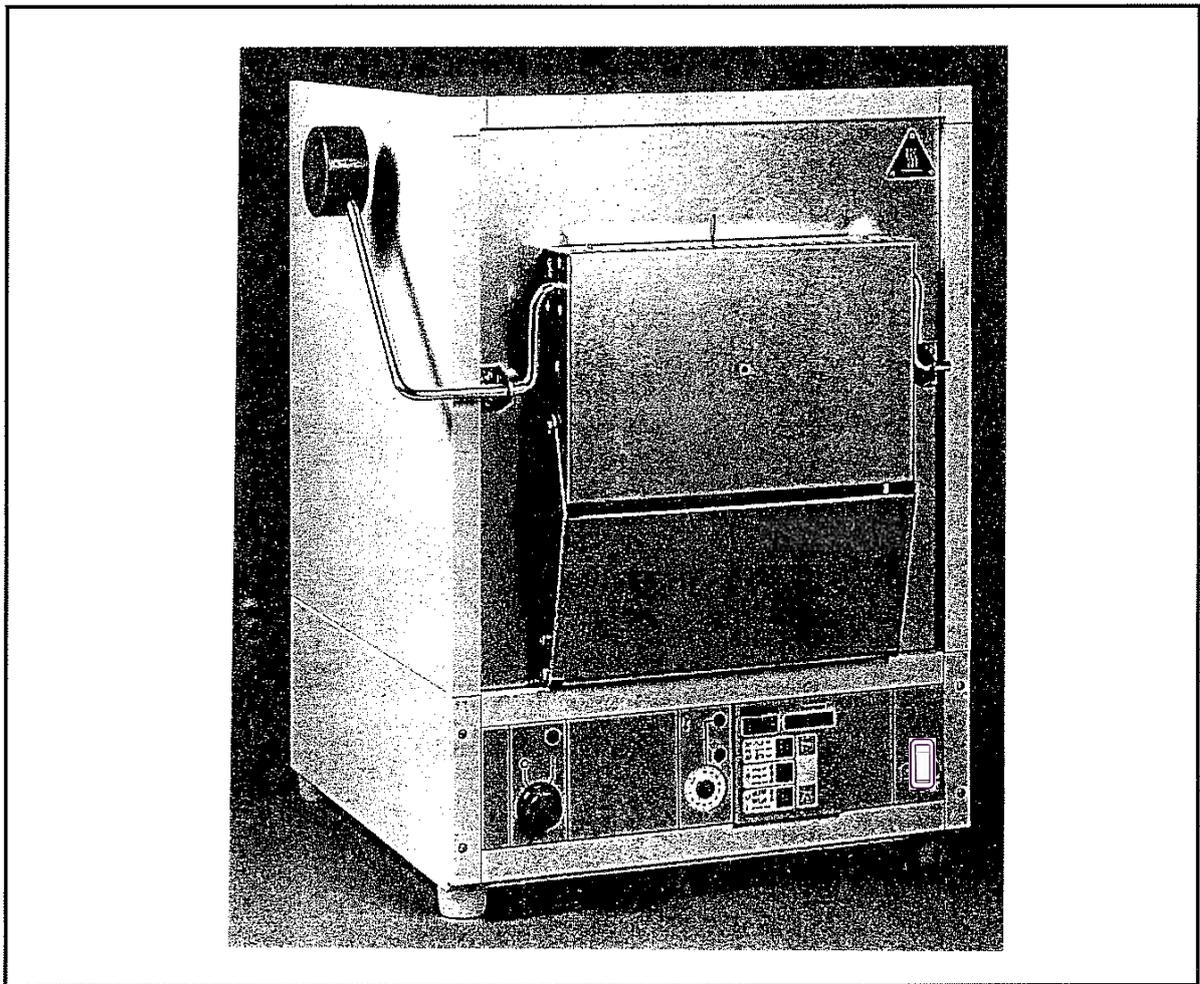


GB

USA

Laboratory Muffle Furnance M 104 Laboratory Chamber Furnance K 114 Operating Instructions



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If translated versions of this manual are used, the German version is the authoritative basis.

Subject to technical modifications.



The safety concerning the protection of persons, environment and material to be treated mainly depends on the behaviour of the operating personnel of these units.

Please read and observe the following instructions carefully before starting the unit in order to avoid faults and resulting damage, especially adverse health effects.

WARNING NOTES

- Caution: General hazard area!



- Caution: Hot surface!



AMBIENT OPERATING CONDITIONS

- For indoor use only
- For altitudes up to 2000 m above sea level
- Temperature range from 5 °C to 40 °C
- Maximum relative humidity: 80 %, for temperatures up to 31 °C, decreasing linearly to 50 % relative humidity at 40 °C
- Main power supply: Voltage fluctuations not to exceed +/- 10 % of the nominal value

ELEKTRICAL DATA

- Overvoltage category: II
- Contamination level: 2

WEEE Compliance:

This product is required to comply with the European Union`s Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



Thermo Electron has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Electron`s compliance with these Directives, the recyclers in your country, and information on Thermo Electron products wick may assist the detection of substances subject to the RoHS Directive are available at www.thermo.com/WEEERoHS.

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Nominal Charge

This instruction manual covers units equipped with the following optional devices :		
Order No.	Model	Option
50 040 485	M 104	Digicon®
50 040 486	M 104	Digicon®, 24-hour timer
50 040 487	M 104	Digicon®, 24-hour timer, exhaust fan
50 040 488	M 104	Thermicon® P
50 040 489	M 104	Thermicon® P, exhaust fan
50 049 820	M 104	Digicon®, adjustable air supply
50 047 438	M 104	Digicon®, 24-hour timer, glazed muffle
50 047 439	M 104	Digicon®, 24-hour timer, exhaust fan, glazed muffle
50 047 440	M 104	Thermicon® P, glazed muffle
50 047 441	M 104	Thermicon® P, exhaust fan, glazed muffle
50 051 429	M 104	Digicon®, adjustable air supply
50 040 903	M 104	Digicon® excl. over-temperature protection
50 040 491	K 114	Digicon®
50 040 492	K 114	Digicon®, 24-hour timer
50 040 493	K 114	Thermicon® P
50 049 812	K 114	Digicon®, adjustable air supply
50 040 902	K 114	Digicon® excl. over-temperature protection



To ensure the safety of personnel, the environment and samples, it is of paramount importance that the operator use these furnaces correctly.

To avoid errors and causing damage, especially personal injuries, be sure to read this manual before using the equipment and to follow all instructions.

