

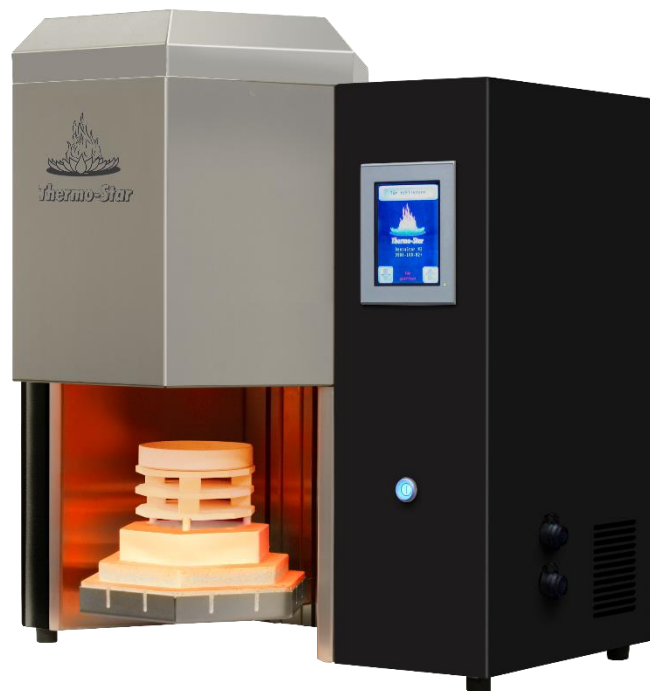


Thermo-Star
Kompetenz in Thermotechnik

Original instruction manual

Denta-Star M2plus

Atmospheric sintering furnace for
sintering of oxide ceramics



Please read this instruction manual carefully and if necessary other documents related to the product to ensure safe and proper application. The manual must be given to the end user who should keep it throughout the service life until disposal.

WELCOME

Thermo-Star GmbH (hereafter referred to as Thermo-Star) appreciates your confidence and delivers to you a sintering furnace (hereafter referred to as furnace).

The furnace was subjected to a complete functional test prior to dispatch and the packaging content was checked for completeness.

HINWEIS

The figures and illustrations used in this document contribute to basic understanding and may be different from the product design.

You can find a list of tables and illustrations in the Appendix.
2. edition, status January 2018

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1 INTRODUCTION

This instruction manual for furnace type “Denta-Star M2” was put together with greatest care and includes important information to ensure a safe, long-term operation.

Please let us have your feedback if any information is incomplete or missing.

1.1 SERVICE

If you have any questions regarding the furnace, components from the scope of supply or this instruction manual, please contact our customer service at

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1.2 STATUTORY DEFECTS LIABILITY

For more information about statutory defects liability, please see our General Terms and Conditions.

 http://www.thermo-star.de/tl_files/docs/Thermo-Star/AGB%20Thermo-Star%20GmbH.pdf

1.3 SYMBOLS USED IN THIS INSTRUCTION MANUAL

The symbols below are used to identify different types of information:



Depiction of warnings

 [Chapter 2.4 “DEPICTION OF WARNINGS”](#)



Refers to information in this instruction manual



Refers to information in other documents

2 SAFETY INFORMATION



Please read the safety notes before installing and putting the furnace into service to prevent personal injury and property damage.

2.1 INTENDED USE

2.1.1 SCOPE

This furnace is used for sintering of oxide ceramics with normal atmosphere.

Areas of application:

- ◆ Dental laboratories
- ◆ Research institutes / universities
- ◆ Ceramic processing factories

Modifications to the status of delivery or other areas of application or utilization are not permitted or may only be carried out after consulting the manufacturer.

2.1.2 IMPROPER USE

Improper use is for example:

- ◆ Drying of all kinds of materials
- ◆ Sintering of chemically treated ceramics
- ◆ Non-compliance with these instructions or other product-related documents
- ◆ Use in potentially explosive areas
- ◆ Use of defective components (deferred maintenance)

Never use gaseous, liquid or slightly volatile substances in the furnace.

This refers particularly to:

- ◆ Salts
- ◆ Oils
- ◆ Greases
- ◆ Acids and alkaline solutions
- ◆ Fuels
- ◆ Resins
- ◆ Plastics

2.2 QUALIFIED PERSONS

All activities on the furnace may only be carried out by qualified personnel who have several years' professional experience and certified knowledge as listed in the table below:

Table 01: Qualification of personnel





Activities	Persons	Knowledge
Design Operational changes	Engineer, designer	<ul style="list-style-type: none"> ◆ Knowledge of high-temperature technology ◆ Evaluation of substance properties and reactions exposed to effects of temperature
Transport Storage	Forwarding agents, traders, repairers	<ul style="list-style-type: none"> ◆ Proof of instruction in freight securing ◆ Safe handling of lifting aids and accessories ◆ Knowledge about handling of hazardous substances
Installation	Supplier, owner, user	<ul style="list-style-type: none"> ◆ Knowledge of electrical supply lines and ambient conditions
Use	Owner, user	<ul style="list-style-type: none"> ◆ Knowledge of information in this instruction manual
Simple maintenance	Owner, user	<ul style="list-style-type: none"> ◆ Knowledge of information in this instruction manual ◆ Basic knowledge of measuring devices for electrical measurements
Major servicing, repair and maintenance work	Qualified personnel	<ul style="list-style-type: none"> ◆ Proof of electrical or mechanical technical training
Disposal	Qualified personnel	<ul style="list-style-type: none"> ◆ Knowledge of dismantling of mechanical and electrical components ◆ Knowledge of professional disposal ◆ Knowledge of recycling of raw materials

2.3 PERSONAL PROTECTIVE EQUIPMENT

Appropriate personal protective equipment must be worn in accordance with the operating location and activities being carried out on the furnace.

The employer must provide personal protective equipment for personnel and supervisors must ensure that the equipment is used.






Table 02: Personal protective equipment

Symbol	Meaning	Explanation
	Use foot protection	Safety shoes offer slip resistance on slippery floors, puncture resistance and protection from falling objects.
	Use eye protection	Protective goggles protect the eyes from dust and other particles or small objects.
	Use hand protection	Protective gloves protect the hands from bruises, cuts, chemical burns and hot surfaces.
	Use protective mask	A mask protects against inhalation of fine dust that is not filtered out and prevents respiratory complaints.

2.4 DEPICTION OF WARNINGS

To make it easier to identify hazardous risks, these are marked in the instruction manual with the following warning symbols and signal words:

Table 03: Risk classifications

Symbol	Signal word	Meaning
	DANGER	This symbol indicates a hazardous situation presenting an immediate threat of death or serious injury to persons and life.
	DANGER	Danger from electrical voltage. This symbol indicates danger from electrical voltage.
	DANGER	Danger from hot surfaces. This symbol indicates risks of burning on hot surfaces.
	DANGER	Danger from hand injuries. Sections marked with this symbol indicate hazardous situations presenting danger from hand crushing.
	NOTICE	Refers to a situation that, if not avoided, could result in damage to the furnace, its components or objects in its environment.

