Thermo Scientific

RI-150CN
RI-250CN

Refrigerated Incubators

User Manual

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Thermo SCIENTIFIC

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Preface

Preface

In order to make the equipment fully functional and ensure safety of the equipment, property, specimens and the operator, read this manual carefully and completely. When you have any question that cannot be explained by this manual, consult your local distributor or supporting technician. It is our pleasure to provide services for you.

General safety notes

Hazard exists if the equipment is used to heat, cool and condition specimen containing or treated with toxic chemicals or hazardous microorganisms; and hazard arises if the specimen within the equipment should be treated at periodic or aperiodic intervals with toxic chemicals or hazardous microorganisms; and hazard develops if specimen liberates hazardous substance under refrigerated and heating conditions with or without additive humidity, where hazardous substance may be exhausted in the air by exhaust opening or operating of the door or, drained through liquid connections or drain device to cause risks.

There exist general hazards related to the application of electrical energy and machine. It is not possible to cover all possibilities; they remain largely within the responsibility and the judgment of the operator!

The equipment must only be used as intended and described in these Operating Instructions. This includes operation by suitably trained qualified personnel.

The maximum temperature deviation both in normal condition and in electro-magnetic interference field according to IEC 61326-1 is ±0.5 °C.

Important symbols

For your safety, pay attention to these important symbols as follows, during moving, installing, operating and maintenance. The equipment is designed for safe operation because of your attention!

Warning, possibility of electric shock!

Inappropriate operation may cause hazard of electric shock and result in serious personal injury or death!

Preface

Caution, important note, and always refer to operating instructions (this document) for detailed information!

The equipment must be operated by well trained qualified personnel only!

Wrong operation may cause personal injury, damage and/or mal-function of the equipment!

Symbols on the equipment

Observe operating instructions!

Warranty

Thermo Fisher Scientific warrants the operational safety and functions of the RI refrigerated incubators only under the condition that:

- ✓ The incubator is operated and serviced exclusively in accordance with its intended purpose and as described in these operating instructions,
- ✓ The incubator is not modified,
- ✓ Only original spare parts and accessories that have been approved by Thermo Fisher Scientific are used (third-party spares without Thermo Fisher Scientific approval void the limited warranty),
- ✓ Inspections and maintenance are performed at the specified intervals,
- ✓ An operation verification test is performed after each repair activity.

The warranty is valid from the date of delivery of the incubator to the customer.

Visit us online to register your warranty: www.thermoscientific.com/labwarranty

Chapter 1 Safety instructions

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Chapter 1 Safety instructions

1.1 Operating environment

The equipment is designed for safe operation under ambient conditions as follows:

- indoor use;
- altitude up to 2,000 m;
- temperature 16 °C to 32 °C;
- maximum relative humidity 75 % at ambient temperature of 32 °C;
- mains supply voltage fluctuations up to ±10 % of the nominal voltage;
- transient overvoltage up to the levels of overvoltage category II;
- temporary overvoltages occurring on the mains supply;
- Pollution degree 2 or less of the intended environments.

1.2 Safety warning

	Not applicable for heating, cooling, conditioning or storage of specimen which is intrinsically explosive, flammable or toxic or, which may liberate hazardous substances under normal operating temperature conditions! Caution: Explosive or flammable hazards!
	The dielectric strength of the equipment may be degraded if after transport or storage in humid conditions. The equipment shall be powered and conditioned at 60°C for at least 1h before commissioned for normal use. Warning, hazard of possible electric shock during the dry-out!