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1 GENERAL SAFETY INSTRUCTIONS

1.1 EXPLANATION OF ICONS

Icon	Explanation
	This icon marks chapters and sections of the instruction manual dealing with safety topics.
	Caution hot surface! Danger of injury!
	Marks information on most effective use of the unit.
 	Unit OFF Unit ON
  	Timer Switching the unit ON after set operating time has elapsed, or for operation without timer. Switching the unit OFF after set operating time has elapsed.
 	Over-temperature protection, upper limit cut-out Deactivation of over-temperature protection
 on off	Exhaust fan Exhaust fan on Exhaust fan off

1 GENERAL SAFETY INSTRUCTIONS

1.2 GENERAL INFORMATION

The unit meets the following safety standards

- EN 61010-1:2001
- EN 61010-2-010:2003
- EN 50366:2003
- EN 61326:1997

The M 104 / K 114 laboratory muffle and chamber furnaces have also been safety-tested by the testing and certification institute VDE. Certain models comply with GS certification standards and with interference standards, depending the optional equipment installed.



When requesting information or ordering replacement parts, please include the data on the nameplate of your unit.



1.3 OPERATING INSTRUCTIONS

The operator (company) is expected to provide anyone who works on or with the equipment with written instructions for the tasks to be performed based on this instruction manual. These instructions should be easy to understand and in the language of the persons operating the equipment.

LOG BOOK

We suggest that you keep a log book to document information on tests, calibrations and work done on or with the unit, such as maintenance and alterations (see **APPENDIX** for suggestions).



1.4 SAFETY INSTRUCTIONS

To ensure the safety of personnel, the environment and samples, it is of paramount importance that the operator uses these laboratory furnaces correctly.

To avoid errors and causing damage, especially personal injuries, be sure to carefully read this manual before using the unit and to follow all instructions.

When installing and operating the unit, be sure to **comply additionally with all applicable laws, regulations and guidelines of your country.**

The **operator (company)** is expected **to provide** anyone who works on or with the equipment with **written instructions** for the tasks to be performed **based on this instruction manual**. These instructions should be easy to understand and in the language of the persons operating the equipment.

1 GENERAL SAFETY INSTRUCTIONS



1.4 SAFETY INSTRUCTIONS

The **unit is not to be used** to heat foods.

The **unit is not to be used** for drying or heat treatments of substances which release gases or vapours into the atmosphere that are flammable or dangerously explosive when mixed with air. This furnace is equally unsuitable for the heat treatment of combustible dusts and fibrous materials.



Metal surfaces around the mouth of the furnace become hot at high operating temperatures. There is a **DANGER OF INJURY**. Avoid contact with these surfaces.

Special measures must be taken and strictly observed during **external temperature measurement** to ensure protection of personnel from electrical shock.

The **door-operated safety switch is to be tested** at fixed regular intervals, at the very least once per year, to ensure that it is technically in perfect working order.

To safeguard temperature protection functions, functionally **test the over-temperature protection system** at appropriate intervals (at least every 3 months). Its electrical functions should be tested additionally, at least once each year.

Flue gases resulting from heat treatments are to be **safely conducted out of the room**. Be sure to observe the environmental protection measures and regulations applicable in your country.

Test the mains supply cable and connecting plug for possible defects before using the unit. The unit is not to be connected to the mains circuit if defects are detected.

The voltage specified on the nameplate of the unit must match the voltage delivered by the mains power supply.

Work on electrical components installed in the unit may only be carried out by Thermo service personnel. The unit is to be disconnected from the mains power supply during servicing.

Use **only authorised replacement parts**. The use of any other parts can present unforeseeable risks and is not approved under any circumstances.

To ensure the proper functioning and safety of the unit, all necessary tests, and maintenance and repair work should be carried out by Thermo service personnel or someone authorised by our company.

Thermo Electron LED GmbH can not be made liable for any damage caused by the unit if repair work, which is not carried out by Thermo service centres, leads to faulty operation of the unit, or if parts other than authorised REPLACEMENT PARTS AND ACCESSORIES are used.

Export versions of the unit, without over-temperature protection systems, may only be operated under constant observation.

2 AREAS OF APPLICATION

The muffle/chamber furnace is designed for thermal technology applications in the laboratory:

- Volume of furnace work chamber 4.7 l (M 104) or 3.8 l (K 114)
- Heat treatment of samples and objects from 300 °C to 1000 °C (M 104) or to 1100 °C (K 114)
- Loads of up to 5 kg

The unit is generally designed for installation and operation in the following areas:

- Laboratories, such as those found in manufacturing trades and industry, schools, universities, hospitals and biology.

It is used for:

- ageing, analysis, tempering, decomposing, baking, annealing, hardening, soldering, oxidising, reducing, incineration and preheating.

The over-temperature protection "upper limit cut-out" which can be supplied with the unit enables operation without constant supervision.

The unit is designed for continuous operation.

To avoid samples being unevenly exposed to heat, care must be taken to maintain a distance from the inner surfaces of the furnace work chamber.

Provisions should always be made to provide operators with protective clothing, such as working gloves and protective glasses, due to the often high temperatures existing in the working environment.



Do not use the unit:

- to heat up foods
 - for drying or heat treatment of substances which release gases or vapours into the atmosphere that are flammable or dangerously explosive when mixed with air. This furnace is equally unsuitable for the heat treatment of combustible dusts and fibrous materials.
-
-

3 DESCRIPTION OF UNIT

The basic design of the unit comprises casing, work chamber, tilting door and switching and controlling components.

The work chamber of the M104 laboratory muffle furnace consists of a ceramic muffle. The heating elements are covered and embedded in the muffle. The muffle furnace is designed to operate at temperatures of up to 1000 °C.

The work chamber of the K 114 laboratory muffle furnace consists of fiberboard. Exposed heating elements are set into grooves in the walls and ceiling of the furnace chamber. A ceramic plate covers the floor of the furnace chamber. The unit is designed to work at operating temperatures of up to 1100 °C.

Fiber materials provide the unit with thermal insulation showing reliably good heat containment properties and temperature/time parameters.



The metal surfaces around the mouth of the furnace can become extremely hot during operation at high temperatures. Care must be taken against the danger of injury. To warn against touching them, these surfaces have accordingly been marked with the symbol shown here.

The furnace chamber is closed off by a tilting door.

The door is opened and closed with a lever on the right side of the unit. The hot interior side of the door swings downward when the door is opened. An integrated protective shield against escaping heat and heated particles simultaneously folds out. The lowered door then serves as a surface on which the unloaded samples can be placed.

There is an aperture (Ø 5 mm) in the middle of the swing door which serves as an access for encased thermocouples providing external measurement of temperatures inside the furnace chamber.



Special measures must be taken and strictly observed to ensure protection of persons from electrical shock when using external temperature measurement devices. Failure to observe these measures is EXTREMELY HAZARDOUS and presents a DANGER of DAMAGE TO ALL CONNECTED SYSTEMS - please refer to instructions in the appropriate section of this manual.

The operating elements for built-in electrical components are integrated into the operating panel of the switching and control unit.