Warning example:



SIGNAL WORD (Warning)

Cause

Effects

Protective measure(s)

2.5 UNAUTHORIZED PARTS

Before market launch, the furnace was subjected to extensive tests and quality controls. All components were tested under the highest load levels. Mounting unauthorized parts affects safety and will exclude all statutory defects liability by Thermo-Star. Use only original spare parts or spare parts approved by Thermo-Star when replacing parts.

2.6 GENERAL HAZARDOUS POTENTIAL



This chapter specifies general hazards resulting from the furnace.

2.6.1 MECHANICAL HAZARD



When closing the furnace i.e. moving the furnace floor up hands or fingers could be crushed. Do not leave the furnace floor unattended during activity.

Please note the safety notes on the furnace.

2.6.2 THERMAL HAZARD



The furnace operates in cycles. Thermal hazards arise from the furnace floor during operation. Because of its design, the furnace floor will not cool down completely. Temperatures of up to 150°C are reached under regular operating conditions.




Please note the safety notes on the furnace.

2.7 ELECTROMAGNETIC COMPATIBILITY

The device does not cause any electromagnetic emission levels or faults in other devices.

2.8 RESPONSIBILITY OF THE OWNER


The owner and/or user is responsible for ensuring compliance with the following:

- ◆ Operate the furnace only in accordance with its intended purpose and in proper condition.
 [Chapter 2.1 "INTENDED USE"](#)
- ◆ The functionality of protective devices may not be affected.
- ◆ Comply with maintenance intervals and eliminate faults immediately.
- ◆ Eliminate faults yourself only when the required measures are indicated in this instruction manual.
- ◆ Thermo-Star or a qualified service company is responsible for implementing all other measures.
- ◆ Check that the furnace type plate is complete and legible.
 [Chapter 4.5 "TYPE PLATE"](#)
- ◆ Provide sufficient personal protective equipment and ensure that it is worn.
 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)
- ◆ Provide the full instruction manual on-site and instruct personnel accordingly.
- ◆ First aid: we refer to local and internal corporate provisions when dealing with accidents. Ensure that sufficient staff are trained in first aid.
- ◆ The operator must provide suitable fire-fighting equipment and make sure that the location and handling of fire extinguishers are known. If unsuitable fire-fighting equipment is used, harmful fumes or hazards from electric shock may occur.



Danger of injuries or death from electric shock.

Never use water to extinguish electrical equipment. Risk of electric shocks.

- ◆ Employ only authorized and adequately qualified personnel.
 [Chapter 2.2 "QUALIFIED PERSONS"](#)

3 TRANSPORT AND STORAGE

This chapter provides information about proper transport and storage of the furnace.

HINWEIS

The furnace and all loose parts and accessories (packed in cardboard or transport tube) are delivered in a stackable transport packaging made of wood.

→ [Chapter 4.1 "SCOPE OF SUPPLY"](#)

→ [CHAPTER 4.2.2 "CHARACTERISTICS AND TECHNICAL DATA"](#)

3.1 SAFE TRANSPORT AND STORAGE

During transport and storage, the following hazards must be expected:



WARNING

Read the following safety notes carefully before transport or storage.

Misuse can cause serious injuries.

Make sure that transport and storage personnel are qualified as required.

→ [Chapter 2.2 "QUALIFIED PERSONS"](#)

Transport of the furnace by persons

Physical injuries because of too heavy weight

2 persons are required for transport.

→ [Chapter 3.2 "TRANSPORT"](#)

→ [CHAPTER 4.2.2 "CHARACTERISTICS AND TECHNICAL DATA"](#)

Transport using truck or industrial truck

Serious crushing, impacts and accidents as a result of inappropriate handling

Wear personal protective equipment.

→ [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

Transport the furnace as it was delivered (packed in transport box).

Make sure that the freight is properly secured.

Check that the lifting accessories are suitable and undamaged.

Transport using a loading crane

Serious crushing and impact injuries from swinging or falling loads

Wear personal protective equipment.

→ [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

Comply with the maximum load of the crane system and lifting accessories.

Never stand under swinging loads.


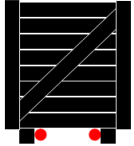

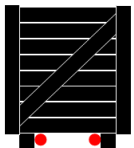

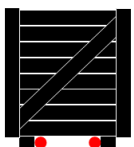

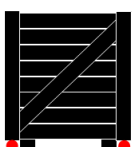

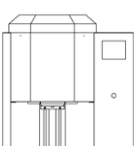
Keep other persons out of the danger zone.

Avoid swinging movements.

3.2 TRANSPORT

Please refer to the notes concerning correct transportation of the unit given below. Red points indicate the respective lifting points.

Table 04: Types of transport

Type of transport		Permitted lifting points
	→	
	→	
	→	
	→	
	→	

3.3 STORAGE

HINWEIS

Inappropriate storage might damage the furnace. Make sure you meet or exceed these requirements:

- ◆ If possible store the furnace in the transport packaging
- ◆ Avoid dusty or corrosive atmospheres
- ◆ Temperature: $-20^{\circ}\text{C} < T_{\text{storage}} < 60^{\circ}\text{C}$
- ◆ Humidity: $< 80\%rH$, non-condensing










4 DESCRIPTION OF THE PRODUCT

This chapter provides information about the scope of supply, characteristics, accessories and functionality.

4.1 SCOPE OF SUPPLY

When unpacking check that the supplied product is undamaged and complete (see the table below). There may be differences in the scope of supply as the furnace is subject to prior sale. Please note the vendor's delivery notes.

Table 05: Scope of supply of the furnace

Amount / component	Description	Figure	Packing
1 x furnace	Denta-Star M2		Transport box
1 x mains cable	Mains cable 1.8m, 1.5mm ² IEC 320 <-> C19		Plastic-wrapped
1 x sintering beads	Sintering beads 200g		PET bottle
1 x protective cover	Protective cover 140x40mm		Cardboard
3 x spacer	Spacer h: 20mm		Cardboard
1 x setter	Setter 140x2mm		Cardboard
1 x base plate	Base plate 140x8mm Dodecagonal		Cardboard
5 x heating elements	Heating element		Transport sleeve "TwistPack", if not pre-assembled
4 x connecting strip	Connecting strip EE100 used to connect the heating elements		Cardboard, if not pre-assembled
1 x display protective foil	Display protective foil Self-adhesive	--	Cardboard
1 x documentation	Instruction manual	--	Cardboard
1 x USB stick	Factory settings	--	
Each sintering aid is suitable for temperatures $T \leq 1,550^{\circ}\text{C}$ & $\Delta T/t \leq 800^{\circ}\text{C/h}$			

4.2 PRODUCT CHARACTERISTICS

This chapter describes the main characteristics of the furnace.

4.2.1 SHORT DESCRIPTION OF THE FURNACE

A double fiber-insulated chamber is heated electrically. The required cooling is carried out using a second wall and ventilators.

The chamber floor and the load (sintering aids and ware to be sintered) are placed in the furnace chamber using an electrically-operated lifting system. They are subjected to thermal treatment with normal atmosphere.

An electronic PID control with storage capacity for several temperature-time profiles is available.