Chapter 1 Safety instructions

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1.3 Caution

	Caution: Risk of biological and chemical hazards! When hazardous substance may be exhausted in the air by exhaust opening or operating of the door or, drained through liquid connections or drain device for condensate: a) hazard exists if the equipment is used to heat, cool and condition specimen containing or treated with toxic chemicals or hazardous microorganisms; b) hazard arises if the specimen within the equipment should be treated at periodic or aperiodic intervals, with toxic chemicals or hazardous microorganisms; c) hazard develops if specimen liberates hazardous substance under refrigerated and heating conditions with or without additive humidity.
	Reduce the frequency of door operating and keep the door opening as short as possible! It takes time for the equipment to recover the temperature and temperature distribution! The temperature difference may result in condensing and dripping of the condensate on surface of the specimen!
	The swivel casters shall be locked once the equipment is seated and leveled so that it doesn't move or travel during operation which otherwise may result in hazard from imbalance or side skid!
	Equipped with a refrigerant condensing unit, never tilt the equipment beyond 30 ° during movement or transport! In case the equipment arrives in upside down, rollover or tilted conditions, the dielectric strength of the equipment may be degraded. The equipment must be kept standstill for at least 24 h before commissioned for normal use! The inlets of fresh air and outlets of exhausting air for the condensing unit shall be kept clear of any obstacles! Use refrigerant only as indentified on the nameplate!
	The minimum distance away from the back and sides of the equipment to the wall, furniture or other installations shall be 300 mm!
	Keep the equipment away from hot-air emitting source, direct sunshine, strong magnetic field and electric sparks! Neither contamination of high concentration dust or corrosive gas, nor strong airflow surrounds!

Chapter 1 Safety instructions

	Voltage, frequency and current for power supply must meet the requirements as designated on the nameplate! Use power socket matching the power plug of the equipment. Hot line (L) and neutral line (N) for single phase equipment must not be reversed!
	Socket for power supply must be equipped with protective ground (PE) to prevent against hazard of possible electric shock.
	Connect the power from behind the equipment. Plug in and remove the cable by directly holding the plug. No dragging of cable in any part. Protect the cable from being damaged by contacting with the hot surface of the equipment, exhausting hot air or mouse etc!
	Keep clear of inlets of top plenum and outlets of back plenum for the circulating air. Excessive hoarding of specimen or blockage of the air circulating may cause frost accumulation on surface of the evaporator, localized temperature distribution and degraded performance!
	Do not disassemble or exchange assembly parts and electric circuits by unauthorized personnel! Hazard of possible electric shock! In case of repairing, contact authorized local distributor or maintenance engineer. Always remove the mains plug from the socket before cleaning, moving, maintaining or repairing!
	If you come in touch with the PCB's of the equipment please take care that you follow the electro-static discharge (ESD) guidelines and use ESD protection kit to prevent any damage on the electronic components.
	Perform regular check or maintenance for the following at designated intervals: Clean the cabinet interior weekly or necessary! Decontaminate cabinet interior and shelves on case-by-case basis if necessary! Check the air tightness of the door gasket at three months intervals! Check and clean the condenser at six months or when necessary! Check cabinet Klixon for safety at six months intervals or more frequently when necessary!

1.4 Intended use / incorrect use of the equipment

1.4.1 Intended use

The equipment, RI150 and RI250, are laboratory devices designed for biotechnological and

microbiological applications, i.e. thermal processing and storage. The equipment allows the simulation of the special physiological ambient conditions for cell cultures due to the exact control of temperature in the range of:

+4 °C to + 60 °C.

The RI refrigerated incubator series has been designed for installation and operation in the following environments:

- Laboratories for cytobiological and biotechnological experiments of safety levels L1, L2, and L3.
- Medical-microbiological laboratories in accordance with DIN 58956.
- Laboratories in the central area of clinics and hospitals.

1.4.2 Incorrect use of the equipment

Do not use cell or tissue cultures in the equipment that are not in accordance with the regulations of safety levels L1, L2, and L3.

Do not use tissues, substances or liquids that:

- are easily ignitable or explosive,
- release vapors that form combustible or explosive mixtures when exposed to air,
- release poisons.

When installing and operating the equipment, make sure you comply with all applicable regulations of your country.

Chapter 2 Installing and operating

Chapter 2 Installing and operating

2.1 Installing

2.1.1 Unpacking

Unpack the equipment and sort the accessories respectively and carefully. The packing carton, pallet etc, are designed for one shipment only. For future shipment, prepare the packing materials as received.

Check the equipment and accessories for potential transport damages. If there is any damage visible on the equipment, a claim must be filled in writing with the freight forwarder; a notification to the freight forwarder is obligatory so that the shipment can be examined. Inform Thermo Scientific for any missing accessories and servicing or repairing.

