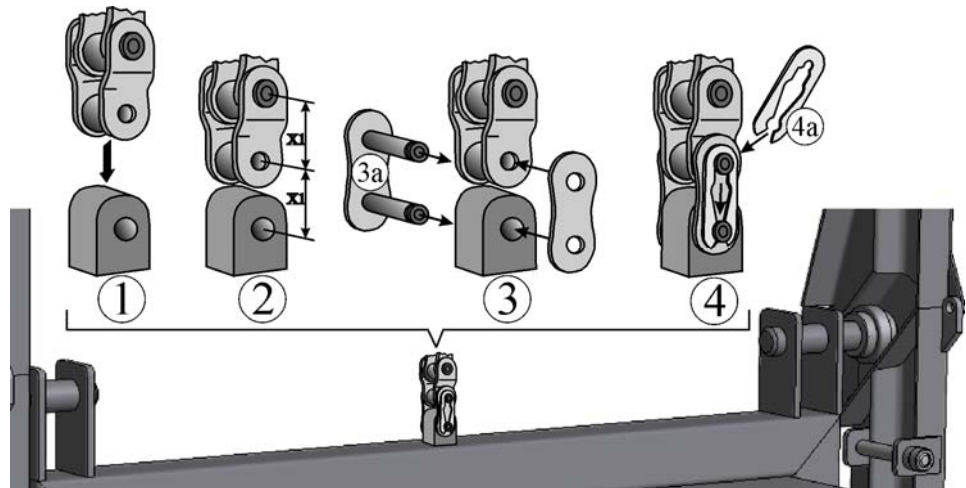
Fig. 22: Example: Installing the door contact switch (similar to picture)

Installing the Chain to the Lift Door

Connect the chain to the chain suspension unit of the lift door and secure it with the chain lock. The chain lock must be slid into the appropriate ring groove of the lock member rivet bolts to secure the chain.

Ensure that the chain lock is securely connected.

The chain is installed in the sequence of steps shown in the figure below.



3a) Lock member rivet bolts 4a) Chain lock

Fig. 23: Installing the chain (similar to picture)

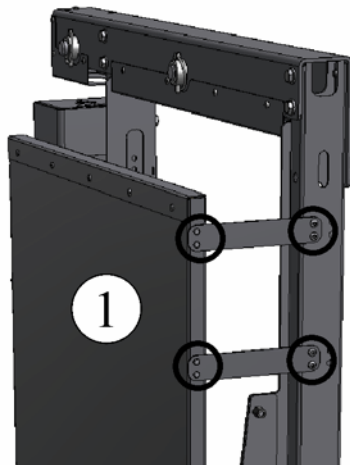
Removing the Transportation Fittings (furnace model with safety latch)

The door collar and lift-door insulation are extremely vulnerable to breakage when exposed to mechanical stress during transportation. To prevent the insulation from "abrading" on the door collar during transportation there are small wood blocks where the guide rollers are located. After the furnace system has been connected to the power source and is ready to operate. Drive the lift door to the upper position until the lift has been secured by the furnace door block (see section "Operating the Lift Door").

| | | |
|--|---|--|
| | ! WARNING | |
| | <ul style="list-style-type: none"> • Danger of crushing in the guide rollers of the lift door • Fingers/hands exposed to crushing • Only after the lift door has been secured using the furnace door lock on the lift door track can the transportation fittings be removed. | |

Installing the heat protection shield (depending on model)

Use a suitable tool to fix the heat protection shield to the lift door guide with the supplied screws and make sure that it sits firmly in place; tighten the screws if necessary.



1) Heat protection shield (when present)

Fig. 24: Installing the heat protection shield (depending on model) (similar to picture)

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.

Connecting the coupling socket with the quick-action coupling with a pneumatic door opener (accessory)

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

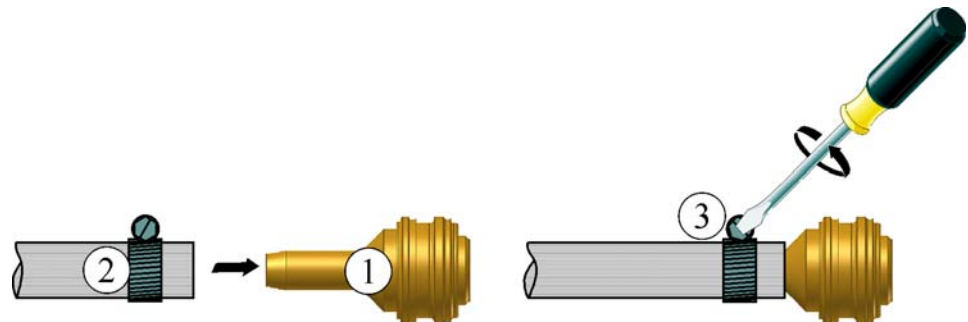


Fig. 25: Connection between coupling socket and hose (similar to picture)

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



Fig. 26: Connection between coupling socket and quick-action coupling (similar to picture)

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

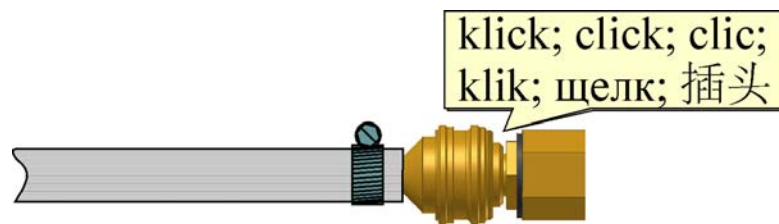


Fig. 27: Connection between coupling socket and quick-action coupling (similar to picture)

Disconnect the Connection at the Coupling Socket and the Quick Coupling

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

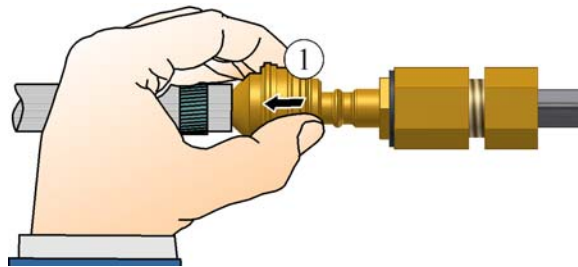


Fig. 28: Disconnect the coupling socket from the quick coupling (similar to picture)

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

5.4.2 Setting the Traveling Distance for the Pneumatic Door Opener

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

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

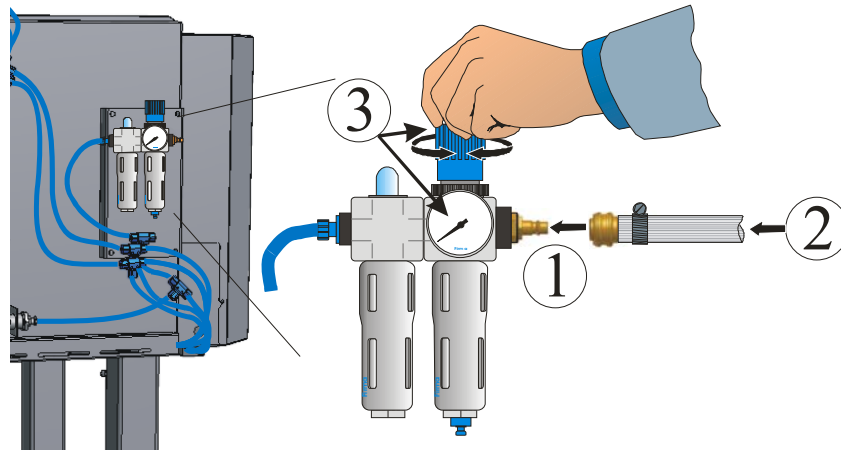


Fig. 29: Operating pressure (similar to picture)

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

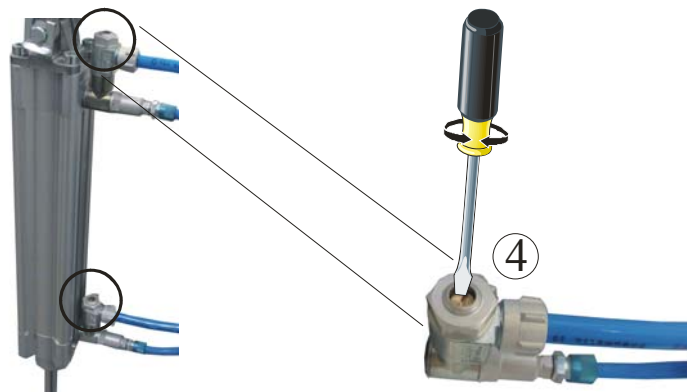


Fig. 30: Closing and opening speed of the door (similar to picture)

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

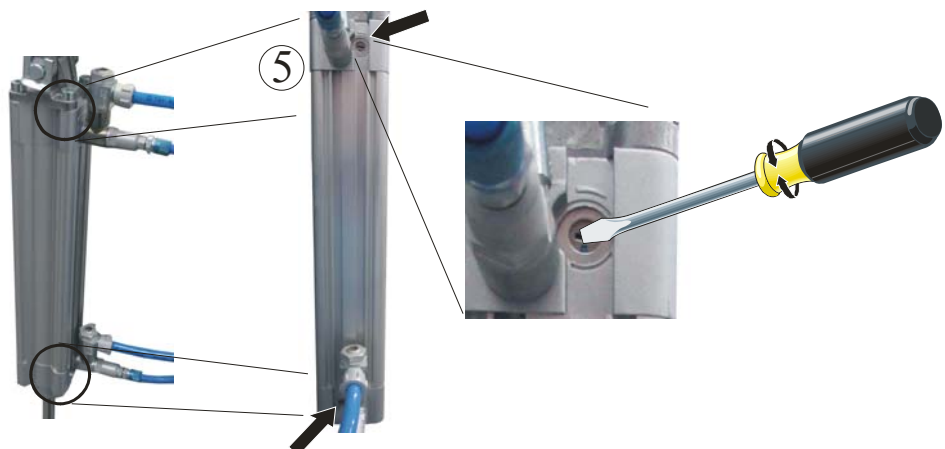


Fig. 31: Set the cushioned stop position (similar to picture)

5.4.3 Assembling the Bypass Connection

Mount the bypass connection (model-related) that is part of the delivery on the furnace.

- At the bypass connection position there are screws (1) to assemble the connection; these must be loosened beforehand.
- Place the bypass connection (2) with the screws loosened on to the correct position on the furnace and fasten it with suitable tools.

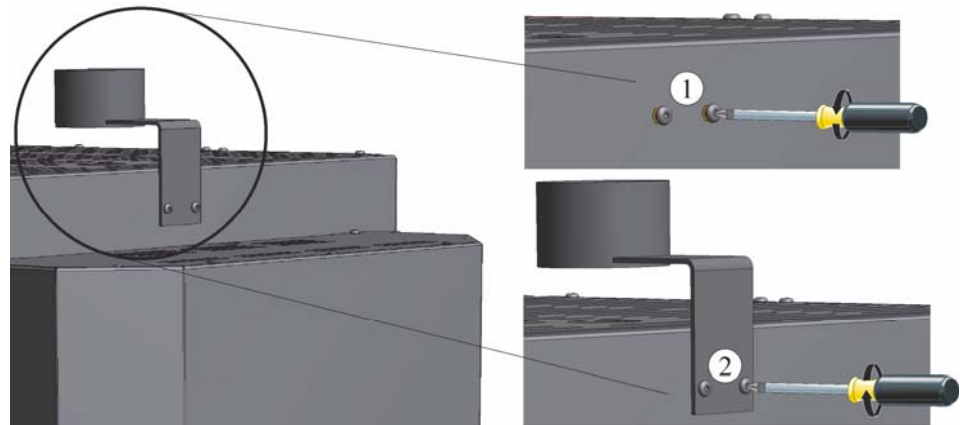


Fig. 32: Assembling the bypass connection (similar to picture)

5.4.4 Assembling the Air Inlet Flap After Assembling the Frame

When the furnace has been carefully placed on the frame (1) and has been secured in place with the screws, the air inlet flap can be installed under the floor of the furnace (see Installation (Furnace Location) – Installing the Frame if not Installed).

Where the air inlet flap is to be installed, there are screws (3) to fasten the air inlet flap that first have to be undone (the quantity and position of the screws depend on the furnace model).

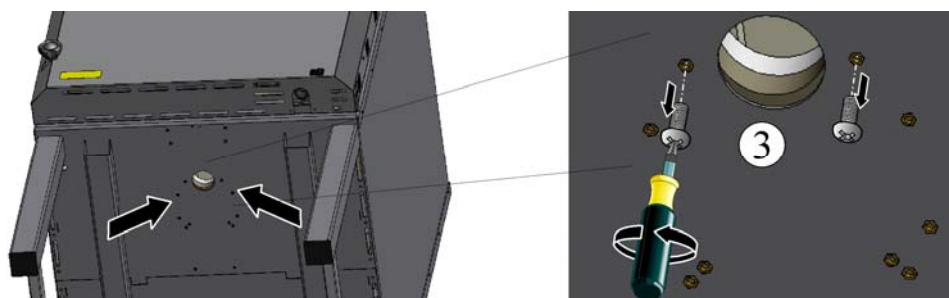


Fig. 33: Undo the screws of the air inlet flap (similar to picture)

Place the air inlet flap with the screws at the correct position on the furnace floor and fasten with a suitable tool. Check that the connection (screws) between the air inlet flap and the furnace floor is firm.

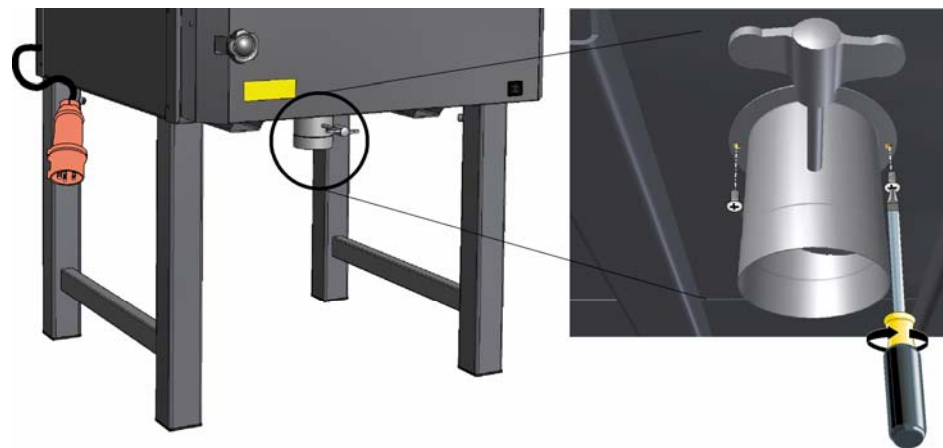


Fig. 34: Installing the air inlet flap (similar to picture)

5.4.5 Place the Controller in the Holder on the Furnace (model-related)

Place the controller in the holder on the furnace.

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



Fig. 35: Place the controller in the holder on the furnace (similar to the picture)

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

5.4.6 Installing the Scale (Accessory) Model LH ../..SW

- Place the supplied scale (1) in the bracket in the middle beneath the furnace.
- Place the weighing device (2) on the scale and undo the adjusting screw (3) of the weighing device (do not unscrew it completely).
- Carefully insert the ceramic plungers (4) into the holes on the base from inside the furnace and carefully place them in the weighing device (2).
- Inside the furnace, place the weighing plate (5) on to the ceramic plunger.