The unit is designed as a plug-in unit and is supplied with a fixed mains connection. A PE conductor (protection class I) provides protection against electrical shock.

The laboratory furnace is equipped with radio interference suppression.

Temperature control is provided by an electronic temperature controller featuring a sensor defect indicator. The interior temperature is measured by a thermocouple. A power semiconductor in the temperature controller regulates the power supplied for heating.

3 DESCRIPTION OF UNIT



3.1 SAFETY FEATURES

The unit is designed to provide the following safety features:

- Protection of the operator from injury and dangerous currents
- Protection against the risk of fire in the work area
- Thermal protection of the load during normal operation and in case of breakdown

3.1.1 PROTECTION AGAINST HEAT AND HEATED PARTICLES

Protection against heat and heated particles is integrated into the tilting door mechanism. It protects the operating elements and surfaces around the unit from direct heat radiation. Heated particles are captured when the door is opened.

3.1.2 COOLING SYSTEM OF THE UNIT

The laboratory furnace is equipped with a monitored cooling system which prevents the casing of the small unit from overheating. If the temperature of the housing exceeds the pressed temperature values, the unit is switched off automatically.



Under certain operating conditions, there may be delays before operation of the unit can be restarted:
residual heat, existing after the unit has been operated at high temperatures and then switched off, may shut off the built-in temperature controller. The unit can put **Back into operation after a period of approximately 10 minutes.**

3.1.3 DOOR-OPERATED SAFETY SWITCH

At operating temperatures above 700 °C the conductivity of the ceramic insulation inside the work chamber is likely to increase. To safeguard against electrical shock, the unit is equipped with a reliability-tested positive-open safety switch.

When the tilting door is opened, all poles of the heating current are disengaged and galvanically disconnected from the mains power supply circuit.



The door-operated safety switch is to be tested at fixed regular intervals, at the very least once per year, to ensure that it is technically in perfect working order.

3 DESCRIPTION OF UNIT



3.1 SAFETY FEATURES

3.1.4 OVER-TEMPERATURE PROTECTION FEATURE

The unit is supplied with an electronic upper limit cut-out (TWB) with sensor defect recognition. It is electrically and functionally independent of the temperature control system.

When functioning properly, the TWB shuts down the unit across all poles of the current to the heating elements when temperatures rise above the preset temperature limit, thereby activating the red "malfunction" indicator. The unit is reset manually (control panel key) once the unit has cooled. A tool, such as a coin or screwdriver, is used to adjust the preset temperature value.



To safeguard temperature protection functions, test the over-temperature Protection system periodically to ensure that it is functioning properly (at least every 3 months). Its electrical parts should be tested additionally, at least once every year.

Please refer to the section "OVER-TEMPERATURE PROTECTION" for detailed information, including how to functionally test and adjust the TWB.

3.1.5 SAFETY EXTRA-LOW VOLTAGE

The measurement and control circuits of the control and monitoring system, which have galvanic contact to the furnace chamber, are isolated from the mains power supply (SELV). This ensures protection against electrical shock when the furnace door is open and the controller remains switched on. It is thus not necessary to switch off the control devices.

3.1.6 UNITS WITHOUT OVER-TEMPERATURE PROTECTION

Export versions of the unit can also be supplied without over-temperature protection.



Units without over-temperature protection are only to be used when their operation is constantly monitored.

3 DESCRIPTION OF UNIT

3.2 OPTIONAL FITTINGS

3.2.1 THERMICON® P TEMPERATURE CONTROLLER

(see section CONTROL PANEL for description)

On customer request, the unit can be supplied with a programmable temperature controller.

3.2.2 24 - HOUR – TIMER

(see section CONTROL PANEL for description)

An electromechanical 24-hour timer can be installed to switch the unit on and off at specified times.

3.2.3 EXHAUST FAN

(Available only for M 104. See section CONTROL PANEL and the chapter **SETUP AND INSTALLATION** for detailed description)

The unit can be equipped with an exhaust fan to expel flue gases generated by heat treatment.



Flue gases resulting from heat treatments are to be safely conducted out of the room. Be sure to observe the environmental protection measures and regulations applicable in your country.

3.3 ACCESSORIES ¹⁾

Accessories available for the muffle/chamber furnace:

3.3.1 FURNACE TRAY

Heat resistant steel (material no.: 1.4841); used as a tray or as a shelf for samples loaded into the chamber.

3.3.2 EXHAUST FLUE

To conduct flue gases generated during heat treatment into laboratory or building extraction systems. Refer to the chapter **SETUP AND INSTALLATION** for further instructions on installation.

1) For details on ordering see chapter **AUTHORIZED REPLACEMENT PART AND ACCESSORIES**

3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

Switching and control elements are incorporated into the control panel.

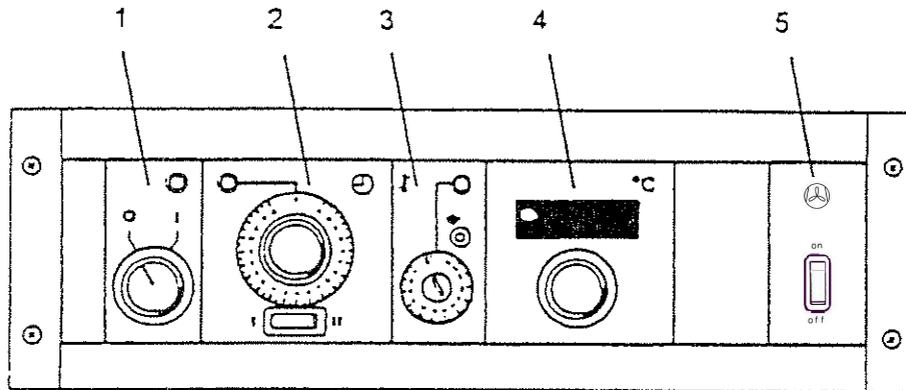


Figure: Control Panel

- 1 Mains switch
- 2 Timer (Option)
- 3 Over-temperature protection
- 4 Temperature controller
- 5 Exhaust fan switch (Option)

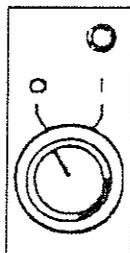
3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

The numbers assigned to the descriptions below refer to illustration of the CONTROL PANEL on page 14.

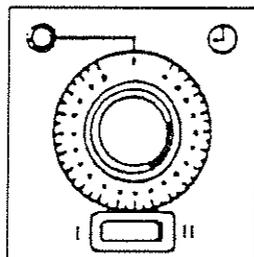
3.4.1 MAINS SWITCH

For turning the unit on or off; a green display light indicates that the unit is ready for operation.



3.4.2 24-HOUR TIMER (OPTION)

A timer to switch the unit on or off at preset times.



A display light indicates when the timer is in operation.