The controller is operated using a full-color graphical user interface with multilingual menu positioned on the front of the furnace (referred to as HMI). The man switch is located under the HMI on the front of the furnace. An USB and Ethernet connection located on the right side can be used for extended operation. The supply connection for power is installed on the back of the furnace.

Internal battery buffering protects the furnace and load from power failures.

4.2.2 CHARACTERISTICS AND TECHNICAL DATA

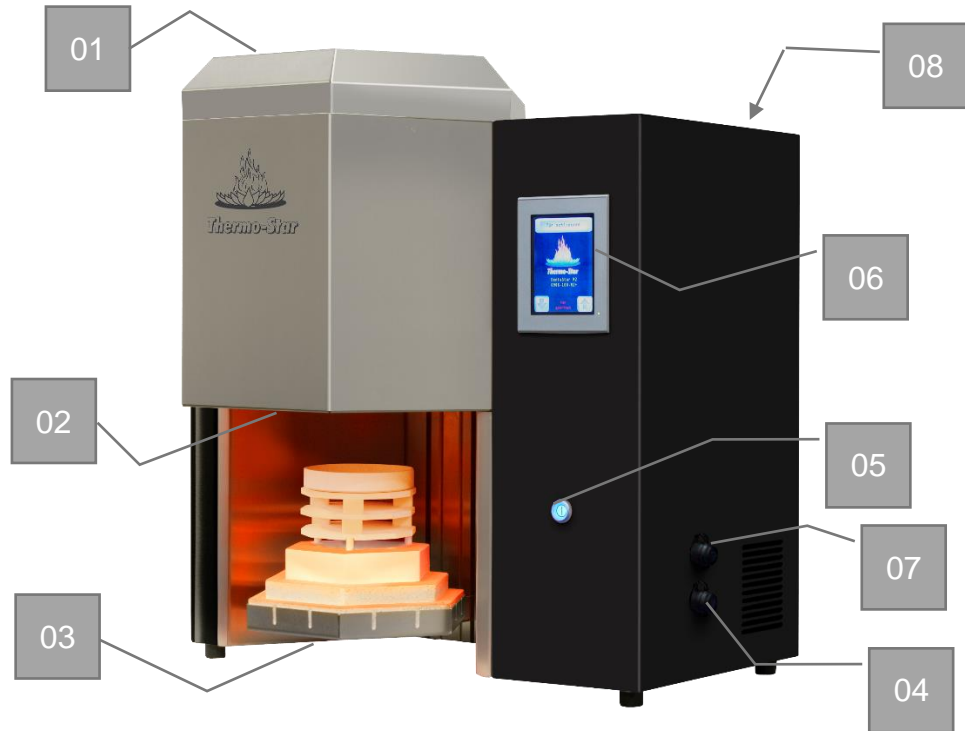
Table 06: Characteristics and technical data

General	
◆	Alumina fiber insulation (Al_2O_3)
◆	6 molybdenum disilicide heating elements ($MoSi_2$)
◆	Housing made of powder-coated steel sheet and stainless steel
◆	Bolted cover and back wall for easy maintenance
◆	6 rubber feet
◆	Separate cooling air outlet (downwards and to the back, on top)
◆	Ethernet connection (RJ45)
◆	USB connection
Mechanical	
◆	Size: 730/600/810 mm (W/D _{Furnace} [D _{Floor space}]/H)
◆	Weight: 90/140 kg (net/transport)
Electrical	
◆	Voltage: 220-240 V
◆	Supply: ≤ 16 A
◆	Power: ≤ 2,500 W
◆	Temperature: ≤ 1,600°C

4.3 COMPONENTS

The figure below shows the assembly and location of each component. They will allow the descriptions given in the following chapters to be assigned to the individual components.

Figure 01: Furnace overview



- 01 Cooling air outlet, top
- 02 Cooling air outlet, bottom
- 03 Furnace floor
- 04 Network connector RJ45
- 05 Main switch

- 06 HMI
- 07 USB connection Supports 4 GB max.
- 08 Power supply C20, 16 Ampere

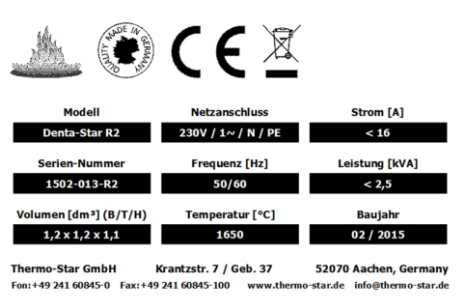
4.4 FUNCTIONALITY

The furnace is a high-temperature furnace with direct, electrical resistance heating. Temperature is measured using a thermocouple type S (Pt-PtRh10%; platinum against platinum-rhodium 10%) placed in the center top of the furnace. The load is assembled on the firing support placed on the furnace floor and the ceramic ware to be sintered is positioned on ceramic sintering aids. The thermal treatment starts after the furnace has been loaded. Select one of the stored programs with temperature-time profile to start the process. The temperature inside the furnace chamber is controlled electronically and modified in accordance with the selected program. The furnace passes into an automated cooling phase after ending a process i.e. when the end segment in the active program has been reached. You can open the furnace at temperatures <300°C to remove sintered products. The furnace can now be reloaded and is ready for the next sintering procedure.

4.5 TYPE PLATE

A type plate is attached to the furnace housing. Please find the following information and keep it at hand for inquiries of any kind:

Figure 02: Example type plate



Modell	Netzanschluss	Strom [A]
Denta-Star R2	230V / 1~ / N / PE	< 16
Serien-Nummer	Frequenz [Hz]	Leistung [kVA]
1502-013-R2	50/60	< 2,5
Volumen [dm³] (B/T/H)	Temperatur [°C]	Baujahr
1,2 x 1,2 x 1,1	1650	02 / 2015

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- ◆ Serial number
- ◆ Power supply
- ◆ Year of construction



4.6 ACCESSORIES

For information about suitable accessories, please see  [Chapter 1.1 "SERVICE"](#)

5 INSTALLATION

This chapter describes how to install the furnace.

Table 07: Requirements for installation

Connections, objects, tools, installation material	
◆	Cutter knife
◆	Screwdriver, TX20, PH1
◆	Open-end wrench SW7
◆	Allen key SW3.0
◆	All components  Chapter 4.1 "SCOPE OF SUPPLY"
◆	Ambient conditions  Chapter 5.2 "LOCATION"

5.1 SAFE INSTALLATION



DANGER

Read the following safety notes carefully before installing the furnace.

Misuse can cause serious injuries.

Make sure that installation personnel are qualified as required.

 [Chapter 2.2 "QUALIFIED PERSONS"](#)

Mechanical hazards

Physical injuries because of too heavy weight

2 persons are required for transport.

 [Chapter 3.2 "TRANSPORT"](#)

 [Chapter 4.2.2 "CHARACTERISTICS AND TECHNICAL DATA"](#)

Serious crushing due to falling components such as furnace, gas bottle etc.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

Electrical hazards

Serious injuries or death through contact with live parts

Disconnect power plug before opening the furnace.

Open the furnace only when required for maintenance purposes.

Check electrical installation before installing the furnace.

Never carry out modifications.

