Thermo-Star
Kompetenz in Thermotechnik

Original instruction manual

Denta-Star S1

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.
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TABLE OF CONTENTS

1 INTRODUCTION

This instruction manual for furnace type “Denta-Star S1” 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

Thermo-Star GmbH
Krantzstr. 7 / Geb. 37
52070 Aachen, Germany
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info@thermo-star.de

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	♦ Knowledge of high-temperature technology ♦ Evaluation of substance properties and reactions exposed to effects of temperature
Transport Storage	Forwarding agents, traders, repairers	♦ Proof of instruction in freight securing ♦ Safe handling of lifting aids and accessories ♦ Knowledge about handling of hazardous substances
Installation	Supplier, owner, user	♦ Knowledge of electrical supply lines and ambient conditions
Use	Owner, user	♦ Knowledge of information in this instruction manual
Simple maintenance	Owner, user	♦ Knowledge of information in this instruction manual ♦ Basic knowledge of measuring devices for electrical measurements
Major servicing, repair and maintenance work	Qualified personnel	♦ Proof of electrical or mechanical technical training
Disposal	Qualified personnel	♦ 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.
HINWEIS	**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 THERMAL HAZARD

The furnace operates in cycles. Thermal hazards arise from the furnace door during operation. Because of its design, the furnace door will not cool down completely. 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.

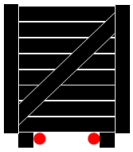
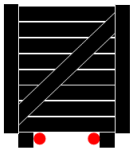
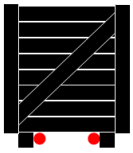
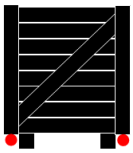
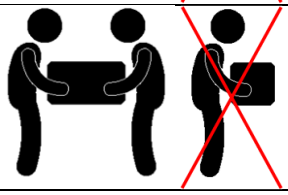
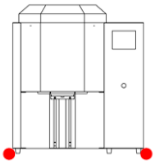
Chapter 2.3 “PERSONAL PROTECTIVE EQUIPMENT”

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°C < $T_{Storage}$ < 60°C
- Humidity: < 80%rH, non-condensing

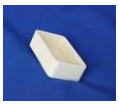
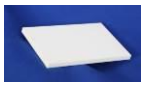
4 DESCRIPTION OF THE PRODUCT

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 S1		Transport box
1 x mains cable	Mains cable 1.8m, 1.5mm² IEC 320 <-> C19		Plastic-wrapped
1 x sintering beads	Sintering beads 200g		PET bottle
1 x protective cover	Protective cover 100x70x30mm		Cardboard
4 x spacers	Spacer h: 20mm		Cardboard
1 x setter	Setter 100x70x2mm		Cardboard
1 x base plate	Base plate 100x70x8mm		Cardboard
3 x heating elements	Heating element		Transport sleeve "TwistPack", if not pre-assembled
2 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
Each sintering aid is suitable for temperatures T ≤ 1,550°C & Δ T/t ≤ 800°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 load (sintering aids and ware to be sintered) is placed in the furnace chamber using a tray in the furnace door. They are subjected to thermal treatment with normal atmosphere.
An electronic PID control with storage capacity for several temperature-time profiles is available.
The furnace is operated using an industrial controller positioned on the front of the furnace. A door switch located below can be used for extended operation.
The main switch and the supply connections for power are located on the back of the furnace.

4.2.2 CHARACTERISTICS AND TECHNICAL DATA

Table 06: Characteristics and technical data

General
♦ Alumina fiber insulation (Al_2O_3)
♦ 3 molybdenum disilicide heating elements ($MoSi_2$)
♦ Housing made of powder-coated steel sheet and stainless steel
♦ Bolted cover and back wall for easy maintenance
♦ 4 rubber feet
♦ Separate cooling air outlet (upwards and to the side, backwards)
Mechanical
♦ Size: 450/390/660 mm (W/D/H)
♦ Weight: 62kg (Net)
Electrical
♦ Voltage: 220-240 V
♦ Supply: ≤ 16 A
♦ Power: ≤ 2,500 W
♦ Temperature: ≤ 1,550°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	04	Setter
02	Cooling air outlet, side	05	Controller
03	Furnace door	06	Door opener
07	Connection to power supply & main switch (back of the furnace)		

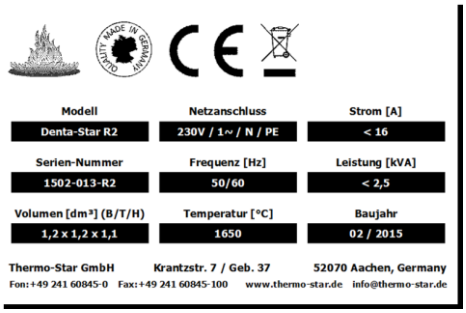
4.4 FUNCTIONALITY

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 of the furnace chamber side wall. The load is assembled on the firing support placed in the furnace door 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



- 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 5.2.1 “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.