- Align the weighing device and ceramic plungers on the scale so that the plungers are not on top of the holes to the furnace. If the ceramic plungers “touch” the holes (insulation) in the base of the furnace, the measurement result can be distorted.
- The ceramic plungers (4) can be aligned with the adjusting screws (3).
- Connect the scale with the plug.
- Regarding the functions of the scale: refer to the separate instructions
- Separate instructions for VCD software (optional)

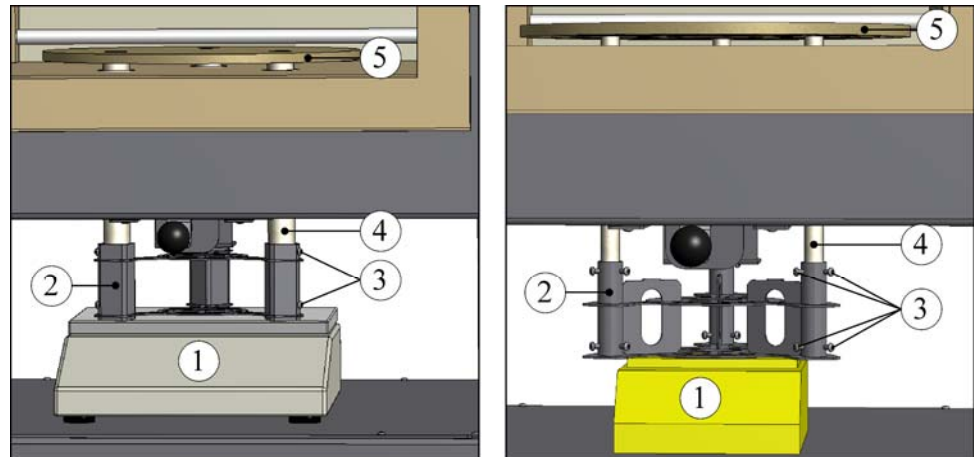


Fig. 36: Scale (similar to picture)

Note

Instructions, data and help on the scale can be found in the operating instructions for your scale.

5.4.7 Venting Exhaust Fumes

Exhaust air control without piping/hood

If the process causes the release of hazardous vapors or gases, the operator must vent the exhaust gases **through the exhaust-air flaps to a suitable exhaust air purification system out of the building and supply sufficient fresh-air for the inlet flap.**

In this case the operation of the furnace is not permissible without a suitable exhaust air purification system and exhaust air pipework to carry the exhaust out of the building.

You must ensure that the hot air emitted by the furnace does not endanger people, property or the building.

When starting up, you must ensure that enough fresh air (room ventilation) comes into the room (for example: by opening windows).

If no exhaust top hat is included in the scope of delivery, an equivalent construction must be provided.

Large heat loads released into the working environment during cooling may have to be drawn off by a structure built for that purpose. This also applies if the room housing the furnace is small. Even when the exhaust-air flaps are closed enormous heat loads can be produced.

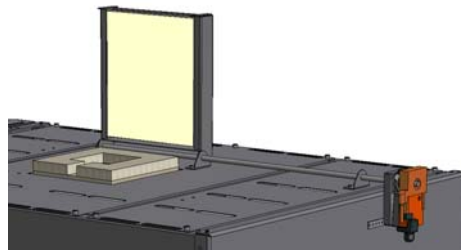
The exhaust can be removed passively by the natural draw of the extended piping or actively by a suction unit provided by the customer.

A passive or active suction system must be able to draw off the air flows and temperatures produced by the furnace. Any bottleneck or backing up in the direction of the furnace is not permissible.

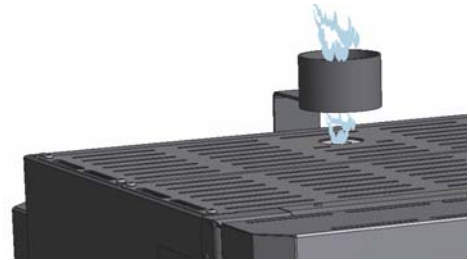


Caution

The exhaust can only be vented if the workspace is ventilated with a corresponding fresh-air opening (for example: by opening windows).



Exhaust air flap



Bypass nozzle for forced ventilation/gas outlet

Fig. 37: Exhaust air flap/bypass nozzles (similar to picture)

Exhaust air control with piping

When ceramics are fired, depending on the quality of the clay and/or glaze, they can emit gases and vapors that are harmful to your health. It is therefore necessary to make sure that the "exhaust gases" emitted from the exhaust air opening are directed outdoors in a suitable manner (ventilate the working area). If adequate ventilation cannot be ensured at the working area, the "exhaust gases" must be removed via a pipe. We recommend that you connect a pipe to the furnace to remove the exhaust gases.

A suitable metal exhaust gas pipe with NW80 can be used to vent the gases. Use only metal pipes (example: stainless steel). The pipe must be attached facing upwards and be fixed to the wall or ceiling. Adequate room ventilation is needed to achieve the bypass effect.

Vapors may not be extracted through a fan.

Assume a maximum exhaust gas temperature of approx. 200 °C (392 °F) for the piping system. There is a risk of burning at the bypass connection and the piping. Make sure that the wall duct is made from (A) heatproof material.

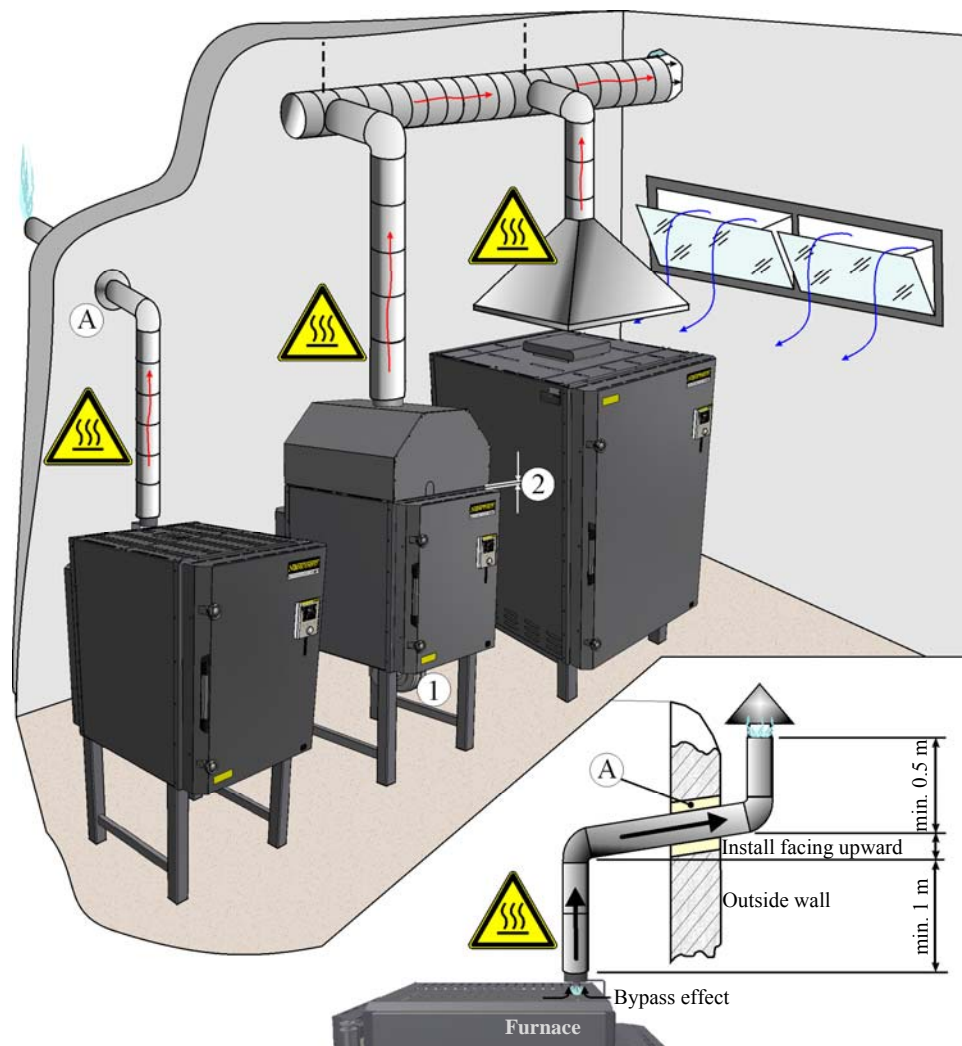


Fig. 38: Example: Assembling exhaust air piping (similar to picture)

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.

If the furnace is installed in a "passive house" it must be ensured that the room has an adequate fresh air supply. Because of potential aggressive vapors, we do not recommend that it is connected to the house ventilation system. We recommend a separate furnace room that can be ventilated adequately.

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.

Volumetric Flow Quantities and Temperature Behavior

Use the exhaust air volumetric flow rates in the table below to calculate the exhaust air piping via the bypass connector. If the exhaust air piping is designed continuously rising with DN 80 according to our recommendations, it can be assumed that this value will be achieved if this volume of air can also be fed to the room from outdoors (ventilation opening with a minimum cross section of 50 cm²).

In the case of furnaces with an exhaust air flap and also the fresh air fan option the volumetric flow rate is much higher and can be extracted from the room only in combination with an exhaust air hood (flue).

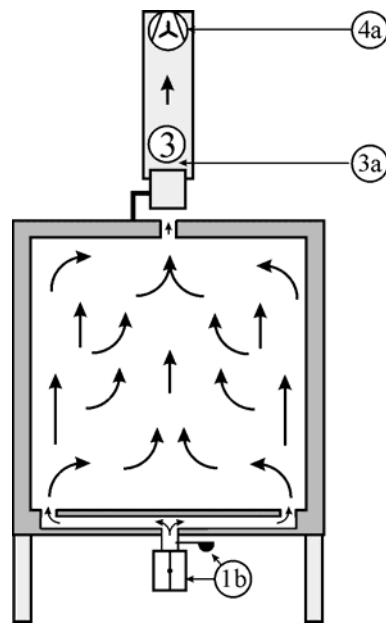
| Furnace model | Maximum temperature inside the furnace in °C | ① Flow rate of cooling fan ¹ m³/h | ② Flow rate of exhaust air flap ¹ m³/h | ③ Flow rate of bypass connector ¹ m³/h | ④ Flow rate of exhaust air hood ¹ m³/h |
|--|--|---|--|--|--|
| N 40 E(LE) – N 300(H) | 1300 | - | - | approx. 25 | - |
| N 300(H) | 1300 | max. 600 | approx. 40 | - | approx. 260 |
| N 440(H) | 1300 | max. 600 | approx. 40 | - | approx. 260 |
| N 660(H) – N 1000(H) | 1300 | max. 600 | approx. 40 | - | approx. 400 |
| Top 16 – Top 220 | 1300 | - | - | approx. 25 | - |
| LH 15/12 - LF 120/14 | 1200/1300/1400 | max. 600 | approx. 90 | approx. 25 ² | approx. 400 |
| LH 216/12 – LH 216/14 | 1200/1300/1400 | max. 600 | approx. 90 | approx. 25 ² | approx. 400 |
| ①a | 1x cooling fan D05 ambient air (~ 25 °C) | | | | |
| ②a | Additional air drawn from the environment (mixing air flow) (~ 35 °C) | | | | |
| ③a | The exhaust air must be dissipated and the maximum temperature defined by the customer. It must be ensured that the flow of hot air emitted from the furnace is not hazardous to people, property or the building. | | | | |
| ④a | Recommended exhaust air fan (not part of the delivery/must be provided by customer) | | | | |
| ¹ if present (model-related) | | | | | |
| ² only when cooling fan is switched-off | | | | | |

Fig. 39: Flow rates and temperature patterns

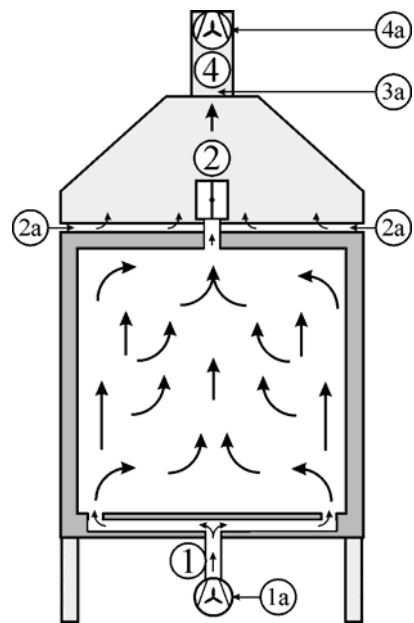
The information described above and in the table relates exclusively to extraction of the gases from the furnace. The heat occurring in case of fire may make additional room ventilation necessary, depending on the size of the room. As the heat depends to a great extent on the firing program, it is not possible to provide precise data. 1/3 of the heating power of the respective furnace can be used as a guide for dimensioning room ventilation.

Warning:

Active ventilation of the installation room must not cause underpressure in the room, as otherwise extraction of the exhaust air from the furnace via the bypass connector will be affected.



Example: Furnace with air inlet valve/flap (1b) and bypass connection



Example: Furnace with cooling fan, exhaust air flap, and exhaust air hood (flue)

5.4.7.1 Installing the Exhaust Hood(s)(design and number depending on furnace model) (Accessories)



When the furnace is delivered, remove the packaging materials. The exhaust hood/s must be visually checked for damage. We recommend that at least two or more persons perform the work of transporting and installing.

Protective gloves must be worn when installing the exhaust hood/s.

The danger of falling is still present (from the roof of the furnace, from the ladder or from the scaffolding). Observe the occupational safety regulations of the respective country of installation.

When positioning the exhaust hood make sure the orientation is correct. Position the cut-out of the exhaust hood on the side of the shaft (1) of the exhaust-air flaps (if included).

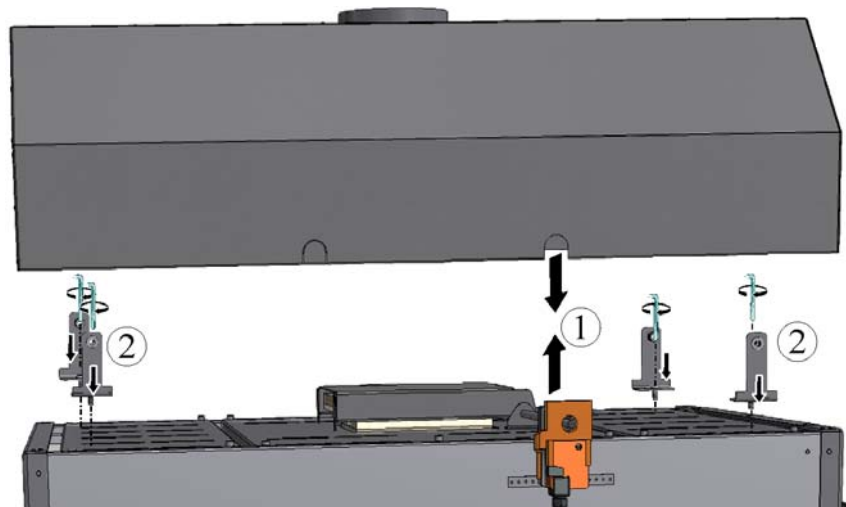


Fig. 40: Example: Positioning the exhaust hood/s (similar to picture)

The screws (2) for fastening the exhaust top hat are on the roof of the furnace. Position the exhaust top hat/s where the screws have been screwed in at the factory. The quantity and positions of the screws may vary from one model to the next. Tighten the screw materials to the furnace turning clockwise and make sure they are firmly in place. The exhaust-air flap/s under the exhaust top hat/s must be able to move freely.

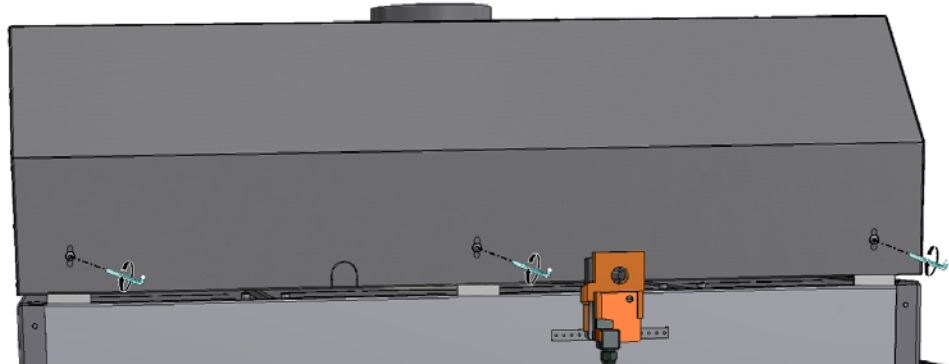
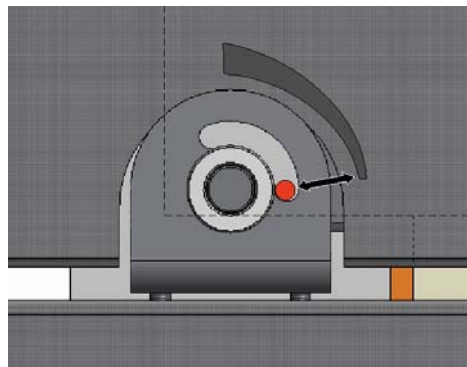


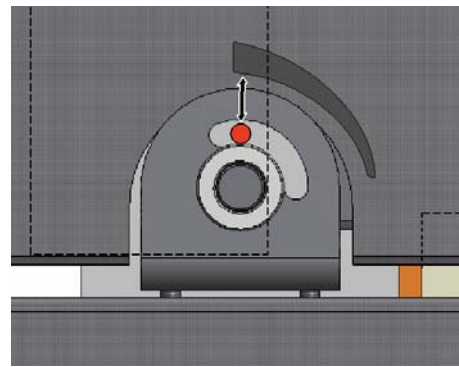
Fig. 41: Example: Positioning and fastening the exhaust hood/s (similar to picture)

5.4.7.2 Checking the Status of the Exhaust Air Flap(s) when an Exhaust Air Hood (Flue) is Used

If an exhaust air hood (flue) is used, the status of the exhaust air flap(s) (open or closed) can be checked by the position of the adjusting ring at the end of the drive shaft of the exhaust air flap.