Function selector switch:

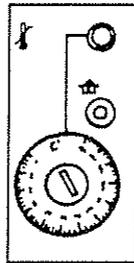
- I = Turn on the furnace when the preset time has been reached, or, operate the furnace without the timer function.
- II = Turn off the furnace when the preset time has been reached.

3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

3.4.3 OVER-TEMPERATURE PROTECTION

Over-temperature protection is provided by the electronic upper limit cut-out (TWB).



The "malfunction" display light is illuminated when the TWB is activated.

The unit is reset manually after it has cooled down (↑ - key).

A tool, such as a coin or screwdriver, is used to adjust the value of the TWB on the control panel.

Adjustment of the TWB to the upper temperature limit desired:

- To use the upper limit cut-out as protection for the unit (protecting the unit and the working environment), adjust the TWB to the highest possible temperature setting.
- To use the TWB to protect samples (protecting the unit, environment and the samples), set it to approx. 50 °C the setting of the temperature controller.



The upper limit cut-out should periodically be tested to ensure that it is functioning properly (refer also to the section SAFETY FEATURES).

Functional test:

First, ensure that the temperature set on the temperature controller has been reached and remains constant.

Now set the TWB to approx. 50 °C below the temperature displayed on the temperature controller. The TWB should be activated (the red "malfunction" display light is illuminated).

The TWB is functioning properly.

Now set the TWB to the temperature limit for the type of protection required.

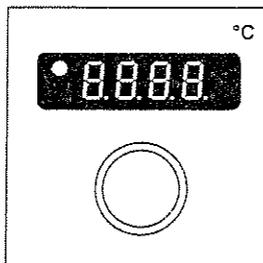
If "malfunction" is indicated during operation:

Check the settings of the TWB and the temperature controller. Make any necessary adjustments. If difficulties persist, contact our service department.

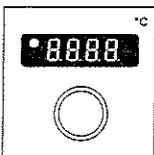
3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

3.4.4 TEMPERATURE CONTROLLER Digicon



Temperature can be displayed and adjusted in increments of 10 °K.

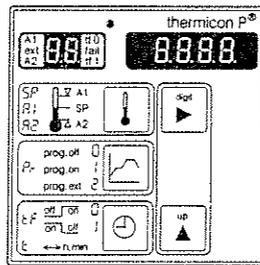
Command	Dial/Remarks	Display/Remarks/Condition
Turn unit on		 <p>Furnace temperature is displayed</p>
Select preset temperature	Press and hold down dial	 <p>Display changes from actual to nominal temperature</p>
	Hold down dial and turn in clockwise direction = raise preset value	 <p>Nominal value rises</p>
	Hold down dial and turn in counter-clockwise direction = lower preset value	 <p>Nominal value decreases</p>
Reset unit to NEW nominal value	Release dial	<p>Furnace temperature is displayed</p>
Pulse signal on "HEATING" indicator: nominal temperature of furnace chamber held constant by controller		

3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

3.4.5 TEMPERATURE CONTROLLER Thermicon® P

The controller can be used as a temperature regulator or as a temperature/program regulator.



- To use as a temperature controller without programming functions:

Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Turn unit on	All display elements illuminated for approx. 20 sec. - controller self-test - then display of furnace temperature	
Display preset temperature	 Press (nominal value displayed for approx. 15 sec. after release of key)	 Display of current nominal value
Select preset temperature	 Hold down	 → → → →
	/ Select position and change value	
NEUEN Sollwert übernehmen	 Release	 Display temporarily dimmed, value being stored, after approx. 15 sec. display of stored value followed by display of temperature in furnace chamber.
Pulse signal on "HEATING" indicator: nominal temperature of furnace chamber held constant by controller		



When using the temperature controller without programming functions, enter "Pr = 0" to switch off operation.

3 DESCRIPTION OF UNIT

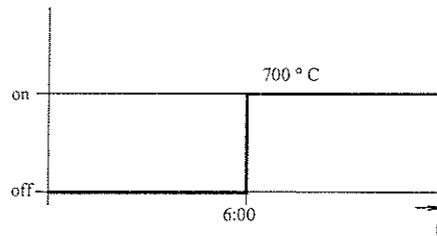
3.4 CONTROL PANEL

To use as temperature controller with timer functions

The timer function can be operated in two modes:

- tf 0:** The timer switches the heating **on** when the preset time is reached.
- tf 1:** The timer switches the heating **off** when the preset time is reached.

Example1: The timer is to switch the unit on after 6 hours and heat the chamber to 700 °C.



Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Turn unit on	All display elements illuminated for approx. 20 sec. - controller self-test - then display of furnace temperature	
Select preset temperature	Refer to use as temperature controller <u>without programming function</u>	
Select operating mode of timer	/ Press (select tf 0)	Position flashes ▲
Switch to time setting function	Release	
Enter time (max. period is 99 hours and 59 minutes (99.59))	Hold down	
	Press	Position flashes ▲
	/ Select position and change value (select 06.00)	→ → → →
	Release	 After approx. 15 sec. "tf 0" and the furnace temperature is displayed.
Unit must remain turned on	Heating will be turned on after the set time period has elapsed.	

3 DESCRIPTION OF UNIT

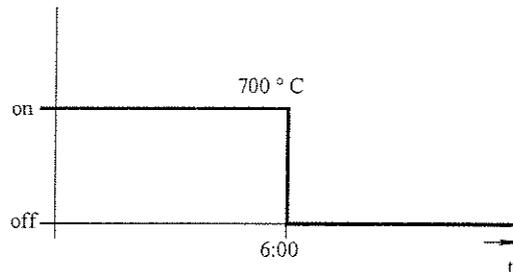
3.4 CONTROL PANEL

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Example1: The timer is to switch the unit on after 6 hours and heat the chamber to 700 °C.



Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Turn unit on	All display elements illuminated for approx. 20 sec. - controller self-test - then display of furnace temperature	
Select preset temperature	Refer to use as temperature controller <u>without</u> programming function	
Select operating mode of timer	 /  Press (select tf 1)	 Position flashes ▲
Switch to time setting function	 Release	
Enter time (max. period is 99 hours and 59 minutes (99.59))	 Hold down	
	 Press	 ▲ Position flashes
	 /  Select position and change value (select 06.00)	 → → → →
	 Release	After approx. 15 sec. "tf 0" and the furnace temperature is displayed.
	Heating will be turned on after the set time period has elapsed.	

 If no timer function is required, select "tf 0" and enter the time "00.00".