5.2.1 LOCATION

Requirements imposed on the operating location:

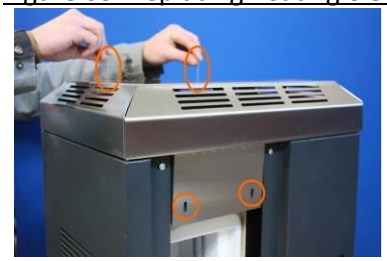
- Humidity < 85%rH, non-condensing
- Ambient temperature > 5°C and < 25°C
- Even surfaces
  Load-bearing capacity > 100kg
  Temperature resistance > 60°C
- Air quality of the ambient air should generally correspond to that of the outside air
  Components that are not permitted:
  Grinding dusts (independent 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

5.2.2 SETTING UP THE FURNACE

Step 1	Open the transport packaging on each side and remove. The transport box can be stored and reused. Screwdriver TX20
Step 2	Remove protective foils and accessories cardboard box and dispose of them correctly. Cutter knife
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” Allen key SW3.0 Open-end wrench SW7
Step 5	Connect to power supply Chapter 5.2.4 “ELECTRICAL CONNECTION”
Step 6	Connect to network (optional) Chapter 5.2.5 “NETWORK CONNECTION”

5.2.3 MOUNTING HEATING ELEMENTS

Figure 03: Replacing heating elements

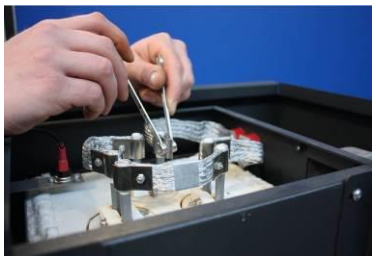


- Remove cover screws on both sides left and right

- 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 and insert cover screws at front and back and screw on tightly

5.2.4 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 02

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”

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. After booting, the controller 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 door is fully open

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:

- Make sure that the load does not protrude over the base plate.
- The maximum loading height is 70mm

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 door is fully open

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 and 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 and their functions.

7.1 GENERAL FURNACE OPERATION

7.1.1 OPENING AND CLOSING THE FURNACE

To unlock the door, push and hold the button.
While holding the button push the furnace door slightly and pull it open.

HINWEIS

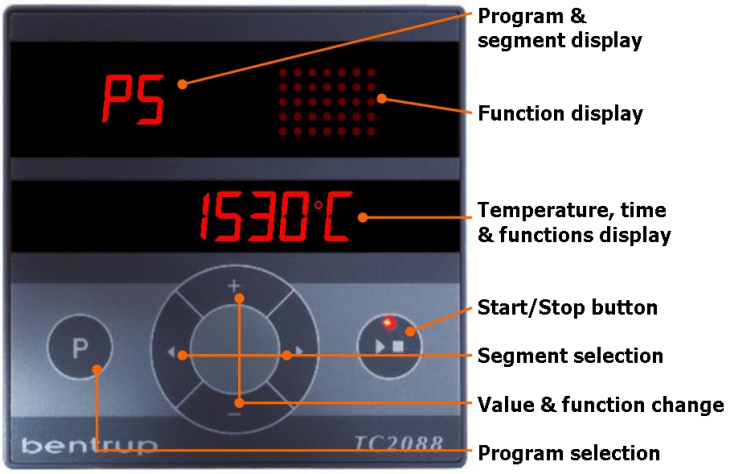
Make sure that the temperature is below 300°C when opening the door.

To close the door, push it until you can hear and feel that it has locked into position.

Figure 04: Door unlock

7.1.2 CONTROLLER COMPONENTS

Figure 05: Controller scheme



7.1.3 SELECTING A PROGRAM

Push the PROGRAM button  until the required program number appears on the display in the top left corner.

Example for program number 5: “P5”

HINWEIS

The controller shows the maximum temperature of the selected program in the bottom line. While selecting a program, do not activate any other button.

Figure 06: Controller

The illustration above changes after only a few seconds without pushing any keys and displays information about the program segment with the highest temperature.