List of accessories, RI-150CN

Qty	Descriptions	Remarks
1	Operating instructions	This document
1	Fuse (250V~/6.3A)	Breaking capacity: 63 A
8	Shelf clips	
2	Perforated shelves	
1	Power cable, IEC, 230V~/50Hz, 2800mm, Black, VDE approved or equivalent	

List of accessories, RI-250CN

Qty	Descriptions	Remarks
1	Operating instructions	This document
1	Fuse (250V~/6.3A)	Breaking capacity: 63 A
12	Shelf clips	
3	Perforated shelves	
1	Power cable, IEC, 230V~/50Hz, 2800mm, Black, VDE approved or equivalent	

Chapter 2 Installing and operating

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	Do not disassemble or exchange assembly parts and electric circuits by unauthorized personnel! Hazard of possible electric shock! In case of damaged shipment and dent, deformation or distortion of the enclosure, contact authorized local distributor or personnel.

2.1.2 Installing

Install the equipment on a rigid, nonflammable surface and well-ventilated place. If the equipment is installed on an unstable surface or floor, abnormal noise may be generated. Keep enough space between wall and back, both sides of the equipment for ventilation.

The voltage, frequency and current of the power supply must be rated at least the same as those designated on the plate of the equipment. The switch board is recommended to be on the back right side of the equipment and equipped with outlet matching the power plug of the equipment.

	Keep the equipment away from hot-air emitting source, direct sunshine, strong magnetic field and electric sparks! Neither contamination of high concentration dust or corrosive gas, nor strong airflow surrounds!
	Voltage, frequency and current for power supply must meet the requirements as designated on the plate! Use power socket matching the power plug of the equipment. Hot line (L) and neutral line (N) for single phase equipment must not be reversed!
	Socket for power supply must be equipped with protective ground (PE) to prevent against hazard of possible electric shock.

Chapter 2 Installing and operating

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2.2 Descriptions

2.2.1 Front view

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Fig 1 Front view

01 Power switch
02 Controller
03 Side fresh air inlets
04 Perforated shelves
05 Access port
06 Observation window
07 Handle
08 Swivel casters
09 Top plenum with circulating fan
(Picture is for reference only)

Fresh-air inlet openings are important for safety and proper function of the equipment especially the refrigerating condensing unit. Keep clear of the fresh air inlet openings at any time. Blocked or degraded ventilation may cause hazards of overheating or over pressure of the refrigerating condensing unit.

The first time powering up after repairing or standstill for long period, or at designated intervals under normal use, check the functionality of the following parts or components:

Check the air tightness of the door gasket at three months intervals!
Check the clearance of the condenser at six months intervals!

Keep clear of inlets and outlets of back plenum for the circulating air. Excessive hoarding of specimen or blockage of the air circulating may cause frost accumulation on surface of the evaporator, localized temperature distribution and degraded performance!

Chapter 2 Installing and operating

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2.2.2 Back view

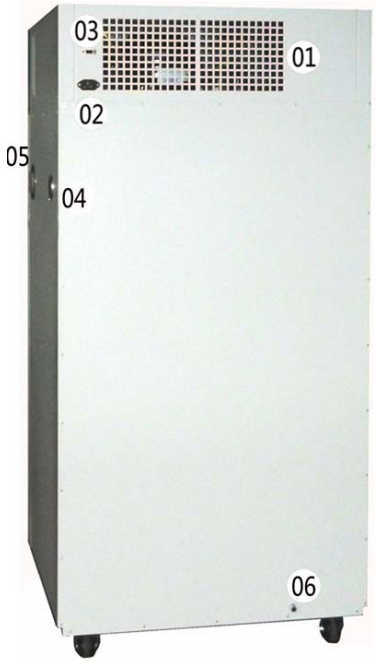

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Fig 2 Back view

01 Outlets for condenser exhaust
02 Mains power socket, IEC, 10A max
03 RS232 interface, DB9 socket
04 Ventilating outlet for exhaust air (option)
05 Access port
06 Tube outlet for condensate

Regular check of the condensate outlet for clearance is necessary for reliable and safe operation of the equipment. Intervals of 3 months for normal use, or the first time powering up after repairing are recommended.

Clearance of the ventilating openings for exhausting air is important for efficient and safe operation of the equipment, especially the condensing unit. Extreme temperature may exist at the exhausting area. Do not put temperature sensitive items nearby or touch area of hot surfaces. Never cover or block the exhausting openings! Degraded or blocked ventilation may cause overheating, over temperature and over pressure of the refrigerating system.