3 DESCRIPTION OF UNIT

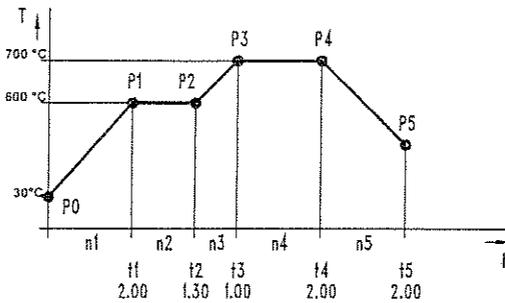
3.4 CONTROL PANEL

- To use as temperature controller with programming function:

The controller can execute time/temperature programs of up to 9 programming steps followed by a command to return to start position.

n1 ... n9: Program steps
 r: Return command (see example)
 P0 ... P9: Preset nominal temperature
 t1 ... t9: Preset times for each program step

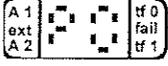
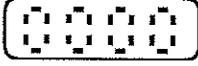
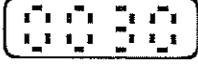
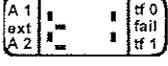
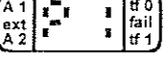
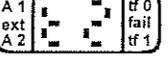
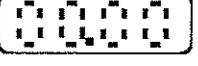
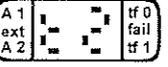
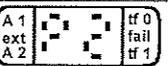
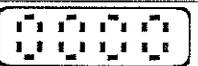
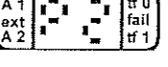
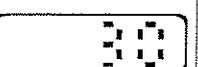
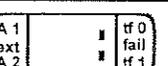
Example 3: Temperature / time program



Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Turn unit on	All display elements illuminated for approx. 20 sec. - controller self-test - then display of furnace temperature	
Select programming operation	Hold down	 Position flashes ▲
Select program function	Press (select prog. on 1)	
Select number of programming steps	Release quickly and hold down again	
	Press (n = 5)	 Position flashes ▲
Select type of return command	Release quickly and hold down again	 Position flashes ▲
	(r = 0: no return to beginning of program, r = 1: return, repeat program from beginning)	

3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Define starting point	 Release quickly and hold down again	  Nominal P0 value is displayed
Enter P0 = 30 °C	 /  Select position and change value	  → → → →
Enter time period for program step (n1)	 Release quickly and hold down again	  Time t1 is displayed
Enter t1 = 2:00 hrs.	 /  Select position and change value	  → → → →
Enter preset temperature (n1)	 Release quickly and hold down again	  Nominal temperature P1 is displayed
Enter P1 = 700 °C	 /  Select position and change value	  → → → →
Time period for program step (n2)	 Release quickly and hold down again	  Time t2 is displayed
Enter t2 = 1.30 hrs	 /  Select position and change value	  → → → →
Enter preset temperature (n2)	 Release quickly and hold down again	  Nominal value P2 is displayed
Enter P2 = 700 °C	 /  Select position and change value	  → → → →
Repeat the same procedure for program steps n3 to n5		
End entry of further program steps	 Release and wait for tP on display	 
Run programmed sequence	 /  Press	 
-	The controller executes the program	The program step and current value are displayed

3 DESCRIPTION OF UNIT

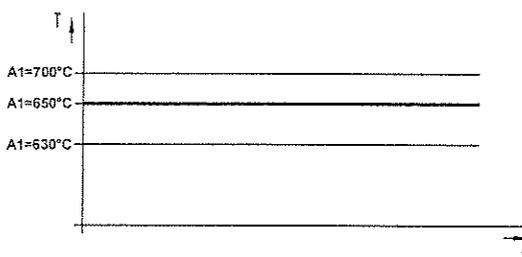
3.4 CONTROL PANEL

- General information on Thermicon® P

You can call up additional information in the different operating modes.

Example 4: Temperature display values can be assigned to monitor any instance of temperatures falling below or rising above the nominal value set. These display values, **A1** and **A2**, can be called up at any time during operation of the temperature controller.

Display **A1**: The temperature of the furnace chamber has risen above the value set for A1.
 Display **A2**: The temperature of the furnace chamber has fallen below the value set for A2.



Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Display nominal temperature	Press (nominal value shown for approx. 15 seconds)	
Display A1 temperature value	Press twice and then hold down	
Select temperature for A1	/ Select position and change value	<p style="text-align: right;">→ → → →</p>
Display A2 temperature value	Press three times and hold down	
Select temperature for A2	/ Select position and change value	<p style="text-align: right;">→ → → →</p>
Example: furnace temperature exceeds value for A1		
Example: furnace temperature below value for A2		
Display timer function	press (status displayed for approx. 15 seconds after key is released) tf 0: Timer turns heating on tf 1: Timer turns heating off	

3 DESCRIPTION OF UNIT

3.4 CONTROL PANEL

Command	Entry / Key(s) / Remarks	Display / Remarks / Condition
Display program operation (Pr = 2 external programmer not available for this unit)	 Press (status shown for approx. 15 sec. after key is released) Pr = 0 Programmer off Pr = 1 Programmer on	
Leave program operation / quit program	 Hold down	
	 Select Pr = 0	

- Error messages

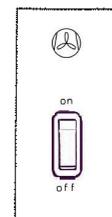
Display / Condition	Remarks	Remedy
	Power failure during timer operation, timer function halted, controller operation off - display shows furnace temperature	Reset timer
	Incorrect entry or controller defective, controller operation is off	Turn unit off and on, reprogram controller, if fault persists contact Service
	Temperature sensor problem or defective controller, controller off	Contact Service



Program is retained in memory during power failures. The program must be restarted once power to the unit is restored.

3.4.6 EXHAUST FAN SWITCH (Option, M104 only)

An on/off switch for the exhaust fan is incorporated in the control panel.
Recommended mode: exhaust fan is **on**



4 SETUP AND INSTALLATION



Follow instructions contained in this instruction manual carefully when setting up, installing and operating the unit. Be sure to comply with all applicable regulations in your country.

4.1 TRANSPORT

Handle with care, avoid vibrating or other possible causes of damage to the unit. Do not grip the door handle or the door itself to lift the unit.

See **TECHNICAL SPECIFICATIONS** for details on weight and dimensions.