Push the START-STOPP button  when you are sure that you have selected the correct program.

7.1.4 SEGMENT FUNCTIONS

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

Possible segment functions are:

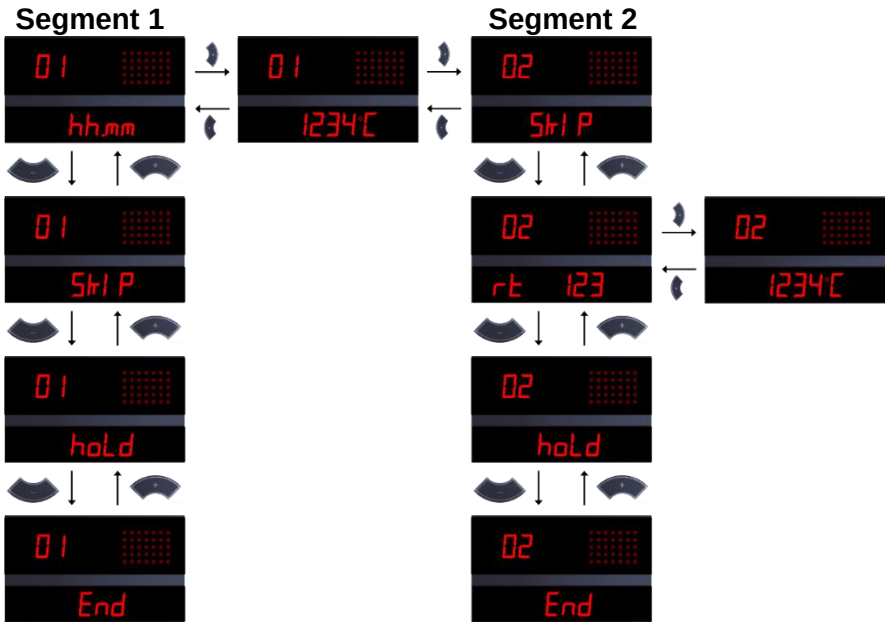
- **Ramp**
  A ramp is used to change the temperature either positive or negative. The setpoint i.e. the temperature to be reached at the end of this segment and the increase i.e. the speed or temperature change used to reach the setpoint define the ramp.

- **Dwell time / Hold**
  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” signalizes to the controller 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.