Exhaust air flap closed



Exhaust air flap open

Fig. 42: Checking the status of the exhaust air flap(s) when an exhaust air hood (flue) is used (similar to picture)



Caution – Danger of falling

Ignoring this can lead to fatal injury. Danger of falling exists at a height less than 1.00 m above the ground or another sufficiently broad bearing surface (for example, on elevated operating positions and workplaces, working platforms, galleries, platforms, footbridges, flying bridges, ramps and stairways).

Openings and recesses through which people can fall (for example in floors, platforms, installation openings, hatchways and pits, non-bearing roofs).

5.4.7.3 Setting the Height of the Exhaust Hood

There should always be a slight underpressure under the exhaust hood (if included), in relation to the surrounding air pressure, when the cooling blower (if included) is switched on. For this reason, when an active suction system is used, the suction power should be adjustable (e.g. by using a throttle flap). The distance (2) of the exhaust hood from the furnace sets the admixture air flow.

When starting up, you must ensure that enough fresh air (room ventilation) comes into the room (for example: by opening windows).

The height of the exhaust hood can be continuously set using the screws (1) at the holders all around the hood. Use a suitable tool to remove the screws. Make sure that a uniform clearance is maintained between the exhaust hood and the furnace all around the hood.

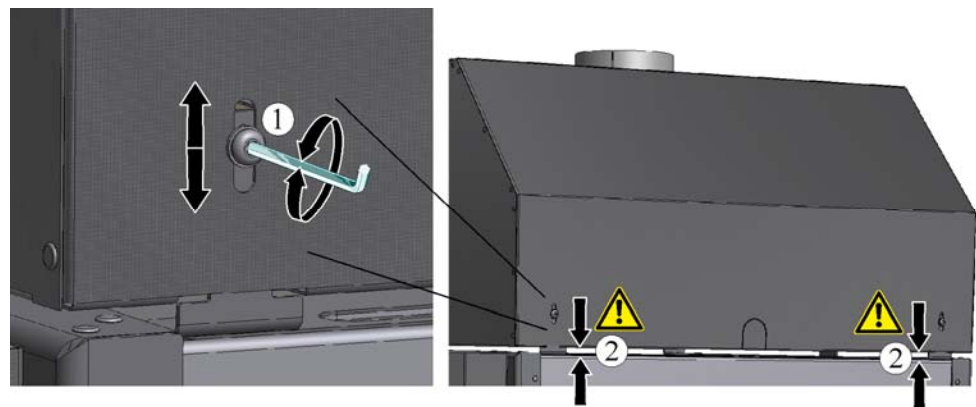




Fig. 43: Setting the height of the exhaust hood (similar to picture)

|  DANGER | |
|--|--|
|  | <ul style="list-style-type: none">• Fire hazard for components installed under the exhaust air hood.• Fire hazard.• There must be an even gap of at least 10 mm all round between the bottom of the exhaust air hood and the top of the furnace. <p>The gap between the bottom of the exhaust air hood and the top of the furnace can be adjusted upward using the screws on the brackets on all sides.</p> |

Exhaust air control with exhaust air hood and fresh air fan (optional)

The exhaust can be removed passively by the natural draw of the extended piping or actively by the suction unit provided by the customer.

A passive or active suction system must be able to draw off the air flows and temperatures produced by the furnace. Any bottleneck or backing up in the direction of the furnace is not permissible.

There should always be a slight underpressure under the exhaust hood, in relation to the surrounding air pressure, when the cooling blower (1) is switched on. For this reason, when an active suction system is used, the suction power should be adjustable (e.g. by using a throttle flap). The admixture air flow can be set by the distance (2) of the exhaust hood to the furnace.

When starting up, you must ensure that enough fresh air (room ventilation) comes into the room (for example: by opening windows).

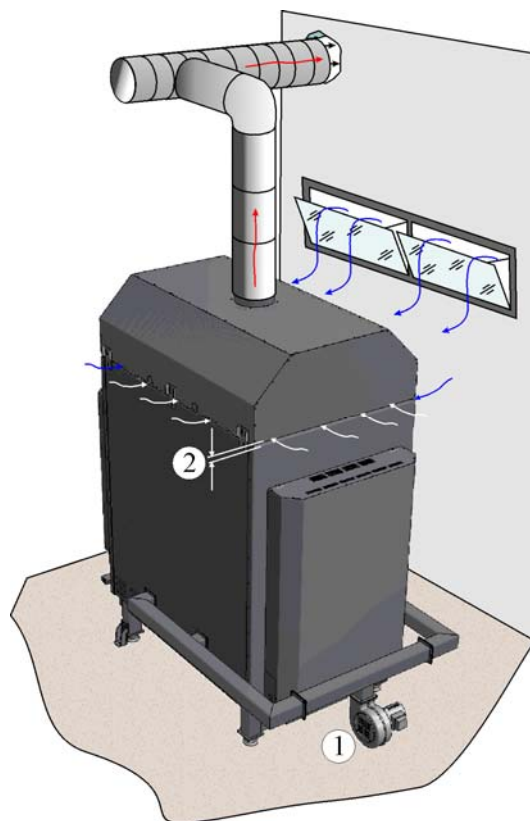


Fig. 44: Example: Venting exhaust air removal through an exhaust hood (similar to picture)

5.4.8 Connecting the Furnace to the Power Supply

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

- The furnace must be installed according to its intended use. The power connection must correspond to the values on the furnace's type plate.
- The power socket must be close to the furnace and be easily accessible. The safety requirements are not met if the furnace is not connected to a socket with a protective ground contact.
- With **230 V** furnace models pay attention that:
the distance between the circuit breaker and the power socket that the furnace is connected to is as short as possible. NO power board or extension cable is used between the power socket and the furnace.
- The power cable must not be damaged. Do not place any objects on the power cable. Lay the cable so that no one can stand on it or trip over it.
- Power cables may be replaced only with similar, approved cables.



Note

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



Fig. 45: Furnace from 3.600 W (CEE plug) (similar to picture)

1. Connect the power cable to the power supply. Use only a grounded socket. Check the ground resistance (acc. to VDE 0100); see also accident prevention regulations. Electrical systems and equipment according to DGUV V3.

Power Connection without Plug-In Power Line:

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

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

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

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

Ensure that the protective conductor terminal is correct.

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

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



Warning - Danger of Electric Shock!

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

The customer must supply the necessary preconditions such as the load-bearing capacity of the bearing surface and a source of electric power.

- Make sure that the power lines are adequately dimensioned and secured corresponding to the furnace's parameters.
- Ensure that the connection line to the furnace/switchgear is protected.

- A residual current circuit breaker (RCCB) cannot be used with the following components:
- Testing of the earth resistance (compliant with VDE 0100); see also the accident prevent regulations.
- Electric facilities and operating equipment compliant with DGUV V3.

You can provide the wiring and electrical connections using the enclosed wiring schematic. The electrical equipment of the machine is shown in the schematic.

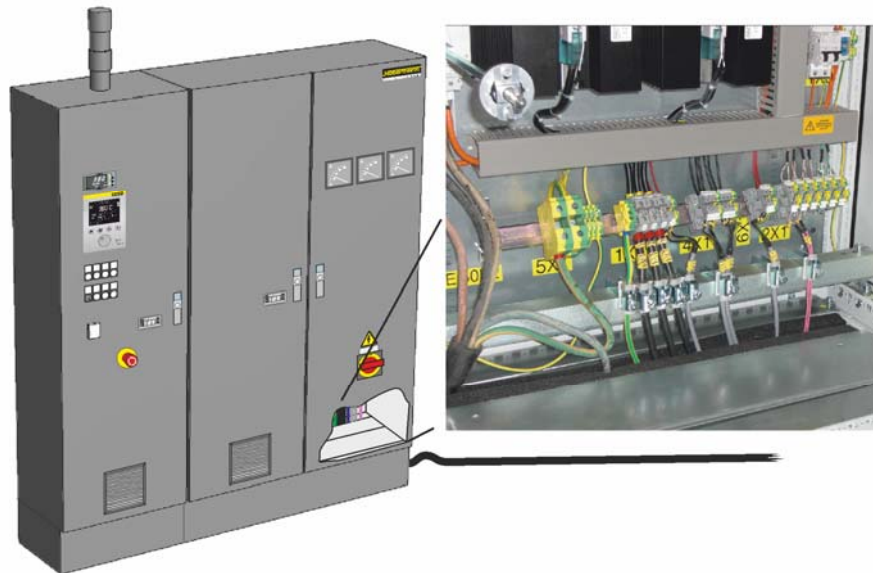




Fig. 46: Example: Power connection



Note

The national regulations of the respective country of operation apply.

| | | |
|---|--|---|
|  | NOTICE |  |
| | <ul style="list-style-type: none"> • Danger from incorrect voltage • Damage to the device. • Check voltage before connecting and starting the furnace. • Compare the voltage with the details on the type plate. | |

5.5 Initial Start-Up

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 instruction manual and the controller instructions are observed and followed.

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

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

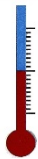
Before placing materials in the furnace, check whether they could harm or destroy the insulation or the heating elements. Materials that could damage the insulation include: alkalis, alkaline earths, metal vapors, metal oxides, chlorine compounds, phosphorous compounds, and halogens. **If applicable, read the labels and instructions on the packaging of materials that you use.**



Note

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

5.6 Recommendations for Heating Up the Furnace for the First Time



Heat the furnace to dry out the bricks and to get a protective oxide layer on the heating elements. There may be some unpleasant odors while the furnace is heating. This is due to binder being emitted from the insulation material. It is advisable to ventilate the room in which the furnace is located well during the first heating phase.

- Half open the air inlet valve/flap (see "Operation")
- Close the door (see "Operation")
- Switch on the furnace/controller with the power switch (see "Operation")
- Open the exhaust air flap (if present) (see "Operation")
- Heat the empty furnace, if necessary with new furnace furniture (shelves and props) to 500 °C in 6 hours, and then heat at full power and keep this temperature for one hour before allowing the furnace to cool naturally. Read the controller instructions for how to enter temperatures and times.



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

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

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

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



Before



After (nest formation)

Insulation

The furnace insulation is made from high-grade fireproof material. Due to thermal expansion, cracks in the insulation will occur after a few heating cycles. These have no influence on the function, safety or quality of the furnace. The refractory bricks (insulation) are of a particularly high quality. Due to the manufacturing process small holes or cavities may occur. These are quite normal and underline the quality features of the bricks. These holes or cavities are not a reason for complaint.

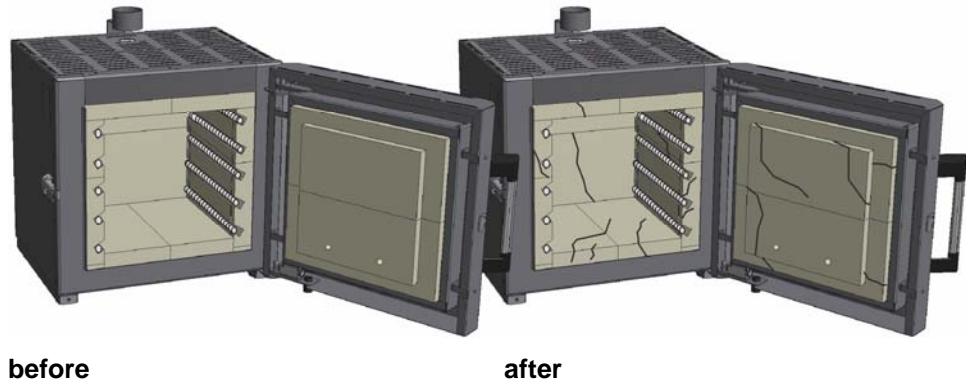


Fig. 47: Example: Cracks in the insulation after a few warm-up cycles.

Note

New kiln furniture (e.g. shelves and props) should be heated once to dry them out (as described above). When cold, heating elements are extremely brittle. Take great care when filling, emptying and cleaning the furnace.

The door must be locked during firing. To extract emitted gases and vapors more quickly and to shorten the cooling phase after firing, the air inlet valve or flap (model-related) can be completely or partially opened.

5.7 Loading/Charging

- Only operate the furnace when all the protective equipment and safety-related systems, e.g. removable protective equipment, EMERGENCY-OFF equipment, noise insulation, suction equipment, are in place and functional!
- Only materials whose characteristics are known may be heated. Consult all available safety-related material data sheets.
- Loading a very large quantity of product into the furnace chamber can substantially lengthen the warm-up times.
- When the furnace is being loaded be sure to avoid point loads on the bogie. It has been certified for a charge of 10 kg/dm² charging surface of the bogie. Depending how the bogie is driven, smaller charge quantities are also possible since, for example, a rubber-tired bogie which is loaded to the limit is much more difficult to drive than one on tracks.
- During any movements of doors and bogie, the operator must ensure that nobody can be accidentally injured. The position of the operator must be selected so that he can keep an eye on all moving parts. It is prohibited to spend any time in the furnace.
- Before every start the operator must be sure that there are no people in the furnace chamber.
- It is prohibited to sit or stand on the bogie while it is in motion.

- If it can be at all avoided, do **not** open the furnace when it is hot. When it is necessary to open the furnace at a high temperature, the time should be kept to an absolute minimum. Personnel must wear the appropriate protective clothing, and the workspace must be adequately ventilated as stated in the section entitled "Safety". The housing or its paneling can discolor (especially if the furnace is opened while hot), but this does not impair the functionality of the furnace. We recommend leaving the load in the furnace until it is completely cooled off.
- The connection of a gassing system (additional equipment) can enable the furnace chamber to be purged with reducing gases, but a defined atmosphere cannot be achieved in the furnace chamber. Caution: Escaping protective gas exposes people to the danger of suffocation.
- It is absolutely necessary that all the metallic components extending from the furnace are properly grounded while the furnace is operating. This can be necessary, for example, if the furnace is equipped with bores for the introduction of thermocouples.



The maximum load bearing capacity of the furnace base (filling weight) is very dependent on the temperature. We recommend approx. 50 % of the furnace volume in kg as the loading limit.

Example: LH 120 = 120 liters furnace volume (see "Technical Data") corresponds to approx. 60 kg maximum load bearing capacity of the furnace base

Fig. 48: Recommendation: Maximum load bearing capacity of the furnace base

5.8 Preset programs for ceramic applications

With Controllers B400/410, C440/450 and P470/480 the following programs are preset and can be started directly.



Note

In all cases, observe the information and references from the producers of raw materials that may require preset programs to be changed or adjusted. There is no guarantee that preset programs will produce optimum results. The programs set in the factory may be overwritten for personal purposes.

6 Operation

6.1 Controller

B400/C440/P470



Fig. 49: Control field B400/C440/P470 (similar to picture)

| No. | Description |
|-----|--|
| 1 | Display |
| 2 | Control keys for "Start/Hold/Stop", "Menu" selection, "Back" function and information menu selection |
| 3 | Jog dial |
| 4 | USB interface for a USB stick |


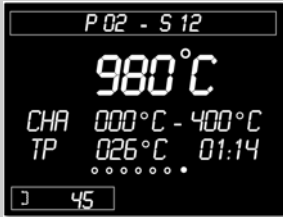


Note


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

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

6.2.1 Turning on the Controller/Furnace

| Switching on the Controller | | |
|--|---|--|
| Steps | Display | Comments |
| Turn on the power switch |  | Turn on the power switch by setting it to "I" (power switch type differs depending on features/furnace model) |
| The overview screen appears. After a couple of seconds, the temperature is displayed. |  | If the temperature is displayed at the controller, the controller is ready to operate. |

6.2.2 Turning off the Controller/Furnace

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

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



Note

Make sure that the doors of the control box are always locked and bolted. Otherwise dirt can be expected to shorten the useful life of the installed electrical switching components.