4.2 UNPACKING THE UNIT

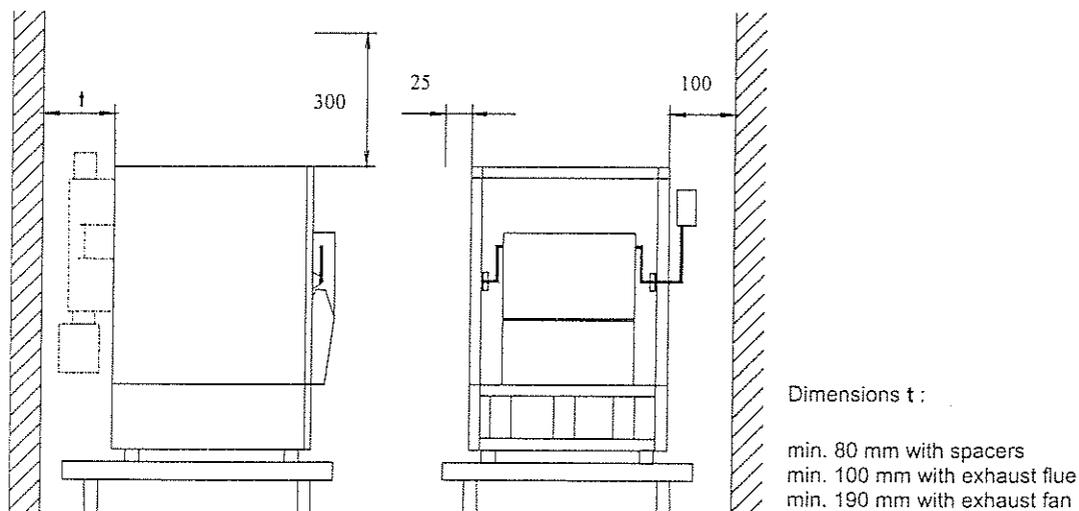
Unpack the unit. Remove transport safety fixtures from the chamber and clean all surfaces of any grit or other contaminants.

4.3 SETUP

The laboratory furnace is to be placed in a stable and perfectly upright position on a firm fireproof surface, such as a laboratory table or support frame.

- It is not possible to stack the M 104 and K 114 furnaces.
- **Room temperature** can be up to 40 °C.
- Do not cover or obstruct the ventilation or exhaust vents of the unit.

4.4 DISTANCE TO OTHER SURFACES AND OBJECTS:



4 SETUP AND INSTALLATION



4.5 MAIN CONNECTION

The unit is supplied with a fixed flexible mains power cable and mounted plug (grounded). Test the mains supply cable and connecting plug for possible faults before using the unit. The unit is not to be connected to the mains circuit if faults are detected.

The device must be set up in a position where the plug of the connecting cable is accessible at any time.

The voltage specified on the nameplate of the unit must match the voltage delivered by the mains power supply.

The furnace is only to be plugged into a properly installed outlet equipped with a PE conductor (Protection Class 1). The mains power circuit should additionally provide protection against leakage current from indirect contacts using a safety switch activated by currents of ≤ 30 mA.

See **TECHNICAL SPECIFICATIONS** for **rated power consumption**.

Mains circuit protection required: T 16 A fuse or B 16 circuit break-switch.

Rubber-sheathed flexible cable of at least 1.5 mm diameter (H 07 RN-F) is to be used for any required power extensions to the connecting plug outlet of the unit.

4.6 NOISE INSULATION

The cooling ventilator and exhaust air fan (option) may cause noise levels to rise above normal levels in unfavorable installation conditions. In such cases, additional measures may have to be undertaken to improve sound insulation in the room.

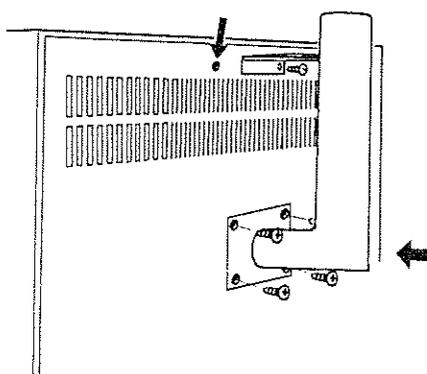
See **TECHNICAL SPECIFICATIONS** for **noise levels**.

4.7 ROOM VENTILATION

Proper ventilation must be installed wherever the unit is set up for operation. Do not operate the unit in non-ventilated enclosed spaces. Special ventilation measures, such as ventilation of designated work areas, are required when several units are set up in the same room.

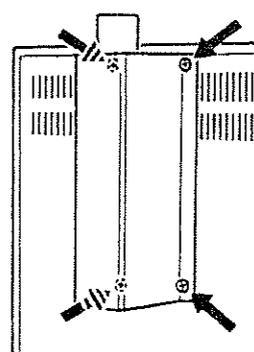
4.8 MOUNTING OF THE EXHAUST FLUE (ACCESSORY)

1)



mount exhaust flue

2)



mount cover

4 SETUP AND INSTALLATION

4.9 CONNECTION TO EXTRACTION SYSTEMS

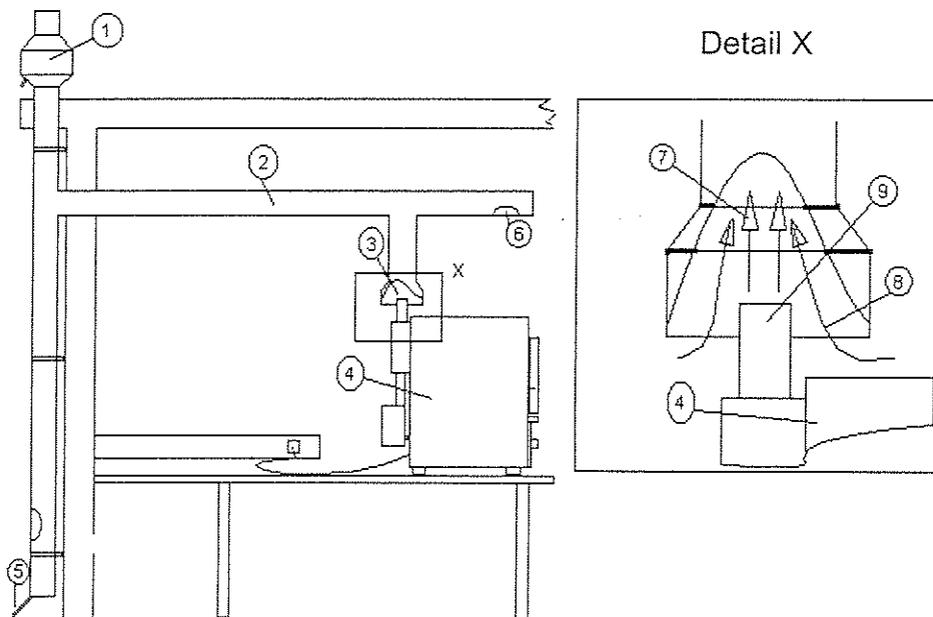


Be sure to observe environmental protection regulations applicable in your country in dealing with flue gases resulting from heat treatments. This may, for example, involve measures to treat such gases with heat or catalysts.

See **TECHNICAL SPECIFICATIONS** for volumes and temperature of flue gases.

A cut off valve must be incorporated into the connection to installed extraction systems. All flue ducts are to be of fireproof materials (recommended: 1.4301 or 1.4571). Openings are required to clean the flue ducts of condensation and residues. The ducts are to be thermally insulated (recommendation: half-round insulating sleeves made of laminated mineral fiber).