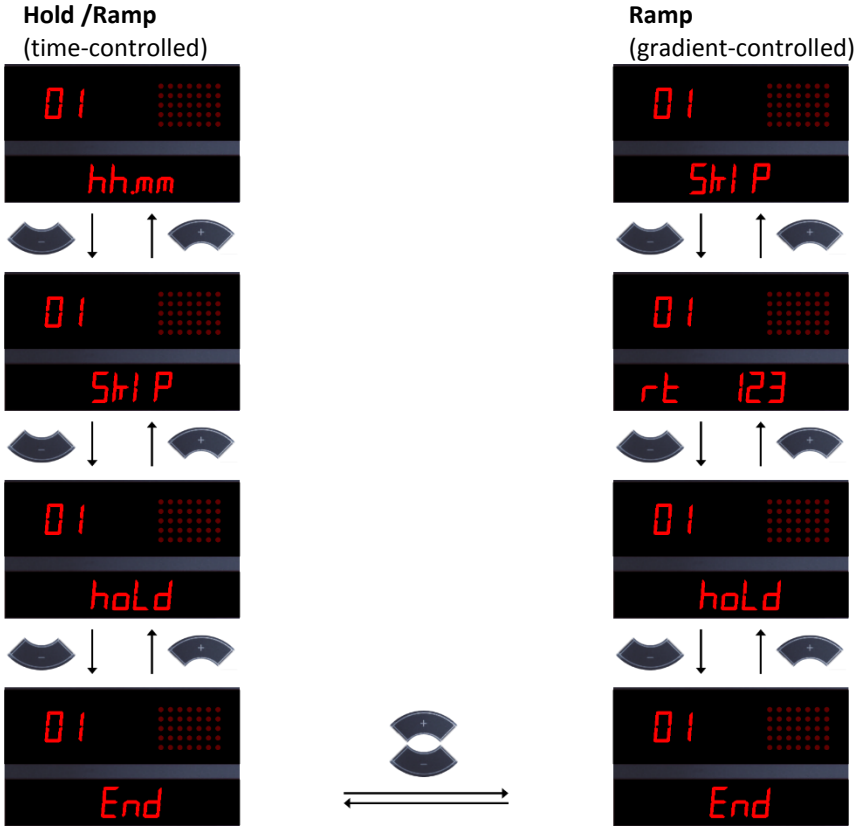
7.2 PROGRAMMING THE CONTROLLER

7.2.1 PROGRAMMING SEGMENTS



Figures 07/08: Programming the controller

7.2.2 SEGMENT FUNCTIONS

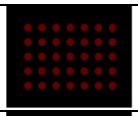
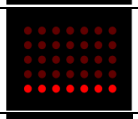
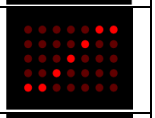
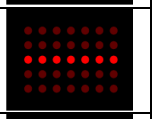
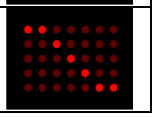


7.2.2.1 HOLD / RAMP (TIME-CONTROLLED)

We recommend that you do not use the time-controlled ramp, as this could result in different and non-defined heating rates.

The controller uses the dwell time to hold the set temperature for a set period of time.
Enter the temperature from the previous segment again when setting the dwell time.
Observe the function display while programming.

Table 08: Functions

No function	
Program delay	
Ramp, increase	
Dwell time / Hold	
Ramp, decrease	

7.2.2.2 RAMP (GRADIENT-CONTROLLED)

When using a gradient-controlled ramp, you specify the heating rate (rt xxx °C) and target temperature. The controller will reach the target temperature heating with constant speed.

7.2.3 EXAMPLE PROGRAMMING

To show an example programming, the following sintering program is entered on program number 5 of the controller.

1. Heating at 600°C/h to 900°C target temperature
2. Hold for 0.5 h
3. Heating at 200°C/h to 1,450°C target temperature
4. Hold for 2.0 h
5. Heating at 600°C/h to 900°C target temperature
6. End of program and natural cooling

Table 09: Example programming

Requirements:	The furnace does not heat up.
Push the PROGRAM button  until the Program / Segment display shows “P5”. Wait approx. 35 seconds until P5 is replaced by a flashing number.	
Push the LEFT ARROW button  until the Program / Segment display shows “00”. Segment “00” in each program allows setting a program delay using the format hh.mm (hour hour.minute minute) to realize a timer start. Entering the value “0.00” starts the controller immediately after pushing the button.	
Push the RIGHT ARROW button  once to change to segment 01. Define a ramp (see 6.2.2 and 6.2.1) using the respective parameters.	
Push the RIGHT ARROW button  once to change to segment 02. Define a dwell time (see 6.2.2 and 6.2.1) using the respective parameters.	

Push the RIGHT ARROW button once to change to segment 03. Define a ramp (see 6.2.2 and 6.2.1) using the respective parameters.	
Push the RIGHT ARROW button once to change to segment 04. Define a dwell time (see 6.2.2 and 6.2.1) using the respective parameters.	
Push the RIGHT ARROW button once to change to segment 05. Define a ramp (see 6.2.2 and 6.2.1) using the respective parameters.	
Push the RIGHT ARROW button once to change to segment 06. Define an end time (see 6.2.2 and 6.2.1) using the respective parameters.	
Wait a few seconds until the display changes automatically. Programming has been completed.	

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 result in 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.

8.2 FURNACE MANUAL

HINWEIS

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

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 result in 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.

9.2 FAULT FINDING

The controller will detect all events that affect proper operation of the furnace. The controller indicates them as warning or error messages.
Readout messages “Operating instructions Bentrup Controllers”.
Warning messages are purely informative. An error occurs if operating conditions are not improved. The furnace will turn off the heating function automatically.

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 result in 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.

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 result in 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.

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
Step 4	Turn off the furnace using the main switch
Step 5	Protect the furnace from dust Cover

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
Step 4	Turn off the furnace using the main switch and disconnect the power plug

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 S1.

Description of unit:	High-temperature furnace
Product name:	Denta-Star S1
Useful volume:	0.7 x 1.0 x 0.7 dm³ (W x D x H)
Max. operating temperature	1,550°C
Serial No.:	xxyy-zzz- S1 The serial No. comprises: (xx:yearyear)(yy:monthmonth)-(zzz:cont_No)-S1 14≤xx≤20; 01≤yy≤12; 1≤zzz≤999
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 August 2015
Signature	_____
Name	S. Vonhoegen
Function	Managing Director

13 APPENDIX

13.1 INDEX OF TABLES

13.2 INDEX OF ILLUSTRATIONS

14 NOTES

Use this page for notes.

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