7 Accessing Extra Functions (Extra 1 and Extra 2) via the Controller

During a heat treatment program, you can call up special functions via the programming of the extra relay. Depending on the required function (see table), the extra relays are set in the corresponding segment during programming and are activated automatically while the program is running:

Controlling the exhaust air flap via extra function 1 (Standard)

| Extra 1 | Extra 2 | Function |
|---------|---------|--|
| x | - | Open/close the exhaust air flap |
| - | - | |

Controlling the exhaust air flap/air inlet flap via extra functions 1 and 2 (accessory)

| Extra 1 | Extra 2 | Function |
|---------|---------|--|
| x | - | Open/close the exhaust air flap |
| - | x | Open/close the air inlet flap |

Controlling the exhaust air flap/cooling fan via extra functions 1 and 2 (Accessory)

Note

If a large cooling fan is used, the fan can only be started when the exhaust air flap is open (there is no error message if the flap is not open).

If your furnace has a small cooling fan (ventilator), this can be started even if the exhaust air flap is closed.

| Extra 1 | Extra 2 | Function |
|---------|---------|--|
| x | - | Open/close the exhaust air flap |
| - | x | Switch the cooling fan on and off |

Controlling the exhaust air flap/solenoid valve (gas supply) via extra functions 1 and 2 (accessory)

| Extra 1 | Extra 2 | Function |
|---------|---------|---|
| x | - | Open/close the exhaust air flap |
| - | x | Switch the solenoid valve (gas supply system) on and off |

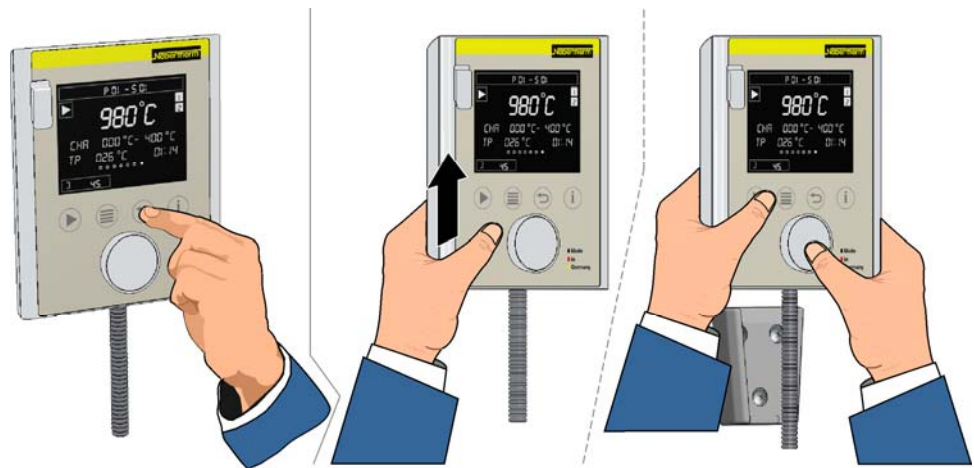
Note

For operation and instructions consult the operating instructions for your controller.

7.1 Handling the Controller

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

After use, replace the controller in its holder.



Simple operation directly
on the controller

Easy and ergonomic handling by removing the controller
from its holder

Fig. 50: Handling the controller (similar to picture)

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



Fig. 51: Place the controller in the holder on the furnace (similar to the picture)

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



Fig. 52: Over-temperature limit controller with manual reset 2132i



Note

See additional operating instructions for description and function

7.2 Opening and Closing the Door

Opening and Closing the Swinging Door

Loosen the locks (1) on the swing door in an anticlockwise direction and swing them towards the furnace door hinges (2).

Pull the door handle (3) to open the swinging door. The swinging door must be fully open to charge the furnace. The door is closed in the reverse sequence. Press the swinging door carefully against the furnace collar (**do not let it swing shut**). The weight of the swinging door can cause damage to the furnace or the door collar.

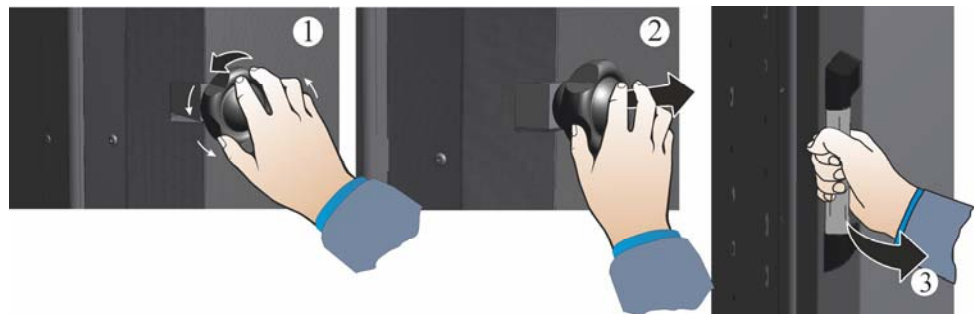


Fig. 53: Opening the swinging door

Close the door in the reverse order. Carefully press the swing door against the furnace collar (do not slam it). The weight of the swing door could damage the furnace and/or insulation. Make sure that the door is firmly closed with the locks (3)



Fig. 54: Closing the swinging door

After closing the door make sure that the door is uniformly closed all around the door (visual check).

Opening and closing the parallel swing door (accessory)

Turn the locks (1a – 1b) of the parallel swing door anti-clockwise and swing the door away from the furnace housing (2a – 2b).

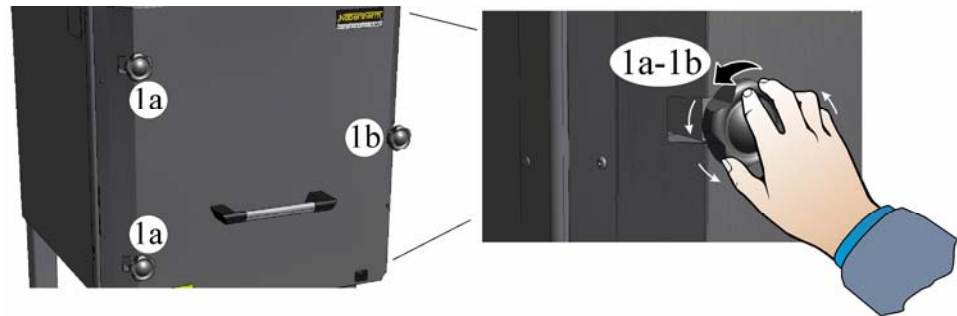


Fig. 55: Opening the parallel swing door

Pull the door handle (3) to open the swinging door. The swinging door must be fully open to charge the furnace. The door is closed in the reverse sequence. Press the swinging door carefully against the furnace collar (**do not let it swing shut**). The weight of the swinging door can cause damage to the furnace or the door collar.

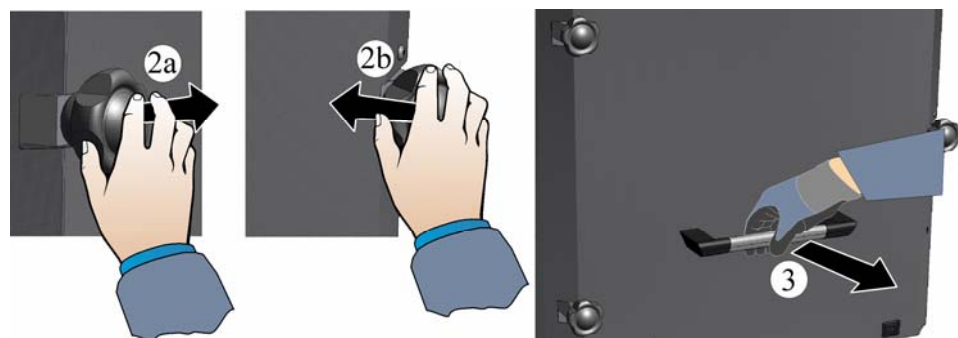


Fig. 56: Swinging the locks away/opening the door

Close the door in the reverse order. Carefully press the swing door against the furnace collar (do not slam it). The weight of the swing door could damage the furnace and/or insulation. Make sure that the door is firmly closed with the locks (3)

After closing the door make sure that the door is uniformly closed all around the door (visual check).

Note

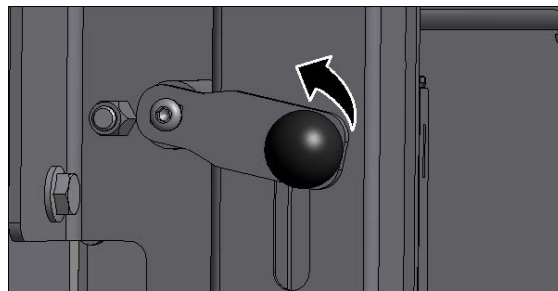
If the door does not close evenly all around, it can be readjusted with the two tensioning screws on the chain (see Aligning/Adjusting the Parallel Swing Door)

7.2.1 Operating the Manual Lift Door (Accessory)

To open the lift door (1), the counterweight (2) must be pulled down as far as it goes. Beforehand, push the lever (3) upwards to unlock the door. The operator must ensure an even speed. The speed must be reduced before the door reaches its end position (4) so that it is not mechanically overloaded. Press the lever (3) down to prevent the lift door being closed inadvertently.

The lift door is closed in the reverse order; i.e, the counterweight must be raised (5). When the door is closed, press the lever (3) down to lock the door.

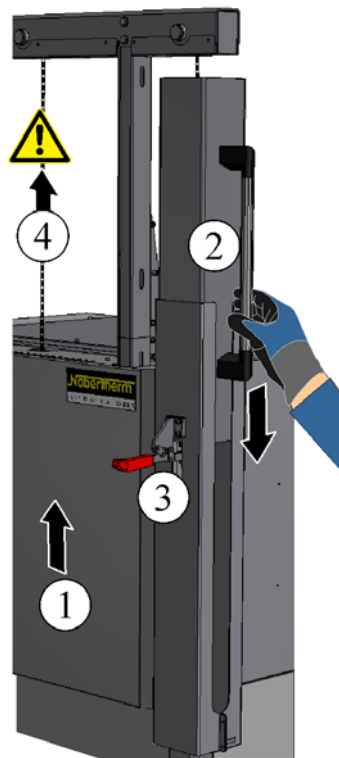
Before closing the lift gate the block must be manually released.



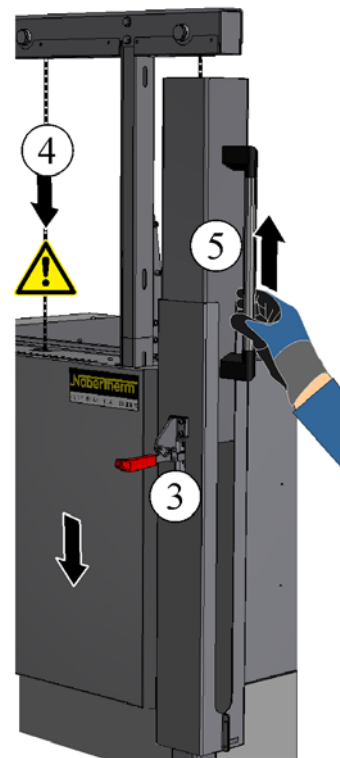
The lever handle must first be adjusted upward and forwards to be able to lower the lift gate.

The lever handle is automatically returned to the initial position when the gate is lowered.

Fig. 57: Manual release of the furnace-door block



Opening the lift door



Closing the lift door

Fig. 58: Opening and closing a lift door manually (similar to picture)

The operator must observe the lifting or lowering movements and make sure that no persons or objects are at risk from the movement.



Raise the lever to unlock the lift door

Lower the lever to lock the lift door

The clamping bolt (1a) can be adjusted with the nut-washer in the clamping arm

Fig. 59: Lever to lock/unlock the lift door with manual lifting device

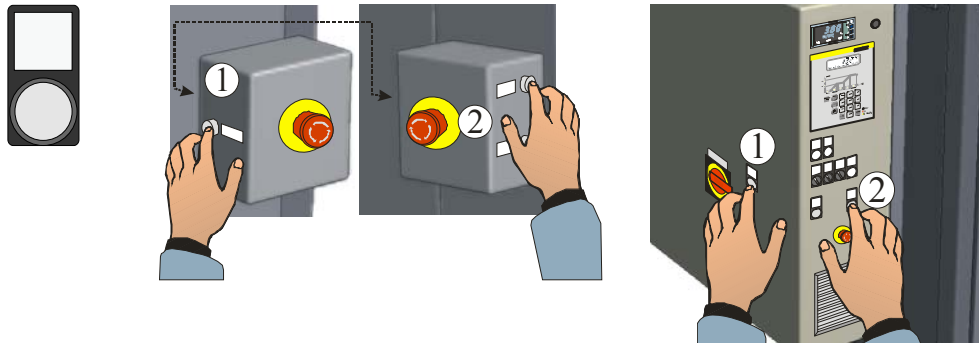
7.2.2 Operating the Pneumatic Lift Gate

7.2.2.1 Pneumatic door opener using two-handed operation

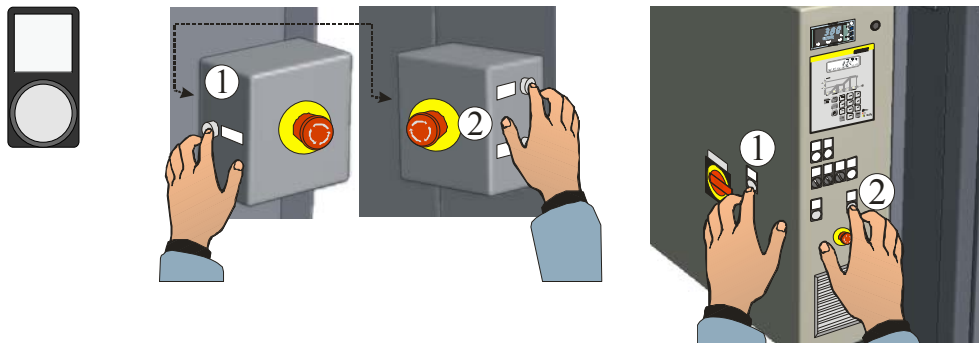
To open the lift door the "Release" key (1) and the corresponding lever/key (2) for "Lift" and "Lower" must be pressed simultaneously (two-hand operation). For safety reasons, the "Release" key and the lever/key for "Lift" and "Lower" must be pressed and held down simultaneously. If either the lever or one of the keys are released the upwards or

downwards movement of the lift door is stopped immediately. The functions of the individual operating elements are explained in writing beside the operating elements. The operating element may differ depending on function and furnace model.

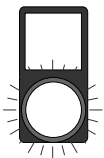
The operator must watch the upwards and downwards movement to ensure that the lift door does not pose a threat to either persons or property.



Press “**Raise lift door**” to open the lift door. (Similar to picture - depending on model)



Press “**Lower lift door**” to close the lift door. (Similar to picture - depending on model)



The **control lamp “Furnace door open”** is lit when the furnace door is not completely closed. For safety reasons, the furnace heating is switched off as soon as the furnace door is opened.



The **Emergency Stop Key** switches off all electrical drives. The system cannot be restarted until the key has been unlocked by turning the knob (or, if a lock is included, using the key).

7.2.2.2 Opening the Door Pneumatically with the Foot Pedal

The operator must observe the lifting or lowering movements and make sure that no persons or objects are at risk from the movement.