5.2 INSTALLING THE FURNACE

HINWEIS




Inappropriate positioning might damage the furnace or surrounding parts.

5.3 LOCATION

Requirements imposed on the operating location:

- ◆ Humidity < 85%rH, non-condensing
- ◆ Ambient temperature > 5°C and < 25°C
- ◆ Even surfaces
 - Load-bearing capacity > 100kg
 - Temperature resistance > 60°C
- ◆ Air quality of the ambient air should generally correspond to that of the outside air
 - Components that are not permitted:
Grinding dusts (independent from material), spray oils, oil vapors, corrosive gases or vapors and other chemical auxiliary materials i.e. scanner sprays, separating agents etc.
- ◆ The distance to the walls, ceilings or other devices should be > 5cm on each side
- ◆ The distance to flammable objects should be > 50cm on each side
- ◆ The distance to hot objects should be > 50cm on each side (monitor and check to exclude potential interactions)
- ◆ Socket with grounding contact and separate electric circuit
 - Fuse preferably with automatic cut-out line protection switch D16A or fusible cut-out

5.3.1 SETTING UP THE FURNACE

- | | |
|--------|---|
| Step 1 | Open the transport packaging on each side and remove. The transport box can be stored and reused.
<small>Screwdriver TX20</small> |
| Step 2 | Remove protective foils and accessories cardboard box and dispose of them correctly.
<small>Cutter knife</small> |
| Step 3 | Lift furnace and place it on the stand / table |
| Step 4 | Mount the heating elements, if not pre-assembled
 Chapter 5.2.3 "MOUNTING HEATING ELEMENTS"
<small>Allen key SW3.0
Open-end wrench SW7</small> |
| Step 5 | Connect to power supply
 Chapter 5.2.4 "ELECTRICAL CONNECTION" |
| Step 6 | Connect to network (optional)
 Chapter 5.2.5 "NETWORK CONNECTION" |

5.3.2 MOUNTING HEATING ELEMENTS



- ◆ Remove cover screws on both sides left and right



- ◆ Lift cover



- ◆ Remove heating elements from the transport sleeves and insert carefully into the holding fixtures

 [Chapter 4.1 "SCOPE OF SUPPLY" / Table 05](#)



- ◆ **Contact heating elements**
Connect pre-installed connecting strips P2E-150 and P2E-200 to the ends of 2 nearest heating elements. Connect all heating elements using 5 connecting strips E2E-100.
Torque: 3 Nm



- ◆ Fit cover



- ◆ Insert cover screws on both sides and screw on tightly

5.3.3 ELECTRICAL CONNECTION

Connect the furnace and socket with grounding contact to the power supply using the mains cable.

Do not use multiple sockets.

Avoid extension cables if possible. However, if necessary, a qualified electrician should carry out the assembly to ensure that the length and line cross-section are in accordance with the conditions on site.

The grounded plug at the end of the mains cable disconnects the furnace from the power supply.

 [Chapter 4.3 "COMPONENTS" / Figure 01](#)

5.3.4 NETWORK CONNECTION (OPTIONAL)

The furnace has a 10/100M-LAN-RJ45 port with Auto-MDI/MDIX.

Connect the furnace, PC, notebook or local network using a standard RJ45 Ethernet cable.

 [Chapter 4.3 "COMPONENTS" / Figure 01](#)

6 FIRST PUTTING INTO SERVICE AND USE

This chapter provides information about how to professionally put the furnace into service for the first time and how to use it.

6.1 SAFE FIRST PUTTING INTO SERVICE AND USE

When putting the furnace into service for the first time and using it, please note the hazards below:



DANGER

Read the following safety notes carefully before putting the furnace into service for the first time.

Misuse can cause serious injuries.

Make sure that operating personnel are qualified as required.

 [Chapter 2.2 "QUALIFIED PERSONS"](#).

Mechanical hazards

Minor crushing as a result of motor-driven lifting movements

Do not store any objects in the space under the furnace chamber.

Carefully observe movements and prevent third parties from contact.

Follow the safety notes.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

Burning as a result of contact with hot furnace load

Observe the temperature display.


Follow the safety notes.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

6.2 PUTTING INTO SERVICE

Requirements for putting into service are:

- ◆ Installation is completed.
 [Chapter 5.2.2 "SETTING UP THE FURNACE"](#)
- ◆ Material to be sintered is available.
- ◆ Temperature-time profile for the material is known.

Persons required during putting into service are:

- ◆ Briefing service technician if necessary
- ◆ Owner or user

HINWEIS

If the furnace is first put into service or used without briefing, proceed in accordance with the instruction manual.

6.2.1 OPERATIONAL CONDITION

Turn on the furnace using the main switch on the front and wait approx. 20 seconds. The internal control starts and loads the firmware. The HMI displays a boot message. After booting, the HMI displays the START SCREEN and signals that the furnace is ready for use.

6.2.2 FIRST LOADING THE FURNACE

PLEASE NOTE Handle sintering aids and insulation components with care. Avoid vibrations and shocks. Keep the surfaces clean and free from foreign particles or deposits.

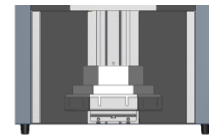
Please find a description of how to load the furnace for the first time below:

Step

Requirements:

- ◆ The furnace floor is set in the lower end position

State



Use sintering aids approved by the manufacturer when loading the furnace. There are no general loading instructions. Basically, any combination is permitted, provided you comply with the following:

- ◆ First, place the load on the dodecagonal base plate arranged on installed supports.
- ◆ Make sure that the load does not protrude over the base plate.
- ◆ The maximum loading height is 90mm starting from base plate top edge.

HINWEIS

The protective cover can be used as a crucible when using sintering beads. Avoid damage to the sintering aids while sintering and ensure sufficient heat radiation from below.

Use ceramic spacers.

Use setters when sintering without sintering beads. The surfaces are much smoother than the surfaces of the base plates and reduce stiction significantly during sintering.

Hot spots may occur when heating and may cause high temperature gradients that could destroy plates and crucibles.

Select extended heating and cooling rates. Power limitation in the lower temperature range is advantageous but not required.

Do not blow plates and crucibles with cold gas.

We do not provide statutory defects liability on material and parts that are subject to wear such as heating elements, ceramic sintering aids and fiber material.

You agree to comply when using sintering aids for the first time.

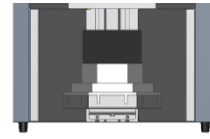
6.2.3 UNLOADING THE FURNACE

Step

Requirements:


- ◆ Sintering process stopped
- ◆ Furnace and load have cooled down sufficiently
- ◆ The furnace floor is set in the lower end position

State




Compared to loading, unloading is usually carried out in reverse order.

6.2.4 RELOADING THE FURNACE

When reloading the furnace, please refer to the procedure described in  [Chapter 6.2.2 “FIRST LOADING THE FURNACE”](#), starting with step 3.

6.2.5 Furnace emergency stop

1. Stop the furnace program, interrupt the process
 [Chapter 7.4 “PROGRAM EXECUTION”](#)
2. Turn the main switch to position “on”
3. Do not disconnect the furnace from the mains supply and do not interrupt the ventilators
4. Allow the furnace to cool down sufficiently and turn off when setpoint <50°C

7 OPERATION

This chapter describes the control unit screen masks (the instruction manual refers to them as HMI) and their functions.