Chapter 3 Controller descriptions and operation

3.1 Controller panel

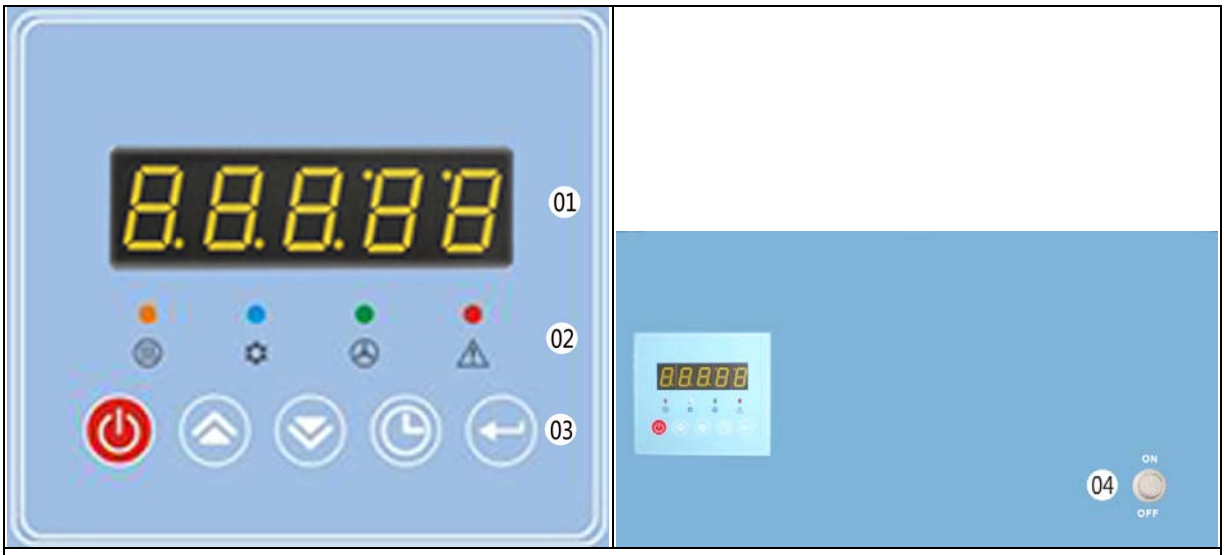

Fig 3 Controller panel

01 Display for temperature and working parameters 02 Status indicators 03 Keyboard 04 Power switch

3.1.1 Display for temperature and working parameters

Normally it displays the equipment temperature once switched on and initiated or oFF when standby.

Other possible symbols include: SEt, Ht, Lt, HEAt, CooL, Auto, Atc, AS, ASd, cF, dEFr, dEFt and ESc. Related definitions are as follows:

SEt	Ht	Lt	HEAt	CooL	Auto	Atc
Setting of temperature	High limit of temperature	Low limit of temperature	Additional heating	Compressor mode	Restart after power failure	Abs. temp calibration
AS	ASd	cF	dEFr	dEFt	ESc	oFF
Timer: Auto startup	Timer: Auto shut down	Celsius or Fahrenheit	Setting of defrosting	Recover to defaults	Exit the setting menu	Controller standby

Detailed description of control operation:

Chapter 3 Controller descriptions and operation

SEt: Setting of working temperature, must be 5 °C higher than low limit Lt and 5 °C lower than the high limit Ht. The temperature setting beyond the scope will not be accepted.

Ht: This parameter is an absolute value and used for reminding only. When temperature in the equipment is higher than the SEt value, Ht is displayed. The controller will trigger a beeping alarm and disable the heating. While the actual temperature is higher than the Ht setting, The Ht may be set to a higher value by pressing  so that Ht beeping can be cleared. If the actual temperature is recovered to lower than the Ht setting, the Ht alarm will disappear automatically with seconds of delay, or may be cleared immediately by pressing  . The heating is possible only if the Ht is cleared.