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

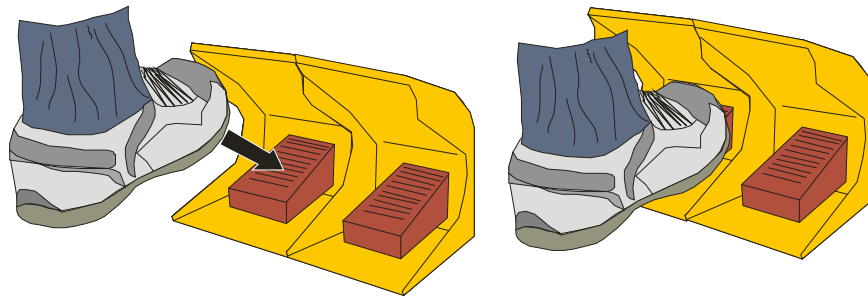
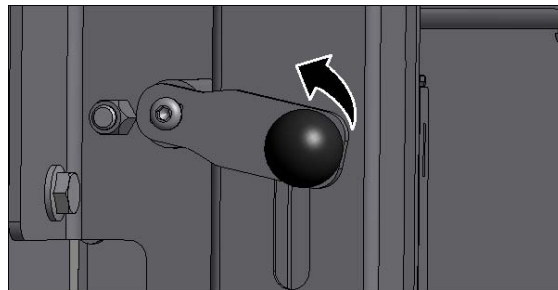


Fig. 60: Opening the door

7.2.2.3 Manual Release of the Furnace-Door Block

Before closing the lift gate the block must be manually released.



The lever handle must first be adjusted upward and forwards to be able to lower the lift gate.
The lever handle is automatically returned to the initial position when the gate is lowered.

Fig. 61: Manual release of the furnace-door block

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

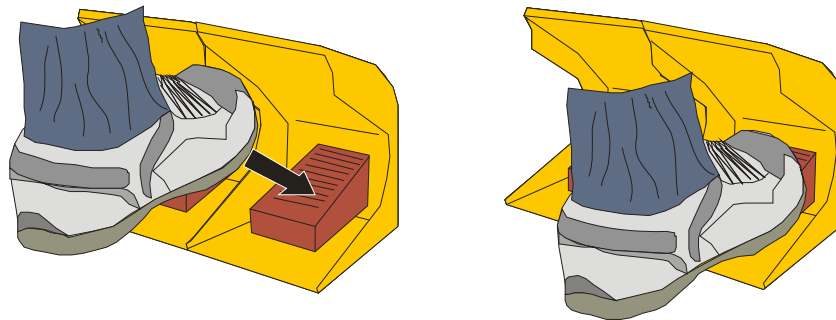


Fig. 62: Closing the door

The operator must observe the lifting or lowering movements and make sure that no persons or objects are at risk from the movement.



Warning - Dangers During Normal Operation!

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

7.3 Using the Scale (When Present) during Operation

During the heating phase of about 2 hours the measurement stabilizes when the required temperature is reached. The weight can be read only when the value has stabilized.

Temperature fluctuations during the process may cause weight fluctuations in certain temperature ranges. These are normal and cannot be avoided. If necessary, adjust the scale after it has adjusted to the heat.

Protect the scale from direct drafts below the furnace and avoid vibration during the weighing process. This can also cause weight fluctuations. Also prevent electrostatic charging. If electromagnetic fields occur, due to the use of cell phones for example, this may cause deviations in the display (incorrect weighing results). In this case, the scale must be shielded against these fields.

Impermissible thawing (air moisture condensing on the device) may occur if a cold device is moved into a much warmer environment; to prevent this, acclimatize the device – not connected to the power supply – for about 2 hours at room temperature and before putting it into operation beneath the furnace.

Carefully place the material to be weighed on top. Observe the max. load bearing capacity. Do not place continuous weight on the plate when it is not in use. It is important that you avoid impacts and extreme adverse effects. Immediately remove spilled material from the scale.

If a fault occurs during the program, switch the scale off briefly and switch it on again. Start the weighing process again.

The weight display may change due to:

- Drafts/air movement.
- Vibration of the bench/floor.
- Foreign bodies touching the weighing plate.
- The scale is no longer properly calibrated.
- Continuous temperature fluctuations.
- Electrostatic charges near the scale.



Note

Instructions, data and help on the scale can be found in the operating instructions for your scale.

7.4 Side Inlet (Additional Equipment)

Bushing for the installation of a component such as a mantle thermocouple. These bushings can be used for corresponding thermocouples, charge control, temperature monitoring or measuring units.

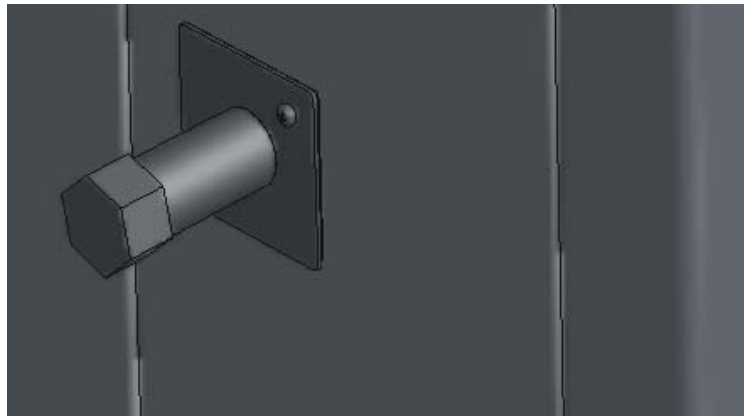








Fig. 63: Bushing

Avoid heat loss by filling the bushing with fiber wool.

| | | |
|---|---|---|
|  | <div data-bbox="879 857 1042 902">  DANGER </div> <p>Do not insert metallic objects, such as thermocouples, sensors or tools into the oven without grounding them properly beforehand. If not available, have an electrician create a ground connection between the object and the oven housing. Ignoring this warning can result in a life-threatening electric shock.</p> |  |
|  | <div data-bbox="839 1223 1023 1267">  CAUTION </div> <ul style="list-style-type: none"> • The surface of the bushing is hot. • Danger of serious skin burns • Heat-resistant gloves must be worn. |  |

7.5 Exhaust-Air Flap

Motorized Exhaust-Air Flap(s)

This furnace has motor-driven exhaust air flap(s). Exhaust air flaps are used to extract exhaust air caused by the process safely from the furnace. The furnace is also supplied with fresh air via the air inlet valve/flap or a fresh air fan (accessory).

If it is necessary only to extract the exhaust air from the furnace and no air exchange is wanted, it is sufficient to open the exhaust air flap(s).

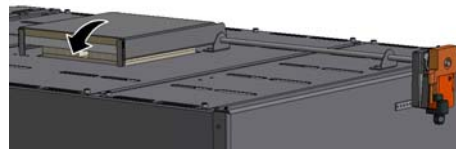
Constant air exchange is ensured if the air inlet valve/flap and the exhaust air flap(s) are opened.

Do not open just the air inlet valve/flap (or switch on a fresh air fan -> accessory), as, in this case, it is not possible to generate a defined state in the furnace.

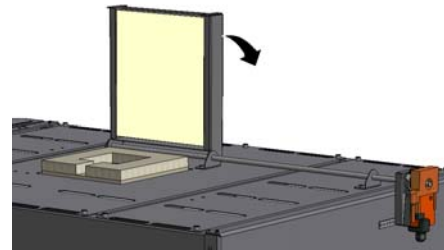


Caution

Operating the furnace with the flaps open can change the temperature conditions in the furnace chamber. If the batch is sensitive to temperature fluctuations it may be advisable to run a test for temperature homogeneity to optimize the process.



Exhaust-air flap closed



Exhaust-air flap open

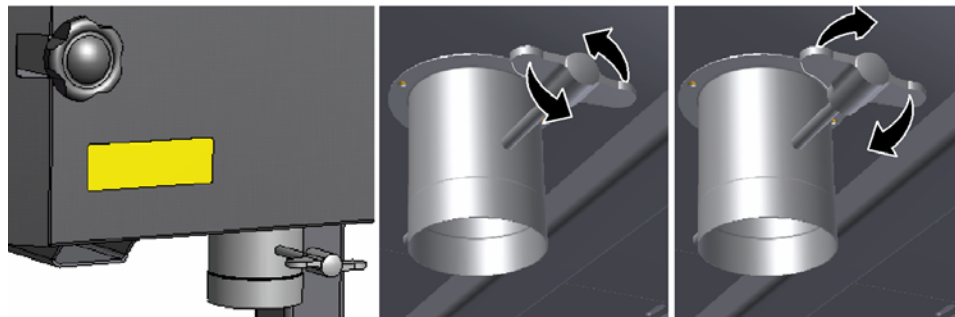
Fig. 64: Controlling the flow of exhaust air (similar to picture)

7.6 Air Inlet Flap

The volume of air fed to the furnace can be adjusted with the air inlet valve or flap (model-related). The air inlet valve/flap is located on the base of the furnace.

After the chemically bound water has been expelled from the ceramics during the firing (max. 600 °C (1112 °F)), the air inlet flap or valve (model-related) of the furnace must be closed to prevent drafts and to ensure good temperature uniformity in the upper temperature range.

Air inlet flap



close

open

7.6.1 Schematic Description of Fresh Air Supply

When ceramics are being fired, gases, vapors, and moisture occur that may cause corrosion on the furnace. To ensure optimum removal of the exhaust gases to the atmosphere, ideally the inlet air opening and exhaust air flap (if present) should remain open to 650 °C (1202 °F) and then be closed to achieve good temperature distribution.

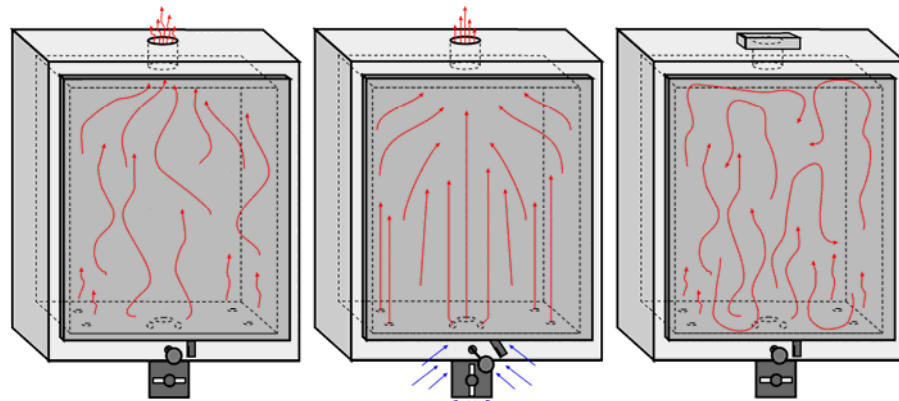
Our chamber furnaces are not suitable for use as drying cabinets.

To reduce the cooling phase after a firing, the inlet air opening (and the exhaust air flap if present) may be opened completely or partially.

Exhaust air (open) is extracted from the furnace (low air flow)

Exhaust air (open), constant air exchange (high air flow)

Exhaust air flap (if present) closed. No air exchange



Air inlet closed

Air inlet open

Air inlet closed

Fig. 65: Schematic description of fresh air supply

7.6.2 Fresh Air and/or Cooling Blower (Additional Equipment)

It is possible to accelerate cooling by switching on the cooling blower and opening the exhaust-air flaps. The rpm control and the associated air quantity can be controlled or regulated using the switchgear and control box in combination with the entered program. See the section "Operation, Display and Switch Elements".

- The switching on of the forced cooling must always be appropriate for the characteristics of the product, switching the forced cooling on at T_{max} is impermissible and endangers both the furnace and the charge.
- We recommend keeping the exhaust-air flaps closed at furnace temperatures $> 1000\text{ }^{\circ}\text{C}$.
- From temperatures lower than $800\text{ }^{\circ}\text{C}$ an active cooling can be used with a smaller variable.
- High cooling speeds enabled by opening the exhaust-air flaps or by using the fresh-air fans at high temperatures result in increased wear and tear on the insulation and the firing auxiliaries.
- A high variable of the fresh-air fans at high temperatures can lead to burns in the vicinity of the exhaust-air flap and the areas above it.

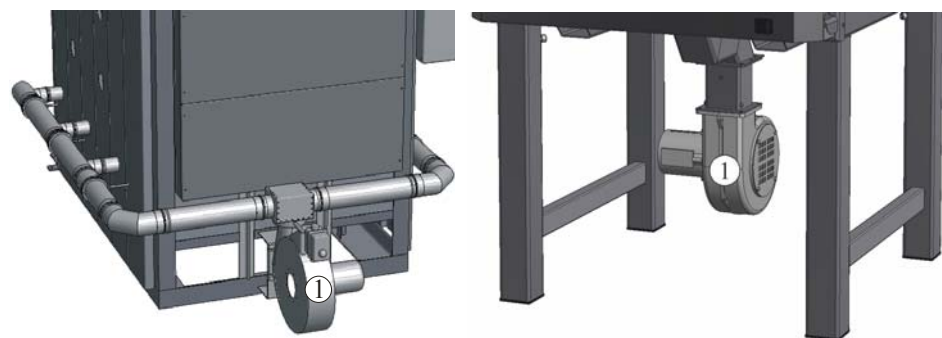


Fig. 66: Fresh air and/or cooling blower

8 Servicing, Cleaning, and Maintenance



Warning! General Hazards!

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



Warning - Danger of Electric Shock!

Work on the electrical equipment may be done only 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.

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.

Cleaning, lubrication, and maintenance tasks may only be performed by authorized experts following the maintenance instructions and accident protection guidelines.

Failure to comply runs the risk of bodily injury, death, or significant property damage!

To avoid the risk of death:

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

Work on the gas/oil firing system may only be performed by qualified experts.

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

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

Furnaces and switching systems must be switched off during maintenance work to prevent accidental start-up, and all moving parts of the furnace must be secured.

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.

The furnace must be visually inspected at regular intervals for damage. The interior of the furnace must also be cleaned as needed (e.g. suction)

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.

The connection terminals of the heating elements should be tightened as needed. Before these tasks, the furnace must be disconnected from power (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.

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

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

In the switching system, there are one or more circuit breakers. 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.

In the switching system cabinet, there are ventilation grates 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.

The equipment must be checked regularly according to the guidelines of the Employer's Liability Insurance Association (DGUV V3) or corresponding national guidelines of the country of operation.



Caution – Danger of falling

Ignoring this can lead to fatal injury. Danger of falling exists at a height less than 1.00 m above the ground or another sufficiently broad bearing surface (for example, on elevated operating positions and workplaces, working platforms, galleries, platforms, footbridges, flying bridges, ramps and stairways).

Openings and recesses through which people can fall (for example in floors, platforms, installation openings, hatchways and pits, non-bearing roofs).

8.1 Furnace Insulation

The refractory bricks (insulation) are of a particularly high quality. Due to the manufacturing process small holes or cavities may occur. These are quite normal and underline the quality features of the bricks. These holes or cavities are not a reason for complaint.

8.2 Furnace Insulation - Handling Fiber Materials

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

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



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

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

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

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

Smoking, eating and drinking at the workplace is prohibited.

In Germany, during work involving insulation, the technical rules for hazardous substances must be applied. In particular: TRGS 500, TRGS 521, TRGS 558, TRGS 559, TRGS 900; <http://www.baua.de> (German).

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

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



Note

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

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



Warning - Dangers During Normal Operation!

Cleaning, lubrication and maintenance work must be performed by authorized experts following the maintenance instructions and occupational safety regulations! We recommend that the maintenance and repair work be carried out by the service team of Nabertherm GmbH. The consequence of non-adherence is substantial property damage, personal injury, or death!

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



- The furnace must be completely emptied.
- Inform operating personnel, appoint supervisory staff.
- Switch off power switch (position "O/OFF") → Switchgear
- Lock the power switch in OFF position with a padlock to prevent an accidental start-up.
- Attach a warning sign on the power switch against re-start (for example: "Danger Maintenance Work - Do not switch the furnace on")
- The protective functions of safety equipment must not be disabled.
- A generously dimensioned maintenance work area must be closed off.
- Make sure that no live voltage is present.
- Make sure the system is voltage-free (dead). The absence of voltage must be determined by an electrician or by a person with electro-technical training. The absence of voltage must be determined at the workplace on all poles.
- Ground and short-circuit the workplace.
- Cover any neighboring parts which are live.



Warning - Dangers During Normal Operation!

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



Warning - Danger of Electric Shock!

Only qualified and authorized electricians may work on electric equipment. During maintenance work, furnace and switchgear must be kept voltage-free to prevent accidental start-ups (switch off the furnace at the power switch) and secure all the movable parts of the furnace. Follow the specifications in the DGUV V3 or corresponding national regulations where the furnace is installed. Wait until the furnace chamber and its attachments have cooled down to room temperature.