Basically, the following applies:

- ◆ The availability and appearance of the buttons depend on the device status.
- ◆ Buttons highlighted in blue are active. When these buttons are activated the respective information (names or values) can be entered or modified using the screen keyboard and the linked functions can be selected.

7.1 START SCREEN


The START SCREEN initiates the HMI. After the furnace has been turned on and the controller has successfully booted, this screen is displayed automatically indicating that the furnace is ready for use.



Figure 03: Start screen












Element	Function
	<ul style="list-style-type: none"> ◆ Displays the current system time ◆ Opens a page for setting of system time
	<ul style="list-style-type: none"> ◆ Displays the current system language ◆ Opens a page for setting of system language
	<ul style="list-style-type: none"> ◆ Opens the INFO category with additional information such as IP address settings, contact data, furnace type, sintering aids, how to load the furnace etc.
	<ul style="list-style-type: none"> ◆ Displays an active alarm ◆ Opens the LOG FILE giving details of alarm types



[Chapter 7.9 "LOG FILE"](#)




- 
 - ◆ Opens the LOG FILE giving details of alarm types

 [Chapter 7.9 "LOG FILE"](#)
- 
 - ◆ Opens the CURVEVIEWER

 [Chapter 7.8 "CURVEVIEWER"](#)
- 
 - ◆ Opens the PROGRAM MANAGEMENT

 [Chapter 7.2 "PROGRAM MANAGEMENT"](#)
- 
 - ◆ Set automatic door opening
- 
 - ◆ Closes the furnace (moves the furnace floor up)
 - ◆ Stops an active movement
- 
 - ◆ Indicates that the furnace is closed
 - ◆ Stops an active movement
- 
 - ◆ Opens the furnace (moves the furnace floor down)
 - ◆ Stops an active movement
- 
 - ◆ Indicates that the furnace is being opened
 - ◆ Stops an active movement
- 
 - ◆ USB data carrier detected or being used

 [Chapter 4.3 "COMPONENTS" / Figure 01](#)
- 
 - ◆ USB data carrier not detected or not being used

 [Chapter 4.3 "COMPONENTS" / Figure 01](#)
- 
 - ◆ Version number of firmware
- 
 - ◆ Current chamber temperature

7.2 PROGRAM MANAGEMENT









Go to PROGRAM MANAGEMENT using the button  on the START SCREEN. All functions that are directly associated with the sintering programs can be accessed using this page. The internal program storage of the furnace offers storage capacity for 6 individual programs. A standard USB data carrier extends the storage capacity to provide 30 programs and also allows data to be imported and exported between furnaces of the same type. The letter “U” in front of the program number indicates a program stored on the USB data carrier. The letter “M” indicates a program saved in the furnace storage. The fields behind the program numbers show the name of the program. Pushing one of the blue bars selects the respective program. Use PROGRAM ACTIONS to stop and call the PROGRAM MANAGEMENT.

Figure 04: Program management



Element	Function
	◆ Returns to the previous page without modifications
	◆ Opens the PROGRAM EXECUTION Required only if the HMI reboots unexpectedly during a process
	◆ Shows USB storage locations  Chapter 4.3 “COMPONENTS” / Figure 01
	◆ Changes to furnace storage locations
	◆ Page down to display smaller program numbers
	◆ Page up to display higher program numbers

7.3 PROGRAM ACTIONS








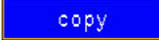

Select a program in the program management to open the screen for program actions. The screen displays the selected program together with the program number and program name as well as the current furnace system time and timer start time.

Possible actions are listed from top to bottom:

- ◆ Direct start (execute)
- ◆ Timer start (execute and indicate time date within 24 hours)
- ◆ Modify
- ◆ Copy

Figure 05: Program actions



Element	Function
	<ul style="list-style-type: none"> ◆ Loads the selected program into the main memory and opens the PROGRAM EXECUTION <p> Chapter 7.4 "PROGRAM EXECUTION"</p>
	<ul style="list-style-type: none"> ◆ Loads the selected program into the main memory and opens the PROGRAM EXECUTION ◆ Starts the furnace automatically at the preset time ATTENTION Before activating, enter the required start time (hours and minutes) in the field on the right. ◆ Pushing the button  is not required. The furnace starts automatically at the preset time. <p> Chapter 7.4 "PROGRAM EXECUTION"</p>
	<ul style="list-style-type: none"> ◆ Loads the selected program into the PROGRAM EDITOR and opens the respective screen <p> Chapter 7.6 "PROGRAM EDITOR"</p>
	<ul style="list-style-type: none"> ◆ Copies the selected program into a temporary memory and opens the PROGRAM MANAGEMENT <p> Chapter 7.2 "PROGRAM MANAGEMENT"</p>

7.4 PROGRAM EXECUTION


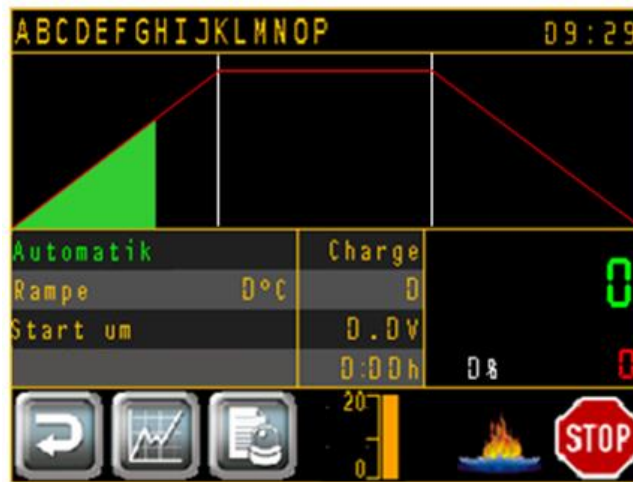



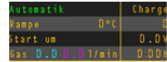








Push the button  in PROGRAM ACTIONS to open the PROGRAM EXECUTION. This screen is displayed throughout the entire process.

Figure 06: Program execution



Element	Function
	◆ Name of the active program
	◆ Current furnace system time
	◆ Graphic process (red) of the selected program and time-based progress (green) of the active process
	◆ Additional values and information about the active process
	◆ Values measured by the temperature controller Actual value in °C, green Setpoint in °C, red Output power in %, white
	◆ Returns to the previous page without modifications
	◆ Opens the CURVEVIEWER Chapter 7.8 "CURVEVIEWER"
	◆ Displays an active alarm
	◆ Opens the LOG FILE giving details of alarm types Chapter 7.9 "LOG FILE"
	◆ Opens the LOG FILE giving details of alarm types Chapter 7.9 "LOG FILE"
	◆ Power consumption in Ampere
	◆ Indicates that the furnace is ready to start ◆ Starts the process using the selected program (not required for timer start) ◆ Indicates that the process is running ◆ Interrupts the process (push once) ◆ Terminates the process (push twice)

7.5 END OF PROCESS

The confirmation page is displayed after successfully completing the sintering procedure. This page can only be left if the process and cooling phase have been completed.