Lt: This parameter is an absolute value and used for reminding only. When temperature in the equipment is lower than the SEt value, Lt is displayed. The controller will trigger a beeping alarm. While the actual temperature is lower than the Lt setting, the Lt may be set to a lower value by pressing  so that Lt beeping can be cleared. If the actual temperature is recovered to higher than the Lt setting, the Lt alarm will disappear automatically with seconds of delay, or may be cleared immediately by pressing  .

HEAt: Additional heating proportion defines the power at which the heating elements will work at set temperatures between 20 °C and 40 °C. (below 20 °C, the heater never works and above 40 °C the heater works according to PID algorithm).

The default value of 20% for this heating proportion should be maintained in all applications and for all temperature settings of the equipment. It is recommended to the user not to change this setting, since it provides the optimal performance and energy efficiency.

In exceptional cases of required higher or lower heating power (i.e. reduction of heat up or cool down time) an adjustment of the HEAt parameter can be selected between 0 and 50%.

- Selection of a higher HEAt would be applicable for situations with low ambient temperature and set temperature close to 40 °C.

- Selection of a lower HEAt would be applicable for situations with high ambient temperature and set temperature close to 20 °C.

Please make sure to go back to default setting as above described situation does not apply anymore.

Chapter 3 Controller descriptions and operation

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With the patented technology of stepper hot-gas bypassing, the equipment has the advantage of precise temperature and cooling capacity control with reduced or even without additional heating, therefore higher energy efficiency and extended defrost intervals are guaranteed.

For temperature control at 40°C and up, heater is controlled by PID, while at temperature below 40°C , stepper valve is controlled by PID. At lower ambient or at higher working temperature, heating by stepper valve hot-gas bypassing may be not enough to keep the temperature. In this case, additional heating is necessary and controlled by HEAt setting.

CooL: Control parameter for compressor, and select among three modes, Auto, on and oFF:

on : Compressor cooling with counter heating by PID, with stepper valve closed. Applicable for working temperature of 10 °C or lower for precise temperature control. Not applicable for long term operation, for possible frost buildup and higher energy consumption.

H9 : Compressor cooling with stepper valve heating by PID. Additional heating is necessary and based on setting of HEAt. Applicable for working temperature between +4 ~ +40 °C, for precise temperature control and best energy efficiency. Note H9 is the default setting for the compressor.

nF : Compressor is modulated by on and off operation based setting of the thresholds and the working temperature. Heater and stepper are disabled. Applicable for temperature stability of ±2 °C or higher.

There are two parameters related to nF mode of the compressor, ON threshold and OFF threshold.

OFF threshold L: This parameter is an relative value and the compressor will be shut down, if the actual temperature becomes lower than SEt temperature plus OFF threshold L.

ON threshold H: This parameter is an relative value and the compressor will be switched on, if the actual temperature becomes higher than SEt temperature plus ON threshold H.

The range of the OFF threshold L and ON threshold H is ±2.0 °C, wherein, L ≤H-0.2

oFF : The compressor and stepper are disabled, and the heater is regulated by PID.

Chapter 3 Controller descriptions and operation

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For RI series equipment, CooL mode of H9 is recommended, and nF is not recommended.

AutO: Select between AoFF and Aon, to define the state of the equipment after power failure: AoFF for standby, Aon for start at set temperature.

AtC: Absolute temperature calibration (ATC), when the temperature displayed differs from the temperature measured by a standard thermometer, ATC is used to calibrate the display.

AS: Timer for automatic startup. Valid only when the equipment is in standby mode. The equipment will be initiated automatically once the set time elapses. The equipment may be started immediately if  is operated regardless of the remaining AS time.

ASd: Timer for automatic shutdown. Valid only when equipment is in operating mode. The equipment will be terminated automatically once the set time elapses. The equipment may be terminated immediately if  is operated regardless of the remaining ASd time.

cF: Shifting of the temperature measurement units. c means Centigrade and F means Fahrenheit. cF setting affects all the parameters related to temperature, such as the display temperature, setting temperature, Ht, Lt and so on. Relationship between c and F is as follows:

°F=32+1.8×°C, °C=(°F-32)/1.8

For example: 0°C=32°F, 100°C=212°F.

dEFr : Defrost cycle. The defrost cycle is disabled as default. For enabling of defrost cycle, input date for intervals of the 2 defrost cycles, and temperature for terminating the defrost process. For example, 0.5 day intervals and 12 °C means defrost will be activated at 12 h intervals and terminated once the cabinet temperature reaches 12 °C. During the defrost process, the compressor and circulating fan are disabled, the temperature of the cabinet is monitored for termination of the defrost process.