Caution – Danger of falling

Ignoring this can lead to fatal injury. Danger of falling exists at a height less than 1.00 m above the ground or another sufficiently broad bearing surface (for example, on elevated operating positions and workplaces, working platforms, galleries, platforms, footbridges, flying bridges, ramps and stairways).

Openings and recesses through which people can fall (for example in floors, platforms, installation openings, hatchways and pits, non-bearing roofs).



Notice

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

8.4 Regular Maintenance Tasks – Heating Elements/Furnace Chamber

| A | B | C | | | D | | | | | E | | F |
|----------------------------------|--|---|---|---|---|---|---|---|---|--------|--------|--|
| | | 1 | 2 | 3 | T | W | M | Q | J | X 1 | X 2 | |
| Heating elements | Visual check: Oxide layer formation, crack formation, rotation around own axis, untwisting of the wrap, nest formation | | | • | | | | • | | | • | |
| Heating elements | Replace | • | | | | | | | • | | • | |
| Run through the heating elements | Clean | | | • | | | | | • | | • | No later than when the heating elements are replaced |
| Run through the heating elements | Replacement | | • | | | | | | • | | • | Recommended no later than when the heating elements are replaced |
| Connect the heating elements | Wiring to the connection ends, corrosion tendency drill ends traces of burning) | | | • | | | | | • | | • | |

| A | B | C | | | D | | | | | E | | F |
|------------------------|--|---|---|---|---|---|---|---|---|-----|-----|--------------|
| | | 1 | 2 | 3 | T | W | M | Q | J | X 1 | X 2 | |
| Support tubes | Visual check, correct position, sag, crack formation | | • | | | | | • | | | • | |
| Support tubes | Replace | | • | | | | | | • | • | | As necessary |
| Bearing bricks | Visual check of correct fit, crack formation | | | • | | | | | • | • | | |
| Power heating elements | Check the load capacity of the heating group | | | | | | | | • | | • | |
| | | | | | | | | | | | | |

| | |
|---|--|
| Symbols: | |
| A = Component / Position / Function / B = Measure / C = Spare Part Stocks / D = Maintenance Interval / E = Performed by / F = Comment | |
| Spare part stocks: | 1 = Stocks urgently recommended 2 = Stocks recommended / 3 = As required, not relevant |
| Maintenance Interval Notice: If ambient conditions are severe, the maintenance intervals must be shorter. | D = Daily, each time before the furnace is started W = Weekly M = Monthly / Q = Quarterly Y = Yearly / • = Check, replace |
| Performed by: | X1 = Operating personnel X2 = Specialist personnel |

8.5 Regular Maintenance Tasks – Insulation Furnace Chamber

| A | B | C | | | D | | | | | E | | F |
|-------------------------|--|---|---|---|---|---|---|---|---|-----|-----|---|
| | | 1 | 2 | 3 | T | W | M | Q | J | X 1 | X 2 | |
| Door and labyrinth seal | Check for damage and loose parts | | | | | | | • | | • | | |
| Collar | Visual check for crack formation, loose segments | | | • | | | | • | | • | | |
| Openings for fresh air | Check insulation for cracks | | • | | | | | • | | • | | |
| Air distribution pipes | Visual check, crack formation / deformation, air discharge direction | • | | | | | | • | | • | | |
| Walls | Visual check for crack formation, | | | • | | | | • | | • | | |

| A | B | C | | | D | | | | | E | | F |
|--------------------------------|---|---|---|---|---|---|---|---|---|----|----|---|
| | | 1 | 2 | 3 | T | W | M | Q | J | X1 | X2 | |
| | surface, chemical corrosion | | | | | | | | | | | |
| Wall offset (furnace interior) | Visual check for crack formation | | | • | | | | • | | • | | |
| Wall offset (furnace interior) | Vacuum clean | | | • | • | | | | | • | | |
| Exhaust gas outlet | Visual check of | | | | | | | • | | • | | |
| Exhaust gas outlets | Replace penetration pipes | | • | | | | | • | | | • | |
| Ceiling | Cracks and ceiling suspension | | | • | | | | • | | • | | |
| Exhaust-air flaps | Check inserts, correctness of the seal | | | • | | | | • | | • | | |
| Exhaust-air flaps | Replacement | • | | • | | | | • | | | • | |
| Exhaust-air flap space | Check fiber block and penetration pipe, especially the edge of the penetration pipe | | | • | | | | • | | • | | |
| SiC/mullite tiling | Check for correct position and for deformations | | • | | | | | • | | • | | |



Note

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

| Symbols: | |
|---|--|
| A = Component / Position / Function / B = Measure / C = Spare Part Stocks / D = Maintenance Interval / E = Performed by / F = Comment | |
| Spare part stocks: | 1 = Stocks urgently recommended 2 = Stocks recommended / 3 = As required, not relevant |
| Maintenance Interval Notice: If ambient conditions are severe, the maintenance intervals must be shorter. | D = Daily, each time before the furnace is started W = Weekly M = Monthly / Q = Quarterly Y = Yearly / • = Check, replace |
| Performed by: | X1 = Operating personnel X2 = Specialist personnel |

8.6 Regular Maintenance Tasks – Switchgear

| A | B | C | | | D | | | | | E | | F |
|--|--|---|---|---|---|---|---|---|---|-----|-----|---|
| | | 1 | 2 | 3 | T | W | M | Q | J | X 1 | X 2 | |
| Air suction filter | Clean or replace filter mat | | • | | | • | | | | • | | Ignoring this can lead to the failure of electronic devices. We accept no liability in case of a production stoppage. |
| Contactors | Check for scorching | | | • | | | | • | | | • | |
| Contactors | Replacement | • | | | | | | | • | | • | |
| USV battery | Replacement | | • | | | | | | | | • | |
| Control box | Vacuum out | | | | | | | | | | • | |
| Switch cabinet cooling unit | Follows the manufacturer's maintenance instructions | | | | | | | | | | • | |
| Check functionality of over-temperature protection | Set the shut-down value under the actual value and have it shut down. | | | | | | | • | | • | | |
| Check the precision of the over-temperature protection (calibrate) | The pre-set shut-down temperature is checked with a certified temperature transmitter. | | | | | | | | • | | • | |
| Check the temperature display (calibrate) | The pre-set shut-down temperature is checked with a certified temperature transmitter. | | | | | | | | • | | • | |
| Check the firmness of all screwed terminal positions. | Contactors, terminals, etc. | | | | | | | | • | | • | |
| Check all connections for smoke residues | | | | | | | | | • | | • | |
| Switchgear: Lamps and signals | Check functionality | | | • | | | | • | | | • | |
| Fuses | Replace after blow | • | | | | | | | | • | | |
| Semi-conductor fuses | Replace after blow | • | | | | | | | | • | | |
| | | | | | | | | | | | | |

Symbols:

A = Component / Position / Function / **B** = Measure / **C** = Spare Part Stocks / **D** = Maintenance Interval / **E** = Performed by / **F** = Comment

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



Notice

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



Warning - Danger of Electric Shock!

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

8.7 Regular Maintenance Tasks – Electrical Testing

| A | B | C | | | D | | | | | E | | F |
|-----------------------------|--|---|---|---|---|---|---|---|---|--------|--------|---|
| | | 1 | 2 | 3 | T | W | M | Q | J | X 1 | X 2 | |
| Insulation resistance check | | | | | | | | | • | | • | |
| High-voltage check | If possible | | | | | | | | • | | • | |
| Protective conductor | Correct fit of protective conductor at the connections between the system parts and covers | | | | | | | | • | | • | |
| Check function | All electrical components | | | | | | | | • | | • | |

Symbols:

A = Component / Position / Function / **B** = Measure / **C** = Spare Part Stocks / **D** = Maintenance Interval / **E** = Performed by / **F** = Comment

| | |
|---------------------------|---|
| Spare part stocks: | 1 = Stocks urgently recommended 2 = Stocks recommended / 3 = As required, not relevant |
|---------------------------|---|

| | |
|--|---|
| Maintenance Interval Notice: If ambient conditions are severe, the maintenance intervals must be shorter. | D = Daily, each time before the furnace is started W = Weekly M = Monthly / Q = Quarterly Y = Yearly / ● = Check, replace |
| Performed by: | X1 = Operating personnel X2 = Specialist personnel |



Notice

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



Note

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



Note

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



Notice

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




8.8 Regular Maintenance Tasks – Documentation

| A | B | C | | | D | | | | | E | | F |
|------------------------|---------------------------------------|---|---|---|---|---|---|---|---|--------|--------|---|
| | | 1 | 2 | 3 | T | W | M | Q | J | X 1 | X 2 | |
| Type plate | Legible | | | | | | | | ● | ● | | |
| Operating instructions | Ensure they are kept near the furnace | | | ● | | | | | ● | ● | | |
| Component instructions | Ensure they are kept near the furnace | | | ● | | | | | ● | ● | | |

Symbols:

A = Component / Position / Function / **B** = Measure / **C** = Spare Part Stocks / **D** = Maintenance Interval / **E** = Performed by / **F** = Comment

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

| | | |
|---|--|---|
|  |  DANGER |  |
| | <ul style="list-style-type: none"> • Danger of electric shock. • Risk of fatal injury. • Work on the electrical equipment may be performed only by qualified electricians or by technicians authorized by Nabertherm. • Switch off the furnace | |

8.9 Cleaning Products



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

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

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

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

| This list must be completed by the operator. | |
|--|--|
| Component and position | Cleaning product |
| Outer surfaces (frames *) | Use commercial cleaning products that are either water-based or non-flammable and free of any solvent *) |
| Outer surface (stainless steel) | Stainless steel cleaner |
| Inside | Carefully clean with a vacuum cleaner (avoid the heating elements) |
| Insulation materials | Carefully clean with a vacuum cleaner (avoid the heating elements) |
| Door seal (if applicable) | Use commercial cleaning products that are either water-based or non-flammable and free of any solvent |
| Instrument panel | Wipe the surface with a damp, lint-free cloth. (e.g. glass cleaner) |

| This list must be completed by the operator. | |
|--|------------------|
| Component and position | Cleaning product |
| *) 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. 67: 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”



Notice

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

| | | |
|--|--|--|
|  | <div style="background-color: red; color: white; text-align: center; padding: 5px;">⚠ DANGER</div> <ul style="list-style-type: none"> • Danger from electrocution • Mortal danger • Switch the power switch to off before cleaning the system. • Do NOT pour water or cleaning agent on inner or outer surfaces • Dry the device completely before restarting. |  |
|--|--|--|

9 Malfunctions

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

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

Call your local electrician for malfunctions that you cannot localize.

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

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

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

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


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

9.1 Error Messages of the Controller

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

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

| ID+ Sub-ID | Text | Logic | Remedy |
|------------|--------------------------|---|--|
| 04-05 | Self optimization failed | The determined values are implausible | Do not carry out self optimization at the lower temperature range of the furnace working range |
| | Battery weak | Time is not shown correctly. A power failure may not have been handled properly | Export all parameters to a USB flash drive Replace the battery (see “Specifications”) |

Error messages can be reset by pressing **twice** the jog dial . If there is another error message, contact Nabertherm Service. Recirculation motors (if included) also remain switched on in case of an error until the temperature falls below the set cut-off temperature.

9.2 Warnings of the Controller

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

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

| No. | Text | Logic | Remedy |
|-----|--|---|---|
| 08 | Alarm 1 - Max | The configured max. alarm 1 was triggered | Optimize the control parameters Alarm set to narrowly |
| 09 | Alarm 2 - Band | The configured band alarm 2 was triggered | Optimize the control parameters Alarm set to narrowly |
| 10 | Alarm 2 - Min | The configured min. alarm 2 was triggered | Optimize the control parameters Alarm set to narrowly |
| 11 | Alarm 2 - Max | The configured max. alarm 2 was triggered | Optimize the control parameters Alarm set to narrowly |
| 12 | Alarm - External | The configured alarm 1 at input 1 was triggered | Check the source of the external alarm |
| 13 | Alarm - External | The configured alarm 1 at input 2 was triggered | Check the source of the external alarm |
| 14 | Alarm - External | The configured alarm 2 at input 1 was triggered | Check the source of the external alarm |
| 15 | Alarm - External | The configured alarm 2 at input 2 was triggered | Check the source of the external alarm |
| 16 | No USB flash drive inserted | | When exporting data, insert a USB flash drive in the controller |
| 17 | Import/export of data via the USB flash drive unsuccessful | The file was edited with a PC (text editor) and saved in the wrong format or the USB flash drive was not detected. You want to import data that is not in the import folder on the USB flash drive | Do not edit XML files with a text editor, only in the controller. Format the USB flash drive (format: FAT32). No quick formatting Use a different USB flash drive (1-8GB) When importing, all data must be in the import folder on the USB flash drive. It is best to use USB flash drives up to 8GB. |
| | Programs are rejected during the import of programs | Temperature, time or rate is outside the limit values | Import only programs that are suitable for the furnace. The controllers differ as regards the number of programs and segments and the maximum furnace temperature. |
| | While programs are being imported, "Error occurred" is displayed | The complete parameter set (at least the configuration files) was not stored in the "Import" folder on the USB flash drive | If you deliberately left out files during import, ignore the message. Otherwise, check the completeness of the import files. |
| 18 | "Heating blocked" | This message is displayed if a door switch is connected to the controller and the door is open | Close the door Check the door switch |

9.3 Malfunctions of the Switchgear

| Error | Cause | Remedy |
|--|---|---|
| Controller does not light up | Controller is switched off | Switch the power switch to “I” |
| | No power available | Is the power cord plugged into the socket? Check the building fuses. Check the fuse of the controller (if present) and replace it if necessary. |
| | Check the fuse of the controller (if present) and replace it if necessary. | Switch the power switch on. If the error occurs again, contact Nabertherm Service |
| Controller displays error | See the separate instructions of the controller | See the separate instructions of the controller |
| Furnace does not heat | Door / cover is open | Close the door / cover |
| | The door contact switch is faulty (if present) | Check the door contact switch |
| | The “wait” or clock icon (product line 400 controllers) lights up | The program is waiting for the programmed start time. Set the wait time to 00:00 or disable it |
| | Error in entering the program | Check the heating program (see the separate instructions of the controller) |
| | Heating element defective | Have this checked by Nabertherm Service or a qualified electrician. |
| Very slow heating of the heating space | The fuse(s) of the connection is/are defective. | Check the fuse(s) of the connection and replace if necessary. Notify Nabertherm service if the new fuse fails again immediately. |
| The program does not jump to the next segment | In one TIME segment in the program input, the wait time is set to INFINITE (product line 400 controllers). If charge control is activated, the temperature of the charge is higher than the zone temperatures. | Do not set the wait time to INFINITE |
| | If charge control is activated, the temperature of the charge is higher than the zone temperatures. | The parameter [LOWER BLOCK] must be set to [NO]. |
| The controller module can not be registered on the operating unit | Addressing error (product line 400 controllers) | Perform a bus reset |
| The controller is not heating in the optimization | No optimization temperature has been set | The temperature to be optimized must be entered (see the separate instructions of the controller) |

9.4 Controller Check List

| | |
|---|---|
| Customer: | |
| Furnace model: | |
| Controller model: | |
| Controller version (see information menu ⓘ): | |
| Controller serial number | |
| Furnace serial number | |
| Error code in the display: | |
| The following errors are dependent on external influences: | 02-05 Ambient temperature too low: < -10 °C (14 °F) 02-04 Ambient temperature too high: > 70 °C (158 °F) |
| Detailed error description: | |
| Export of the service information: | Please export all the data to a USB stick using the function [EXPORT COMPLETELY] Generate a zip file using the ZIP function integrated in Windows (compression) of the exported folder (see the section "Importing and Exporting Data and Parameters") and send them to your contact at Nabertherm Service. |
| When does this error occur? | At specific point in the program or at certain times of day: At specific temperatures: |
| How long has the error existed? | <input type="checkbox"/> Error is new <input type="checkbox"/> Error has existed for a long time <input type="checkbox"/> Unknown |
| Error frequency | <input type="checkbox"/> Error occurs frequently <input type="checkbox"/> Error occurs regularly <input type="checkbox"/> Error occurs rarely <input type="checkbox"/> Unknown |
| Substitute controller: | Has a substitute controller already been used? <input type="checkbox"/> yes <input type="checkbox"/> no |

| | | | |
|--|---|------------------------------|-----------------------------|
| | Did the error continue with the substitute controller? | <input type="checkbox"/> yes | <input type="checkbox"/> no |
| | Checked according to the error search list (see the furnace operating instructions) | <input type="checkbox"/> yes | <input type="checkbox"/> no |

Please enter the following test program so that the furnace heats up at full power:

| Program point | Value |
|--------------------------------|------------|
| Segment 01- Start Temperature | 0 °C |
| Segment 01- Target Temperature | 500 °C |
| Segment 01- Time | 30 minutes |
| Segment 01- Target Temperature | 500 °C |

Close door/lid and start the example program

Please check the following items:

- Does the furnace heat (temperature rise)?
- Is the "Heating" symbol displayed?