FIGURE 07: Confirmation screen




Element

Function



- ◆ Chamber temperature



- ◆ Opens the START SCREEN
 [Chapter 7.1 "START SCREEN"](#)

7.6 PROGRAM EDITOR

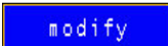


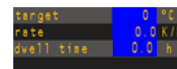






After selecting a program in the PROGRAM MANAGEMENT push the button  to open the PROGRAM EDITOR. This screen is used to create new programs, modify existing ones and save them.

Figure 08: Program editor



Element	Function
	<ul style="list-style-type: none"> ◆ Shows the current program ◆ Modifies the program name
	<ul style="list-style-type: none"> ◆ Indicates the current program step i.e. segment
	<ul style="list-style-type: none"> ◆ Additional values and information about the active process
	<ul style="list-style-type: none"> ◆ Indicates the current segment function (marked yellow) ◆ Modifies the current segment function
	
	<ul style="list-style-type: none"> ◆ Returns to the previous page without modifications
	<ul style="list-style-type: none"> ◆ Indicates that the program has been modified (question mark flashing) ◆ Saves modifications
	<ul style="list-style-type: none"> ◆ Changes to previous segment
	<ul style="list-style-type: none"> ◆ Changes to next segment

7.6.1 SEGMENT FUNCTIONS

Each program has up to 20 segments. Each segment allows setting of the required temperature.

Possible segment functions are:

- ◆ **Ramp**
A ramp is used to change the temperature either positive or negative. The setpoint i.e. the temperature to be reached at the end of this segment and the increase i.e. the speed or temperature change used to reach the setpoint define the ramp.
- ◆ **Dwell time**
A dwell time is used to hold the temperature reached in the previous segment for a specified period of time.
Its duration is defined using a specific time period.
- ◆ **End**
“End” signals to the control system that the program ends with the previous segment and does not require any specific definition. The preset setpoint is “0” to allow rapid cooling down.

7.7 COPY FUNCTION

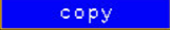









Push the button  in PROGRAM ACTIONS to open the PROGRAM MANAGEMENT. A red field indicates that the COPY FUNCTION is active. After selecting a target storage location, the program can be copied to this location.

Figure 09: Copy function



Element	Function
	<ul style="list-style-type: none"> ◆ Returns to the previous page without modifications
	<ul style="list-style-type: none"> ◆ Opens the PROGRAM EXECUTION Required only if the HMI reboots unexpectedly during a process
	<ul style="list-style-type: none"> ◆ Shows USB storage locations Chapter 4.3 "COMPONENTS" / Figure 01
	<ul style="list-style-type: none"> ◆ Changes to furnace storage locations
	<ul style="list-style-type: none"> ◆ Page down to display smaller program numbers
	<ul style="list-style-type: none"> ◆ Page up to display higher program numbers
	<ul style="list-style-type: none"> ◆ Source and target storage location of the COPY FUNCTION
	<ul style="list-style-type: none"> ◆ Copies the program according to specifications
	<ul style="list-style-type: none"> ◆ Interrupts the COPY FUNCTION

7.8 CURVEVIEWER



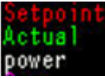



Push the button  on the START SCREEN or PROGRAM EXECUTION to open the CURVEVIEWER. The CURVEVIEWER is an integrated, paperless recorder function recording the last 72 operating hours of the furnace allowing qualitative control of the sintering processes directly in the furnace. However, it does not replace permanent data recording of process values using a USB memory stick or PC.

Figure 10: CurveViewer



Element	Function
	◆ Returns to the previous page without modifications
	◆ Legend of electronic recorder
	◆ Scroll to the left (backwards in time)
	◆ Turn on/off CURVEVIEWER scrolling
	◆ Scroll to the right (forwards in time)

7.9 LOG FILE



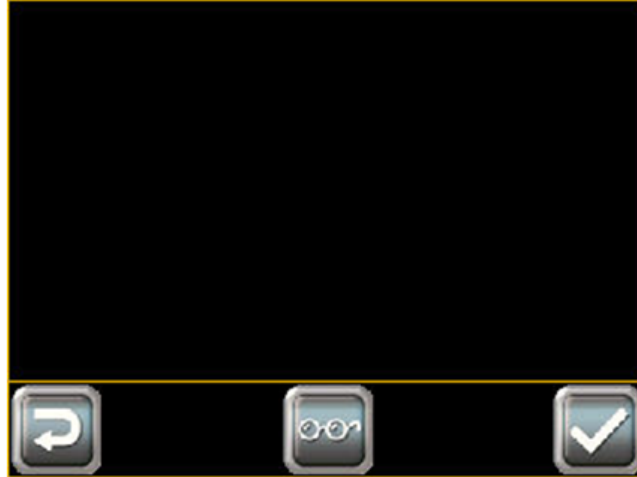



Push the buttons  or  on the START SCREEN or PROGRAM EXECUTION to open the LOG FILE. The LOG FILE provides information about each operating condition of the furnace. All registered events are displayed as plain text messages with time stamps. The color of the text indicates events that have been completed (green) or messages that are currently active (red). Current messages with undefined causes cannot be confirmed.

Figure 11: Log file



Element	Function
	◆ Returns to the previous page without modifications
	◆ Displays an overview of messages
	◆ Confirms active messages (red)

7.10 RESTORE FACTORY SETTINGS

If the furnace is not used over a longer period i.e. > 3 months this might lead to loss of data on the internal memory. The screen illustrated below will appear immediately after the controller is turned on. Take the USB stick supplied with the furnace accessories and plug it into the controller. Push the button “Read System Data” when it appears. Wait approx. 30 seconds before turning the furnace on and off using the main switch. The furnace has been successfully reset to factory settings.

If you have adapted the factory settings to your products, we recommend that you save them regularly on a USB data carrier and import them after resetting to factory settings.

Figure 12: Factory settings



7.11 INFO PAGES




Push the button  on the START SCREEN to access the Info page. This section provides additional information and instructions concerning sintering aids, IP address settings, contact data, furnace type, furnace loading and how to use them.

Figure 13: Info Page



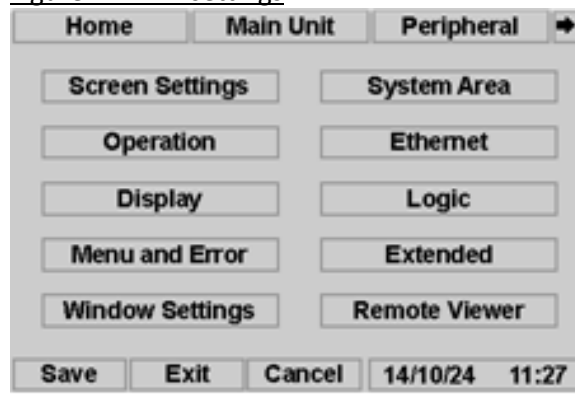
Element	Function
	<ul style="list-style-type: none">Returns to the previous pageModifications not saved
	<ul style="list-style-type: none">Switches to HMI offline menuAdapts the IP address


7.12 LAN SETTINGS

HINWEIS

Incorrect settings in the offline menu might lead to malfunctions or make it impossible to use the furnace. Modification of other settings (except Ethernet) is not permitted. The user is responsible for any consequences.