Illustration of the installation of a unit equipped with exhaust flue and exhaust fan



- 1 Exhaust fan with deflector hood
- 2 Exhaust-gas manifold
- 3 Draft breaker
- 4 Furnace
- 5 Condensate drain
- 6 Access hole
- 7 Exhaust air flow from the unit
- 8 Addition of air from the installation site
- 9 Exhaust air vents of unit (flue/exhaust fan)

4 SETUP AND INSTALLATION

4.9 CONNECTION TO EXTRACTION SYSTEMS

Information on dimensions of installation example:

- Air flow volume above the cut-off valve (position 3) approx. 5 times the air flow volume of the unit
- Inside diameter of flue gas collection ducts 100 mm

Technical measures should be implemented to monitor the flow of air and flue gases, and to prevent operation of the furnace when the extraction system serving the room is defective or switched off (locking mechanism).

Flue ducts for units equipped with exhaust fans may have a maximum length of 5 m (2 bends, angle of 90 °) when gases are conducted into the free atmosphere. It is possible that the flow of gases will be impaired under certain weather conditions.

4.10 EXTERNAL MEASUREMENT OF FURNACE TEMPERATURE

There is an aperture (\varnothing 5 mm) in the middle of the swing door.

This serves as an access for shielded thermocouples providing external measurement of temperatures inside the furnace chamber.



To avoid damage to temperature measurement devices, these are only to be connected to power circuits that are entirely independent of the mains power supply.



To ensure protection against electrical shock, only shielded thermocouple elements which are properly connected to the PE conductor are to be placed through this aperture. Due care must be taken that the thermocouple does not come into contact with the walls of the furnace.



An additional leakage current flows over the thermocouple shield. It is added to the leakage current of the unit. Under unfavorable conditions, the sum of all leakage currents can activate the leakage current protection switch. Recommendation: connect the furnace to a separate leakage current protection switch (rated at \leq 30 mA).

5 OPERATION

5.1 STARTUP OF OPERATION

After setting up and installing the unit, follow the following procedure for starting unit operation:

Command	Control / Remarks	Display / Remarks / Condition
Turn on unit	Mains switch (position 1) = " I "	see page 15
Select nominal temperature	Adjust temperature controller (position 4)	
	Digicon	see page 17
	Thermicon® P	see page 18
Adjust over-temperature protection to upper limit required	Adjust TWB (position 3)	see page 16
Adjust timer (Option)	Select function mode and time on the timer (position 2)	see page 15
Turn on exhaust fan (option)	Turn exhaust fan switch on (position 5)	see page 24
Load samples, wait until furnace chamber temperature is reached if necessary	Refer to chapter OPERATION	see page 30

5 OPERATION

5.2 OPERATING GUIDELINES

Put on personal safety garments necessary to protect hands, face and body; remove jewellery.

Heat is conducted to samples in the furnace chamber through radiation.

To avoid overheating the samples or heat conductors, **distribute samples evenly** throughout the furnace chamber and **do not place them too close to the heating**.

Take care not to damage the heating elements in the furnace chamber when loading the samples.

Soiled surfaces on the inside of the furnace chamber are often the cause of premature damage to insulation and heating. Direct contact of aggressive chemicals with the ceramic and fiber material surfaces is to be avoided.

The durable life of the heating coils is highly dependent on the temperature load. The operation of the furnace at its highest temperatures should be limited to the time necessary for the task being performed. Durable life can also be adversely affected by continually heating and cooling the furnace over a large temperature range. If used often, it is best to run the unit in continuous operation at medium temperatures.

The ventilation and extraction vents on the outside of the unit are not to be covered, nor should any objects be placed on them. Be sure to keep these vents clean.

The over-temperature protection should also be tested by authorized personnel during operation of the unit.

5.3 SHUTDOWN

- Remove samples loaded into the furnace chamber
- Wait for furnace and room temperatures to cool down
- Turn off unit; if it is not to be used for a longer period, disconnect from mains and pull out plug
- Clean out furnace chamber

6 MAINTENANCE



To ensure the proper functioning and safety of the unit, all necessary tests, and maintenance and repair work should be carried out by Thermo service personnel or someone authorised by our company.

Thermo Electron LED GmbH **can not be made liable** for any possible damage caused by the unit if repair work which is not carried out by Thermo service centres leads to faulty operation of the unit, or if parts other than authorised replacement parts and accessories are used.

We recommend that you conclude a service contract with our company. Please contact us for an offer.

6.1 MAINTENANCE / CLEANING

The unit requires very little maintenance. The bearings of the leveraged swing door can be lubricated with graphite oil.

Clean the outer surfaces and control elements with mild detergent and a soft cloth.

Clean away any spillage or residues from the furnace chamber.

The exhaust ducts should be part of cleaning procedures if the unit is connected to extraction systems serving the room where the unit is installed.

6.2 TESTING

To ensure that the unit remains in proper working condition, it should be test at least once a year on the following:

- Mechanical functions
- Operation according to technical specifications
- Electric circuits
- Safety equipment installed in the unit

6 MAINTENANCE

6.3 SERVICING

- Replacement of electrical parts



Work on electrical components installed in the unit may only be carried out by Thermo service personnel. The unit is to be disconnected from the mains power supply during servicing. Use only authorised replacement parts.

6.4 AUTHORIZED REPLACEMENT PART AND ACCESSORIES



The safe and reliable operation of the unit can only be ensured if replacement parts authorised by the manufacturer are used. The use of any other parts can present unforeseen risks and is not approved under any circumstances.

Replacement part / Accessory	Order no. M 104	Order no. K 114
Instruction manual	50 111 935	50 111 935
Circuit diagram	50 040 481	50 040 481
Tray	50 040 950	50 040 950
Exhaust flue	50 040 537	50 040 537
Base plate	50 040 513	50 040 512