Please call up the information menu in the heating up phase for further details.

Date: _____ Name: _____ Signature: _____

10 Spare Parts/Wearing Parts



Ordering spare parts:

Our Nabertherm Service team is available worldwide. Due to our high vertical range of manufacture, we deliver most spare parts from stock overnight or can produce them with short delivery times. You can order Nabertherm spare parts directly from the factory quickly and easily. If you do not find the spare part you are looking for in the spare parts list or in the separate spare parts list, we would be happy to help you. Spare parts can be ordered in writing, by phone or on the Internet -> 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.

| Spare Parts/Wearing Parts | | | | | | | | |
|--|--------------------------------|---|-----------|---|-----------|---------------------------------------|--|---|
| Part number | | | | | | | | |
| 1 Electrical connection / 2 Heating element ^{1, 2} / 3 Heating element, complete set / 4 Support tubes / 5 Support tubes, complete set / 6 Thermocouple ¹ / 7 SiC Floor plate ¹ | | | | | | | | |
| Model | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ► |
| LH 15/12 | 400V, 3/N 5.0 kW | 692251247_Side 692261030_Bottom 692230629_Back wall 692225210_Door | 602211368 | 692020260_Side 692020245_Bottom 692020240_Back wall 692020185_Door | 602001010 | 540300010 Type S, 275mm, 0.3 mm | 691600173 | ○ |
| LH/LF 15/13 | 400V, 3/N 7.0 kW | 692251248_Side 692261031_Bottom 692230630_Back wall 692225211_Door | 602211369 | 692020260_Side 692020245_Bottom 692020240_Back wall 692020185_Door | 602001010 | 540300010 Type S, 275mm, 0.3 mm | 691600173 | ○ |
| LH/LF 15/14 | 400V, 3/N 8.0 kW | 692251249_Side 692261032_Bottom 692230631_Back wall 692225212_Door | 602211370 | 692060260_Side 692060245_Bottom 692060240_Back wall 692050185_Door | 602001011 | 540300021 Type S, 275mm, 0.5 mm | 691600173 | ○ |
| LH 30/12 | 400V 3/N 7.0 kW | 692251248_Side 692261031_Bottom 692230630_Back wall 692225211_Door | 602211371 | 692020330_Side 692020245_Bottom 692020310_Back wall 692020245_Door | 602001008 | 540300010 Type S, 275mm, 0.3 mm | 691600173 | ○ |
| LH/LF 30/13 | 400V 3/N 8.0 kW | 692251250_Side 692261033_Bottom 692230632_Back wall 692225213_Door | 602211372 | 692020330_Side 692020245_Bottom 692020310_Back wall 692020245_Door | 602001008 | 540300010 Type S, 275mm, 0.3 mm | 691600173 | ○ |
| LH/LF 30/14 | 400V 3/N 10.0 kW | 692251251_Side 692261034_Bottom 692230633_Back wall 692225214_Door | 602211373 | 692060330_Side 692060245_Bottom 692060310_Back wall 692050245_Door | 602001009 | 540300021 Type S, 275mm, 0.5 mm | 691600173 | ○ |
| LH/LF 60/12 | 400V 3/N/PE 8.0 kW | 692240009_Side + ½ floor 692230012_Back wall 692220012_Door | 602210128 | 692020430_Side 692020345_Bottom 692020390_Back wall 692020315_Door | 602001003 | 540300010 Type S, 275mm, 0.3 mm | 691600175 | ○ |
| LH/LF 60/13 | 400 V 3/N/PE 11.0 kW | 692240011_Side + ½ floor 692230016_Back wall 692220016_Door | 602210132 | 692020430_Side 692020345_Bottom 692020390_Back wall 692020315_Door | 602001003 | 540300010 Type S, 275mm, 0.3 mm | 691600175 | ○ |
| LH 60/14 | 400V/230V 3/N/PE 12.0 kW | 692240245_Side + ½ floor 692230433_Back wall 692220413_Door | 602210986 | 692060430_Side 692060345_Bottom 692060390_Back wall 692060320_Door | 602001004 | 540300021 Type S, 275mm, 0.5 mm | 691600175 | ○ |
| LH 120/12 | 400 V 3/N 12.0 kW | 692240010_Side + ½ floor 692230013_Back wall 692220013_Door | 602210129 | 692020530_Side 692020500_Bottom 692020490_Back wall 692020420_Door | 602001001 | 540300010 Type S, 275mm, 0.3 mm | 691600015 | ○ |
| LH 120/13 | 400 V 3/N 15.0 kW | 692240012_Side + ½ floor 692230017_Back wall 692220017_Door | 602210133 | 692020530_Side 692020500_Bottom 692020490_Back wall 692020420_Door | 602001001 | 540300010 Type S, 275mm, 0.3 mm | 691600015 | ○ |
| LH/LF 120/14 | 400 V 3/N 18.0 kW | 692240014_Side + ½ floor 692230021_Back wall 692220021_Door | 602210137 | 692060530_Side 692060500_Bottom 692060490_Back wall 692060420_Door | 602001002 | 540300021 Type S, 275mm, 0.5 mm | 691600015 | ○ |
| LH 216/12 | 400 V 3/N/PE 20.0 kW | 692240178_Side + ½ floor 692230309_Back wall 692220286_Door | 602210721 | 692020625_Side 692020595_Bottom 692020590_Back wall 692020515_Door | 602000999 | 540300010 Type S, 275mm, 0.3 mm | 1x 691600015 1x 691600015 (shortened to 250mm) | ○ |
| LH 216/13 | 400 V 3/N/PE 22.0 kW | 692240962_Side + ½ floor 692231323_Back wall 692226829_Door | 602212905 | 692020625_Side 692020595_Bottom 692020590_Back wall 692020515_Door | 602000999 | 540300010 Type S, 275mm, 0.3 mm | 1x 691600015 1x 691600015 (shortened to 250mm) | ○ |

| Spare Parts/Wearing Parts | | | | | | | | |
|--|----------------------|---|-----------|---|-----------|---------------------------------------|---|---|
| Part number | | | | | | | | |
| 1 Electrical connection / 2 Heating element ^{1, 2} / 3 Heating element, complete set / 4 Support tubes / 5 Support tubes, complete set / 6 Thermocouple ¹ / 7 SiC Floor plate ¹ | | | | | | | | |
| Model | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ► |
| LH 216/14 | 400V 3/PE 26.0 kW | 692253130_Side 692241001_Side + ½ Bottom 692231413_Back wall 692226921_Door | 602213057 | 692060630_Side 692060600_Bottom 692060595_Back wall 692060515_Door | 602001000 | 540300021 Type S, 275mm, 0.5 mm | 1x 691600015 1x 691600015 (shortened to 250mm) | ○ |
| ¹ Quantity as required | | | | | | | | |
| ² Support tubes, power cable clamps, and cramps on request | | | | | | | | |



Symbols

- Can be replaced by the customer with tools and instructions.
- Can be replaced by trained personnel with tools and instructions.
- NT Nabertherm Service required



Note

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



Note

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

10.1 Installation/Disassembly of the Side/Surrounding Cover Panels

For maintenance and repairs, the side panels can be removed from the furnace frame.

The locks on the cover panel must be unlocked with a suitable key. Tilt the cover panel slightly and lift it up and out. The panel must be set down on a soft material (such as foam rubber). Depending on the furnace model and features, the position of the locks and appearance may differ. Install in the reverse order.



Fig. 68: Disassembly of the cover panels (similar to picture)

10.2 Replacing a Heating Element



Warning – Danger of electric shock

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

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



Note

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



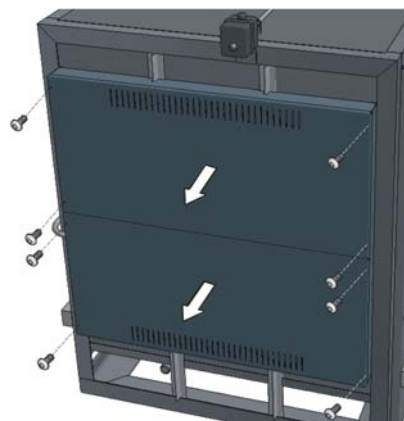
Note

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

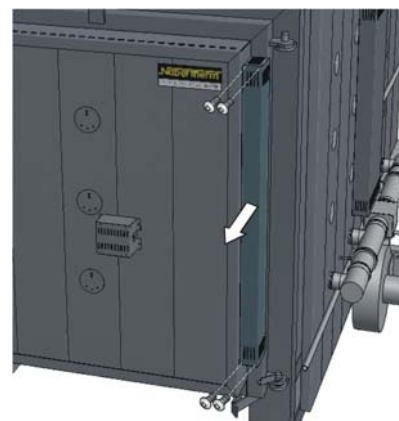
Tip: Because we build many different furnace models, we recommend that you take several photos of the installed heating elements and the switchgear. That simplifies subsequent installation and wiring of new heating elements.

Removing Cover/s

We refuse to accept any responsibility for any and all direct and indirect damages resulting from faulty installation. This also applies to all cases in which generally required installation steps are not described. The replacement of the heating elements requires the cover/s (protective paneling) on the furnace (bogie, depending on model). Use an appropriate tool to remove the screws around the sides of the cover and keep them in a safe place for later use. The number and position of the screws may differ from one furnace model to the next.



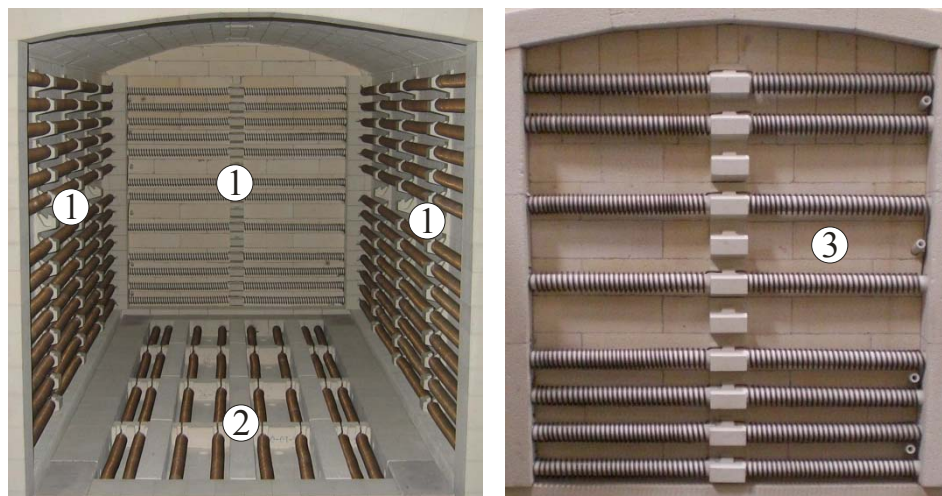
Example: Cover for heating elements in the furnace interior located on the rear side of the furnace



Example: Cover for heating elements in the inner door located on the outer side of the door

Fig. 69: Example: Removing Cover/s

Arrangement of the Heating Elements (depending on model)



- 1 Heating elements furnace interior
- 2 Heating elements bogie (remove base plates) →
- 3 Heating elements door/lift door



Fig. 70: Example: Heating elements of a bogie hearth furnace (depending on model)

Arrangement of the Connection Terminals(dependent on model)



Example: Connection terminals for heating elements in the furnace interior located on the rear side of the furnace

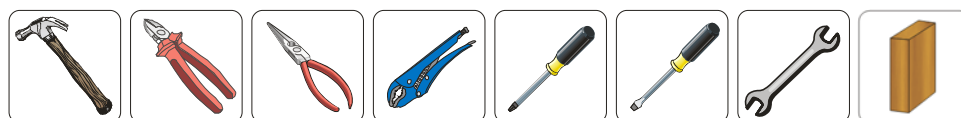
Example: Connection terminals for heating elements in the inner door located on the outer side of the door

Example: Connection terminals for heating elements of the bogie located on the lower side the bogie

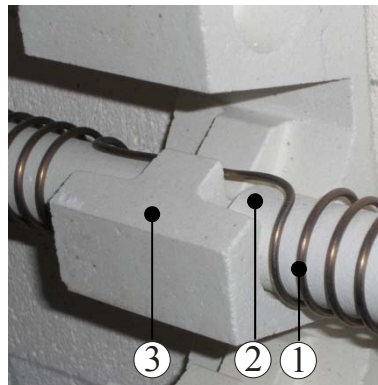
Fig. 71: Example: Connection terminals of the heating elements

Tools Required by Customer for the Installation

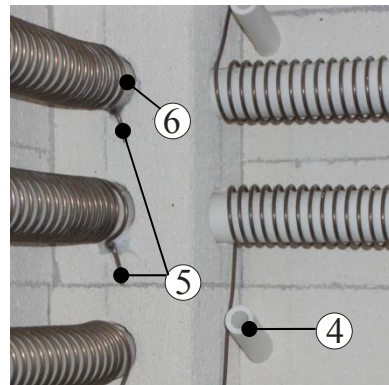
The following tools are required to replace the heating elements. Hammer, cable cutter, long-nose pliers, pipe wrench, screwdriver (depending on the age of the furnace, Phillips screwdriver, flat-tip screwdriver, jaw wrench and a wood block to hammer in the ceramic penetration pipes.



Replacing the Heating Elements (short description)

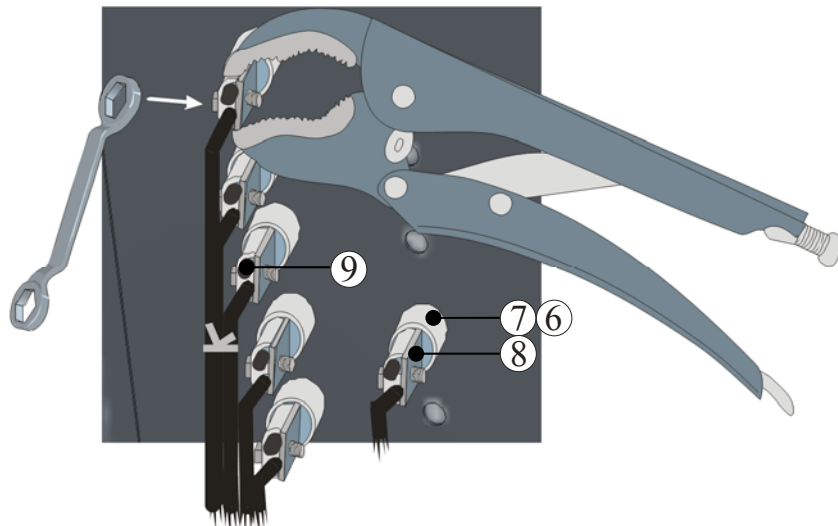


- 1 Heating element (heating coil)
- 2 Support tube
- 3 Support brick



- 4 Holding tube
- 5 Holding clamp/s
- 6 Fiber wadding

Fig. 72: Designation of the required attachments



- 7 Ceramic penetration pipe, 6 Fiber wadding
- 8 Connection terminal
- 9 Heating element end (twisted)

Fig. 73: Example: Connection terminal/s



- **Removing the Heating Elements**
- Remove the protective paneling of the electrical connections (raise base plates from the bogie and carefully remove).
- Loosen the connection terminals at the ends of the heating coils. Replace ceramic penetration pipe as necessary.
- Draw out the existing holding clamps and ceramic tubes for holding the heating element in place out of the masonry (old holding clamps are highly fragile. If a holding clamp breaks, the piece still stuck in the masonry must be removed).
- Remove heating coils carefully with the support tubes (Caution: older heating elements are highly fragile)-

- **Installing the Heating Elements**

- Clean firing deposits from heating chamber, support tubes, support bricks, terminals and ceramic penetrations.
- **Warning:** We recommend using new support tubes, terminals and ceramic penetration pipes (soiled support tubes/ceramic penetration pipes result in early failure of the new heating elements).
- The new heating elements have heating element ends (twisted) protected by a lug. Nip the lugs before installation. Install the heating coil with the support tubes
- Insert the holding clamps into the wall masonry. **Warning:** Do not insert staples into the corner bricks! Warning: Never use the old holes for the new holding clamps. This may result in problems with the Fi switch (if included) Depending on the furnace model, ceramic tubes can also be installed as holders instead of holding clamps.
- Insulate the ceramic penetration pipes with a small amount of fiber wadding from outside. Make the electric connections using the connection terminals: Hold the lower part with a pliers and tighten the screw firmly.
- Recommendation: Retighten all the screws of the connection terminals of the heating elements after one week of operation and, thereafter, once a year. Avoid placing any stress, pressure or twist on the heating wire. If you fail to follow this instruction the result is the immediate destruction of the sensitive heating elements.
- If necessary trim any overlaying fibers to somewhat longer than one terminal width (approx. 2-3 cm).
- Check electrical connections and protective lines to ensure they are correctly connected.
- Install protective paneling of the electrical connections (base plates of the bogie hearth furnace (base plates which are damaged or seriously contaminated must be replaced by new, equivalent base plates).