Figure 14: LAN settings



1. Enable HMI offline menu
 [Chapter 7.11 "Info Page"](#)
2. Select **Main Unit** and **Ethernet**
3. Enter IP address and subnet mask at the respective fields. Enter gateway address on second page if required.
4. Push **ENT** to confirm values
5. Push **Exit** to exit the offline menu after entering all values
6. Push **Save changes and exit** to save changes

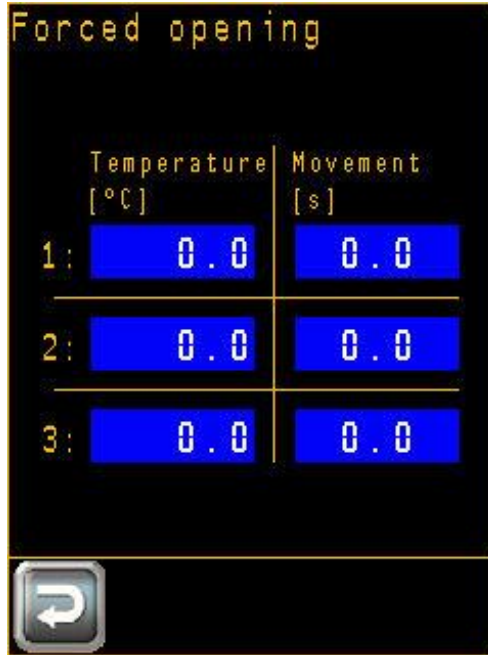
These steps will restart the HMI and all modified settings will be transferred. After restart the furnace will be ready for operation with modified LAN settings.

The responsible network administrator will answer any questions regarding LAN settings.

This furnace requires connection type "TCP/IP HMI" in ThermoView settings.

7.13 AUTOMATIC OPENING

Figure 15: Automatic opening



Three freely selectable steps allow the furnace floor to be moved up for faster cooling. Temperature ranges can be set between 600°C and 1°C. Do not store any objects in the space under the furnace chamber. Otherwise the furnace might tip over when it opens automatically.



DANGER

Mechanical hazards from furnace falling over.

Minor crushing as a result of motor-driven lifting movements

Do not store any objects in the space under the furnace chamber.

Carefully observe movements and prevent third parties from contact.

Follow the safety notes.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

Burning as a result of contact with hot furnace load

Observe the temperature display.

Follow the safety notes.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

8 MAINTENANCE

A long-term, safe and trouble-free operation requires regular maintenance. This chapter provides information about the maintenance and servicing work required.

8.1 SAFE MAINTENANCE

During maintenance, the following hazards must be expected:



DANGER

Read the following safety notes carefully before any maintenance work is carried out.

Misuse can cause serious injuries or death.

Make sure that operating personnel are qualified as required.

 [Chapter 2.2 "QUALIFIED PERSONS"](#).

Disconnect the furnace from the mains supply before any maintenance work is carried out.

Allow the furnace to cool down sufficiently.

The user may only carry out work that is described in this instruction manual. All other work requires comprehensive specialist knowledge and fundamental experience in handling high-temperature and electrical technology.

Electrical hazards

Serious injuries or death through contact with live parts

Disconnect power plug before opening the furnace.

Open the furnace only when required for maintenance purposes.

Check electrical installation before installing the furnace.

Never carry out modifications.

Mechanical hazards

Minor crushing as a result of motor-driven lifting movements

Do not store any objects in the space under the furnace chamber.

Carefully observe movements and prevent third parties from contact.

Follow the safety notes.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

8.2 FURNACE MANUAL

HINWEIS

We recommend that you keep a furnace manual.
This can be useful when tracing measures taken and specific fault finding.

We recommend that you keep a record of the following in the furnace manual:

- ◆ Data of regular inspection and maintenance work
- ◆ Faults, causes of failure, implemented measures
- ◆ Data of repair and maintenance work carried out
- ◆ Data of checks carried out

8.3 MAINTENANCE WORK FOR THE USER

8.3.1 DAILY CONTROLS

Carry out these controls before, after or during the sintering process:

- ◆ Check for visible damage on the insulation of the furnace chamber and the firing support.
- ◆ Check that the lifting movement runs smoothly and check for different sounds.
- ◆ Check that cable and hose connections fit tightly.

8.3.2 MAINTENANCE WORK AS NEEDED

HINWEIS

Use only standard, non-aggressive and non-abrasive detergents to prevent property damage and consequential damage. Never spray detergents directly on furnace parts.

Do not immerse, spray-wash or wet clean the furnace.

Carry out the following work if required:

- ◆ Clean the furnace housing.
- ◆ Clean the sintering aids.
- ◆ Clean the firing support and remove dust using a vacuum cleaner.

8.3.3 REGULAR MAINTENANCE WORK

Qualified personnel should carry out the following work:

- ◆ Clean the electrical components of the furnace.
- ◆ Lubricate the lifting system.

HINWEIS

Do not use dry lubricants based on molybdenum i.e. MoS₂ or graphite.

Recommended greases:

G05, HIWIN

Klüberlub GL-261, Klüber


Mobilux EP1, Mobil

Lagermeister BF2, Fuchs Lubritech

TURMOGREASE CAK 2502, Lubcon

We recommend replacement of the thermocouple after 500 firing cycles.

Check that the connecting strips are seated firmly on the heating elements once a year.

For more information please see  [Chapter 1.1 "SERVICE"](#)

For more information please see  [Chapter 5.2.3 "MOUNTING HEATING ELEMENTS"](#)

9 TROUBLESHOOTING

This chapter provides information about troubleshooting.

9.1 SAFE TROUBLESHOOTING

During troubleshooting, the following hazards must be expected:



DANGER

Read the following safety notes carefully before troubleshooting.

Misuse can cause serious injuries or death.

Make sure that operating personnel are qualified as required.

→ [Chapter 2.2 “QUALIFIED PERSONS”](#).

The user may only carry out work that is described in this instruction manual. All other work requires qualified personnel.

Electrical hazards

Serious injuries or death through contact with live parts

Disconnect power plug before opening the furnace.

Open the furnace only when required for maintenance purposes.

Never carry out modifications.

Mechanical hazards

Minor crushing as a result of motor-driven lifting movements

Do not store any objects in the space under the furnace chamber.

Carefully observe movements and prevent third parties from contact.

Follow the safety notes.

Wear personal protective equipment.

→ [Chapter 2.3 “PERSONAL PROTECTIVE EQUIPMENT”](#)

9.2 FAULT FINDING

The controller will detect all events that affect proper operation of the furnace. The HMI indicates them as warning or error messages.

Readout messages  Chapter 7.9 "LOG FILE".

Warning messages are purely informative. An error occurs if operating conditions are not improved. The furnace will turn off the heating function automatically.

The table below will help to identify the causes of failure and provide information about the measures that must be taken by qualified personnel or a service technician of Thermo-Star GmbH.