7 TECHNICAL SPECIFICATIONS

	M 104	K 114	Unit
MECHANICAL			
Dimensions (W x H x D)			
Outer dimensions:	456 x 646 x 570	456 x 646 x 570	mm
Furnace chamber (excl. door insulation):	170 x 130 x 215	170 x 130 x 175	mm
Loading space in furnace chamber:	130 x 110 x 205	130 x 110 x 165	mm
Usable space (DIN 17 052 Class C, heated depth 160 mm):	130 x 80 x 120	130 x 90 x 120	mm
Base plate (W x H x D):	145 x 10 x 240	145 x 10 x 200	mm
Min. distance of the furnace to neighboring surfaces			
left:	25	25	mm
right:	100	100	mm
top:	300	300	mm
at rear (with spacer):	80	80	mm
at rear (with exhaust flue):	100	100	mm
at rear (with exhaust fan):	190	190	mm
Volumes (see ill. page 34)			
Furnace chamber:	4,7	3,8	l
Loading space in furnace chamber:	2,9	2,3	l
Usable space (DIN 17 052 Class C, heated depth 160 mm):	1,2	1,4	l
Weight			
Unit:	ca. 52	ca. 37	kg
Maximum load:	5	5	kg
THERMAL:			
Operating temperatures:	300 ... 1000	300 ... 1100	°C
Temperature deviation			
Temporal (DIN 12 880 Section 2)			
with spacer:	< ± 1	< ± 2	K
with exhaust flue:	< ± 1	< ± 2	K
with exhaust fan:	< ± 2	-	K
Spatial (DIN 17 052 Class C)			
at 500 °C:	± 12,5	± 9,5	K
800 °C:	± 7,0	± 6,5	K
1000/1100 °C:	± 7,5	± 4	K
Heat rise time (without load)			
with spacer / exhaust flue			
to 500 °C:	ca. 80	ca. 30	min
to 800 °C:	ca. 90	ca. 35	min
to 1000/1100 °C:	ca. 120	ca. 45	min
with exhaust fan			
to 500 °C:	ca. 50	-	min
to 800 °C:	ca. 85	-	min
to 1000 °C:	ca. 160	-	min
Cool down time (to 100 °C, without load)			
with spacer / exhaust flue			
from 500° C:	ca. 540	ca. 310	min
from 800 °C:	ca. 670	ca. 380	min
from 1000/1100 °C:	ca. 730	ca. 410	min
Without exhaust fan			
from 500 °C:	ca. 255	-	min
from 800 °C:	ca. 325	-	min
from 1000 °C:	ca. 350	-	min
Heat radiation to surrounding areas			
at 500 °C:	0,4	0,2	kW
at 800 °C:	0,8	0,4	kW
at 1000/1100 °C:	1,1	0,8	kW

7 TECHNICAL SPECIFICATIONS

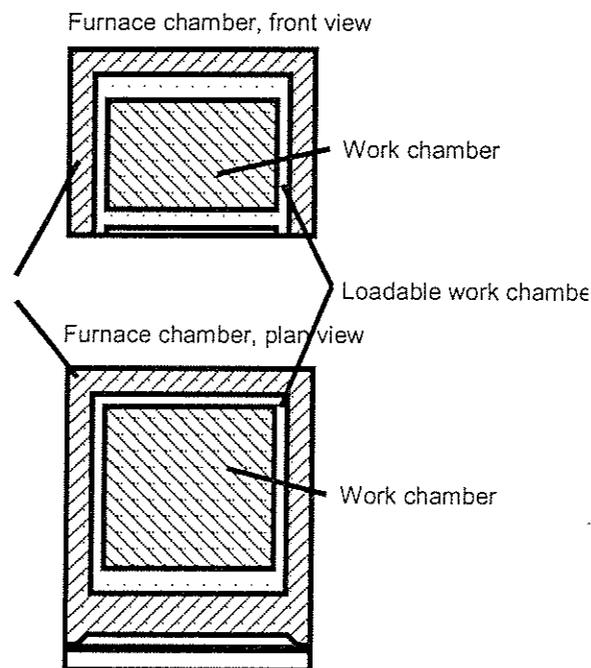
	M 104	K 114	Unit
VENTILATION / FLUE GASES:			
Air replacement in furnace chamber without / with exhaust flue			
at 500 °C:	ca. 15	ca. 18	h ⁻¹
at 800 °C:	ca. 10	ca. 12	h ⁻¹
at 1000/1100 °C:	ca. 8	ca. 10	h ⁻¹
with exhaust fan			
at 500 °C:	ca. 500	-	h ⁻¹
at 800 °C:	ca. 345	-	h ⁻¹
at 1000 °C:	ca. 340	-	h ⁻¹
Flue gas flow (without load) without/ with exhaust flue			
at 500 °C:	70	68	l/h
at 800 °C:	47	46	l/h
at 1000/1100 °C:	38	38	l/h
with exhaust fan	46	-	m ³ /h
Diameter of duct - flue / exhaust fan:	35 / 52	35 / -	mm
Flue gas temperature at duct (at max. operating temp.) without / with exhaust flue: with exhaust fan:	80 (330 1)) 110 (200 1))	200 (400 1)) -	°C °C
1) the higher value applies momentarily on closing of door			
NOISE:			
Noise level (DIN 45 635):	< 58	< 58	dB (A)
ELECTRICAL:			
+ Rated voltage (10%):	1/PE AC, 230	1/PE AC, 230	V
Rated frequency:	50/60	50/60	Hz
Nominal power consumption:	2,5	1,75	kW
Connected load:	2,6	1,8	kVA
Current load:	11,4	8	A
Protection class:	I	I	
Protection type:	IP 20	IP 20	
Circuit protection: (Electrotechnical regulations and EVU-specific technical requirements are to be observed when connecting to mains power supply circuits)	T 16 A fuse or B 16, circuit breaker, connection to leakage current protection switch (≤ 30 mA) recommended		

7 TECHNICAL SPECIFICATIONS

MATERIALS USED		
PART:	M 104	K 114
Outer casing	Zinc-plated sheet steel, painted RAL 9002	Zinc-plated sheet steel, painted RAL 9002
Furnace chamber	Ceramic C 530, DIN VDE 0335	Aluminum silicate fiber ¹⁾
Door insulation	Fireclay brick (chamotte)	Aluminum silicate fiber ¹⁾
Mouth of furnace	Fireclay brick (chamotte)	-
Thermal insulation of the furnace chamber	Aluminum silicate fiber ¹⁾	Aluminum silicate fiber ¹⁾
Base plate	Fireclay brick (chamotte)	Fireclay brick (chamotte)
Tray	Heat-resistant steel	Heat-resistant steel
Heat coils	Cr Al Fe	Cr Al Fe
Control panel	Mixture of ABS and PC	Mixture of ABS and PC
Electrical components	Components coated with various plastics, partially mounted with epoxy resins on circuit boards strengthened with glass fiber.	Components coated with various plastics, partially mounted with epoxy resins on circuit boards strengthened with glass fiber.

¹⁾ Fiber materials used for insulation are classified as hazardous to health in certain countries. No serious risks to the working environment arises from normal operation. Improper handling during repairs or dismantlement of the unit can lead to significant levels of contamination.

Volume Diagram:



8 APPENDIX

CONTENTS

- List of equipment options tested for GS certification
- Draft recommendation for log book

List of equipment options tested for GS certification, with over temperature protection (TWB) for M 104 and K 114		
Order no.	Type	Equipment
50 040 485	M 104	Digicon®
50 040 486	M 104	Digicon®, 24 - hour - timer
50 040 488	M 104	Thermicon® P
50 047 438	M 104	Digicon®, 24 - hour - timer, muffle glazed
50 047 440	M 104	Thermicon® P, muffle glazed
50 040 491	K 114	Digicon®
50 040 492	K 114	Digicon®, 24 - hour - timer
50 040493	K 114	Thermicon® P