Screw tightening torque

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

| Thread diameter Metric thread (M) | Torque in Nm |
|---|--|
|  |  |
| M 4 | 2.0 |
| M 5 | 6.0 |
| M 6 | 8.0 |
| M 7 | 14.0 |
| M 8 | 20.0 |
| M 10 | 39.0 |



Note

Re-install in reverse sequence.



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

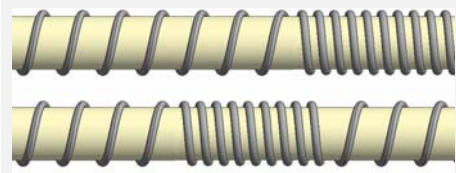
This procedure is for the first start-up and must be repeated after **every replacement** of heating elements.

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

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



Before



After (nest formation)

10.3 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.

Unscrew all the screws of the back wall with a suitable tool and keep them in a safe place for future use. Place the cover on a soft surface (such as foam rubber). The number and position of the screws may differ depending on the furnace model. The picture may differ depending on the furnace model.

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

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*).

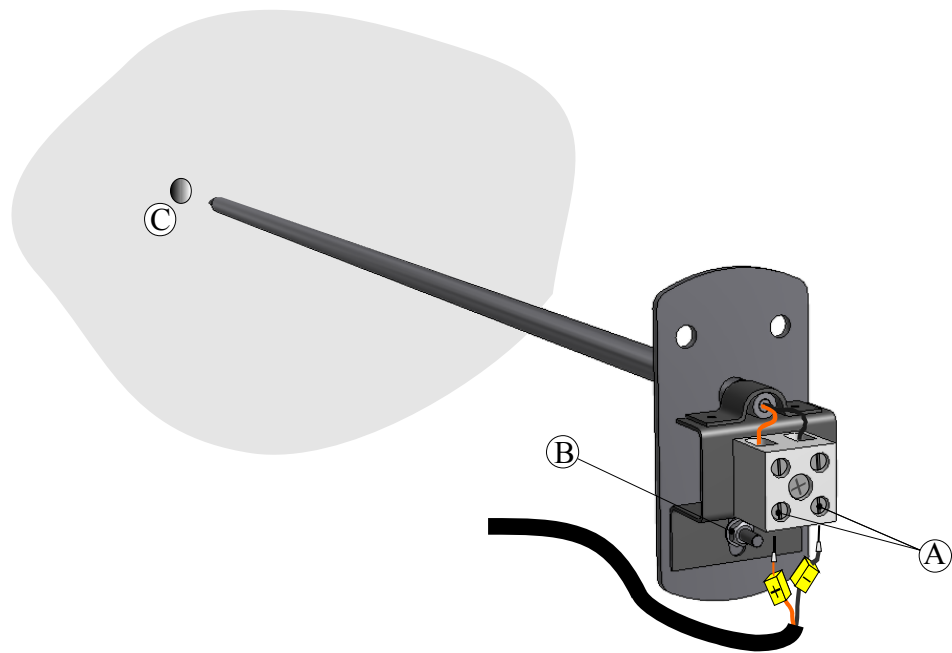


Fig. 74: Removing the thermocouple/s (Similar to this)



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

Re-install in reverse sequence.



Note

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

11 Aligning/Adjusting the Parallel Swing Door



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.

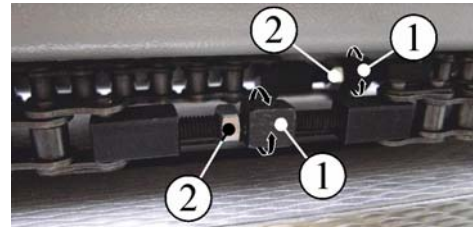
When installing new door insulation or repairing the insulation or due to the effects of high temperatures, it may be necessary to readjust the parallelism of the door, as it does not seal evenly between the furnace collar and the door insulation all around.

The chain is responsible for parallel closing of the door. When adjusted correctly, the door insulation closes evenly against the furnace collar.

Use the tensioning screws to adjust the parallelism between the door seal and the furnace collar. By adjusting the screws, the parallelism of the door insulation can be aligned or adjusted slightly.

First, undo one of the two tensioning screws (1) with a suitable tool (prior to this undo the securing hex nut (2), and, while closing the door, check whether the door insulation closes evenly against the furnace collar. The second tensioning screw can be undone for fine adjustment until the door insulation closes evenly all around.

Then tighten the two tensioning screws “evenly” (you should be able to “depress” the chain slightly with your finger). Then secure the tensioning screws against inadvertent loosening with the hex nut (2) (lock).



1) Tensioning screw

2) Hex nut to secure the tensioning screw

Fig. 75: Tensioning and adjusting the tensioning screws on the chain (similar to picture)

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.

12 Accessories (Options)

12.1 Assembling the charging frame (accessory)

The stacked frame is moved into the furnace with a pallet truck (option) and lowered carefully. Suitable for trucks with fork widths to a maximum of 520 mm.

| No. | Quantity | Name |
|-----|----------------------------------|---------------------|
| A | 1 | Bottom tile |
| O | 1 | Side panel, left |
| C | 1 | Side panel, right |
| D | 1 | Load-bearing fork |
| E | 10 | Bolt M8 x 16 (SW13) |
| T | max. pallet truck width = 520 mm | |

Fig. 76: Individual parts of the charging frame

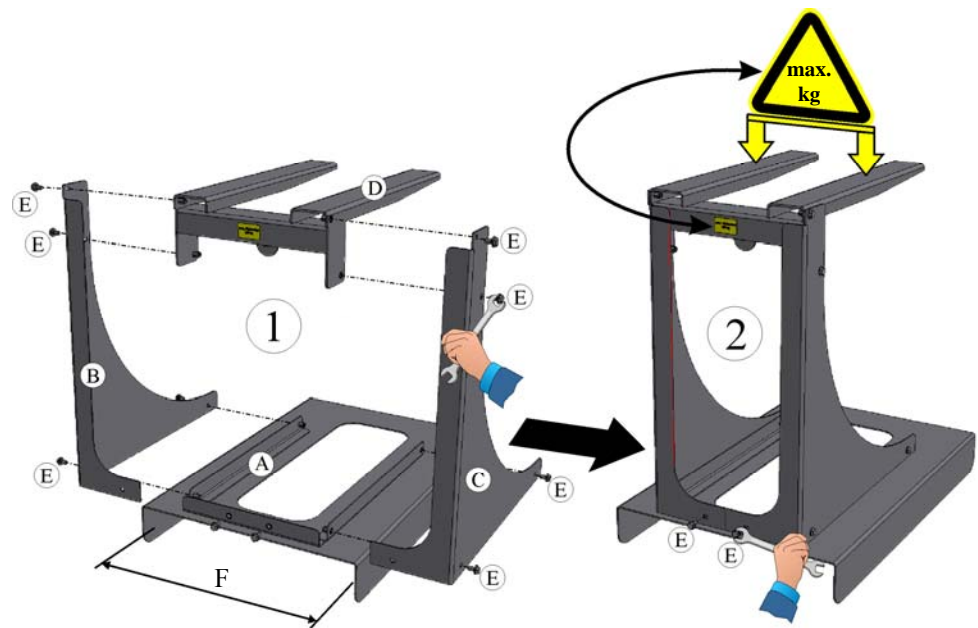


Fig. 77: Assembling the charging frame (accessory)

Place the base plate (A) on even ground. Insert the left (B) and right (C) side panels and fix them in place each with three bolts (E) (M8 x 16, SW 13). Insert the load-bearing fork (D) and fix in place with four bolts (E). Make sure that it is horizontal; it can be adjusted by means of the slotted hole for the bottom bolts.



Caution

Nabertherm assumes no liability for damages caused by improper installation.

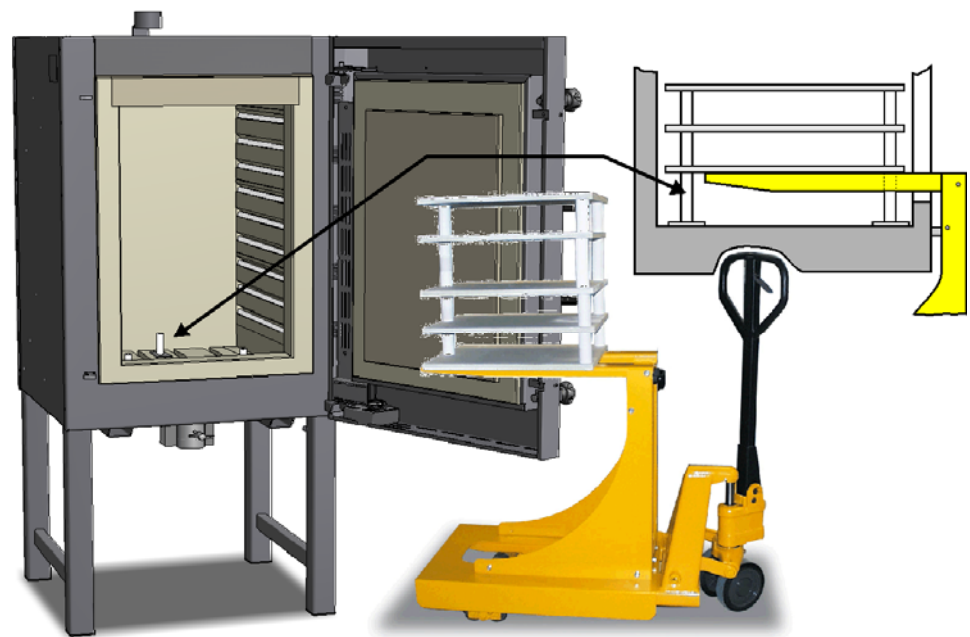


Fig. 78: Example: Charging frame with optional pallet truck

13 Additional Equipment

13.1 Operation with Heat Treatment Accessories

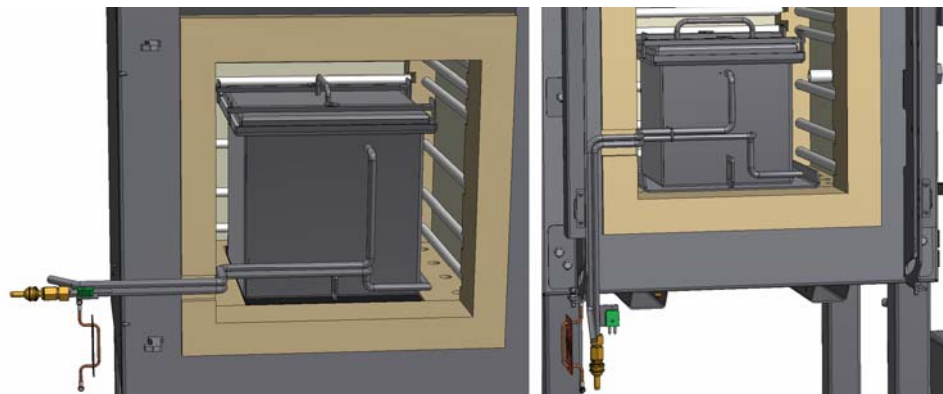
For heat treatments in protective gas Nabertherm offers protective-gas boxes and an extensive range of accessories for use in the furnaces. The advantage of protective-gas boxes is that they achieve a better protective gas atmosphere than furnaces that feed gas directly into the furnace chamber. In furnace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

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



Note

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



Example: Gas inlet with a swing door

Example: Gas inlet with a lift door

Fig. 79: Example: Protective gas box (similar to picture)

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

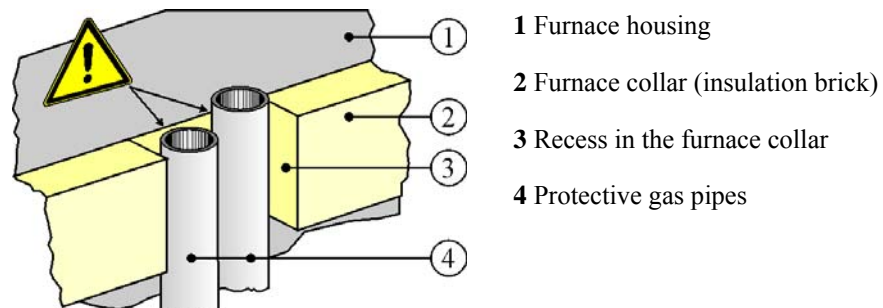


Fig. 80: Pay attention to the furnace collar and the protective gas pipes (similar to picture)

**Note**

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

**Warning – Danger of suffocation**

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

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

Measures: Switch on the extraction system.

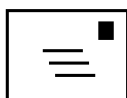
Note

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

14 Nabertherm Service



The Nabertherm Service team is available at all times for furnace maintenance and repair. If you have any questions, problems, or requirements, contact Nabertherm GmbH. By mail, phone, or the Internet.

**Mail**

Nabertherm GmbH
Bahnhofstrasse 20
28865 Lilienthal/Germany

**Phone or fax**

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

**Web or e-mail**

www.nabertherm.com
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:

| | | |
|---|---|-----------------|
|  | | |
| Nabertherm GmbH Bahnhofstr. 20, 28865 Lilienthal/Bremen, Germany Tel +49 (04298) 922-0, Fax +49 (04298) 922-129 contact@nabertherm.de www.nabertherm.com | | |
| | | Made in Germany |
| ① | ② | ④ |
| ③ | | |
| | | |
| | | |
| CE | | |

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

Fig. 81: Example (type plate)

15 Declaration of Conformity



EC Declaration of Conformity

Compliant with EC Directive 2006/42/EC on machinery, Annex II A

We,

Nabertherm GmbH
Bahnhofstr. 20, 28865 Lilienthal, Germany

hereby declare that the following product:

Electrically Heated Chamber Furnaces

| Model | LH 15/12 | LH 30/12 | LH 60/12 | LH 120/12 | LH 216/12 |
|-------|----------|----------|----------|-----------|-----------|
| | LH 15/13 | LH 30/13 | LH 60/13 | LH 120/13 | LH 216/13 |
| | LH 15/14 | LH 30/14 | LH 60/14 | LH 120/14 | LH 216/14 |
| | LF 15/13 | LF 30/13 | LF 60/13 | LF 120/13 | |
| | LF 15/14 | LF 30/14 | LF 60/14 | LF 120/14 | |

fulfills all the pertinent provisions contained in Directive 2006/42/EC.

The product named is also compliant with all the provisions of the following directives:

- 2014/35/EU (LVD)
- 2014/30/EU (EMC)
- 2011/65/EU (RoHS)

The signatories are authorized to compile the relevant technical documents. The address is the stated manufacturer's address.

Any change in the product not approved by the manufacturer invalidates this declaration.

The following harmonized standards were applied:

- DIN EN 61010-1 (07.2011)
- DIN EN 61000-6-1 (10.2007), DIN EN 61000-6-3 (09.2011)

Lilienthal, 15.02.2017

Michael Oberschmidt
Vice President R & D

Thomas Adamek
Head of Quality Management

16 For Your Notes