Table 08: Fault finding

Failure / System message	Possible cause	Measures
Furnace does not turn on HMI remains dark	No voltage supply	Check socket Check mains cable Check device fuse
AUTOMATIC	Standard status report when sintering process is active	Wait for sintering process to end
STOPPED	HMI STOP button activated	Stop sintering process or start again
OVERHEATING	Furnace temperature too high	Check if thermocouple is in correct position and functionality
BIMETALLIC SWITCH	Temperature above the furnace chamber too high	Check ventilators Lower room temperature Replace bimetallic switch
FURNACE OPEN	Furnace open during active sintering process	Check lift position Check limit switch
MAINS VOLTAGE FAULT	No external voltage supply, furnace battery-operated	Check socket Check mains cable Check device fuse
FAULT COOLING FAN 1	Upper cooling fan not supported	Check fan when sintering process is active Check cable connecting fan and circuit board
FAULT COOLING FAN 2	Lower cooling fan not supported	Check fan when sintering process is active Check cable connecting fan and circuit board
TEMPERATURE TOO LOW	Warning, no fault Setpoint at least 40°C above actual value	Check power consumption Check heating elements Reduce furnace load Reduce heating rate
AKKU < 18V	Internal battery low Furnace controller turns off automatically	Check socket Check mains cable Check device fuse Check internal battery



For more information and assistance, please visit our homepage:

<http://www.thermo-star.de/faq/>

10 REPAIR

This chapter provides information about repair work and spare parts.

10.1 SAFE REPAIR

During repair work, the following hazards must be expected:



DANGER

Read the following safety notes carefully before carrying out repair.

Misuse can cause serious injuries or death.

Make sure that operating personnel are qualified as required.

→ [Chapter 2.2 “QUALIFIED PERSONS”](#).

The user may only carry out work that is described in this instruction manual. All other work requires qualified personnel.

Electrical hazards

Serious injuries or death through contact with live parts

Disconnect power plug before opening the furnace.

Open the furnace only when required for maintenance purposes.

Never carry out modifications.

Mechanical hazards

Minor crushing as a result of motor-driven lifting movements

Do not store any objects in the space under the furnace chamber.

Carefully observe movements and prevent third parties from contact.

Follow the safety notes.

Wear personal protective equipment.

→ [Chapter 2.3 “PERSONAL PROTECTIVE EQUIPMENT”](#)

10.2 REPLACING HEATING ELEMENTS

The user can replace a broken and defective heating element.

For information on how to replace heating elements please see → [Chapter 5.2.3 “MOUNTING HEATING ELEMENTS”](#).

10.3 OTHER REPAIRS & SPARE PARTS

For other repair work and spare part orders, please keep your type plate → [Chapter 4.5 “TYPE PLATE”](#) at hand and contact Thermo-Star GmbH, → [Chapter 1.1 “SERVICE”](#).

11 TAKING OUT OF SERVICE & DISPOSAL

This chapter provides information about how to professionally take the furnace out of service and how to dispose of it. This must be carried out by qualified electrician or a service technician from Thermo-Star GmbH.

11.1 SAFE TAKING OUT OF SERVICE

When taking the furnace out of service, the following hazards must be expected:



DANGER

Read the following safety notes carefully before taking out of service.

Misuse can cause serious injuries or death.

Make sure that operating personnel are qualified as required.

 [Chapter 2.2 "QUALIFIED PERSONS"](#).

Electrical hazards

Serious injuries or death through contact with live parts

Disconnect power plug before opening the furnace.

Open the furnace only when required for maintenance purposes.

Check electrical installation before installing the furnace.

Never carry out modifications.

Mechanical hazards

Minor crushing as a result of motor-driven lifting movements

Do not store any objects in the space under the furnace chamber.

Carefully observe movements and prevent third parties from contact.

Follow the safety notes.

Wear personal protective equipment.

 [Chapter 2.3 "PERSONAL PROTECTIVE EQUIPMENT"](#)

11.2 TAKING OUT OF SERVICE

Perform these steps when taking the furnace out of service:

- | | |
|--------|--|
| Step 1 | Allow the furnace to cool down sufficiently
Actual value < 50°C |
| Step 2 | Empty the furnace chamber
Remove all loose parts |
| Step 3 | Close the furnace
Move furnace floor to upper end position |
| Step 4 | Turn off the furnace using the main switch |
| Step 5 | Protect the furnace from dust
Cover |

HINWEIS

The furnace is equipped with an internal buffer battery.

If the furnace is to be out of service for 30 days or longer we recommend that you connect the furnace to the power supply and turn it on for one day each month. This will prevent complete battery discharge and destruction of internal buffer batteries. Alternatively, have a qualified electrician remove the buffer batteries and provide external storage and servicing.

11.3 SHUTDOWN

Perform these steps while shutting the furnace down:

- | | |
|--------|--|
| Step 1 | Allow the furnace to cool down sufficiently
Actual value < 50°C |
| Step 2 | Empty the furnace chamber
Remove all loose parts |
| Step 3 | Close the furnace
Move furnace floor to upper end position |
| Step 4 | Turn off the furnace using the main switch and disconnect the power plug |

HINWEIS


The furnace is equipped with an internal buffer battery. When shutting the furnace down, a qualified electrician must remove the buffer batteries and provide storage or disposal in compliance with local requirements.

11.4 DISPOSAL

HINWEIS

Non-professional waste disposal is environmentally hazardous.

Electrical equipment cannot be disposed of with the regular household waste in accordance with Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) and its German national implementation with Electrical and Electronic Equipment Act (ElektroG). The type plate indicates the respective symbol.

 [Chapter 4.5 "TYPE PLATE"](#).

For professional waste disposal, take the furnace to your local collection points or recycling facilities and have the components recycled.

12 Declaration of Conformity

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en translation

EC Declaration of Conformity in accordance with DIRECTIVE 2006/42/EC, Annex II A

Hereby we declare that the units listed below are in conformity with the essential fundamental safety and health requirements of the EC Directive on machinery.

This Declaration of Conformity relates to the design and construction of the units as introduced by us.

If machinery is changed without our consent this declaration will become void.

We confirm that Thermo-Star GmbH is the manufacturer of Denta-Star M2Plus.

Description of unit:	High-temperature furnace
Product name:	Denta-Star M2plus
Useful volume:	1.4 x 1.0 dm ³ (d x H)
Max. operating temperature:	1,600°C
Serial No.:	xxyy-zzz-M2+ High-temperature furnace
Essential EC Directives:	DIRECTIVE 2006/42/EC on machinery of 17 May 2006 DIRECTIVE 2006/95/EC on low voltage DIRECTIVE 2004/108/EC on electromagnetic compatibility of 15 December 2004
Applied national standards and technical specifications:	VDI 2854, BGV A1
Applied harmonized standards:	EN ISO 12100:2010; EN 746- 1:1997+A1:2009; EN 61000-6-2:2005-08; EN 61000-6- 4:2007/A1:2011; EN ISO 13732-1:2008;
Date of issue:	19 May 2015
Signature	<hr/>
Name	S. Vonhoegen
Function	Managing Director

13 APPENDIX

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