Chapter 3 Controller descriptions and operation

Defrost is necessary only when working temperature is lower than +15°C and when working temperature cannot be maintained because of frost buildup.

To check if frost is build up or not, switch off the compressor for about 60 min, and check the condensate outlet for water flow. Switch on the compressor again to see if working temperature can be maintained. In this case, defrost is necessary.

See 3.7 for details related to dEFr setting.

dEFt: Recover the values to the factory default setting. It may be used when system halts or any other abnormal situation occurs.

ESc: Exit the SEt menu.

The warning or error of the temperature, and door operation when circulating fan in running may be accompanied by the following:

Chapter 3 Controller descriptions and operation

Er01	Er02	Stb	ourh	door
Temp sensor short-circuit	Temp sensor open-circuit	Independent STB or motor Klixon triggered	Overheating of the cabinet	Door opened for more than 10 s

- Er01: Warning of temperature sensor short-circuit. For clearance of warning, see 4.6 or call for service.
- Er02: Warning of temperature sensor open-circuit. For clearance of warning, see 4.6 or call for service.
- Stb: The independent over temperature device or motor Klixon is triggered. Switch off the controller and switch it on again when failure of the Stb is removed. For clearance of warning, see 4.9 or call for service.
- ourh: Warning of the cabinet temperature over 80 °C by software control. For clearance of warning, see 4.8 or call for service.
- door : Warning when the door is opened for more than 10 s. During door alarm, the circulating fan and the heating are disabled. If the door alarm is kept for more than 3 min, the compressor will be shut down. Warning disappears automatically when the door is closed, and the circulating fan resumes immediately, while the heater and the compressor will resume with designated delay for normal operation (see 3.1.2).

3.1.2 Working status indicating

			
Heating in progress	Compressor working	Circulating fan running	Alarm triggered

 Heating: Press the  key for more than 2 s to initiate the circulating fan, and the heating is possible with about 3 s of delay. If heating is desired, orange LED lights. Orange LED will be steadily lit with full power heating; When LED flashes, the heating power is automatically adjusted to meet actual need. LED flashing frequency keeps constant when temperature is stabilized.

Chapter 3 Controller descriptions and operation

Compressor: Press for more than 2 s to initiate the circulation. The compressor is enabled with about 3 min of delay, after which blue LED lights and refrigeration is possible.

Circulating fan: Press the key for more than 2 s to initiate the circulating fan with green LED on.

Alarm: Red LED is flashing, when there is beeping and warning is triggered. For possible cause of the alarm, refer to 3.1.1.

3.1.3 Key functions and navigation of the menu

There're 5 keys as follows, the function and their operation are summarized and listed in the table:

Key	Function	Operation	Description
	Initiate or terminate fan circulating	Press and hold the key for more than 2 s	Temperature regulating is possible only if the circulating fan is initiated.
	Set the working temperature, see flow chart 3.1.3.1	Press the button for less than 1 s	SEt is first displayed, then press to enter, change the digits by pressing , accept the setting by pressing .
	Set the working parameters, see flow chart 3.1.3.2	Press and hold the key for more than 2 s	Ht is first displayed, press for Lt, CooL, AuEo, AEc , AS, ASd, cF, dEFr, dEFt, use ESc for exit; Press to enter for change of a definite setting of the working parameter, for example Ht. Change the digits or setting by pressing , accept the setting by pressing , or confirm and exit automatically in 4 s.

Chapter 3 Controller descriptions and operation

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	Initiate the timer	Press  and  at the same time, then release the buttons	When the equipment is in running mode, timer for RSd is valid, while the equipment is in standby mode, timer for RS is valid. The time is set by RS and RSd.
	Move between settings or increase the value	Press the key shortly for slow movement and continuously for fast changing	
	Move between settings or decrease the value	Press the key shortly for slow movement and continuously for fast changing	

Chapter 3 Controller descriptions and operation

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3.1.3.1. Flow chart of key operation, setting the working temperature, for example to 37.0 °C.

Equipment status	Key symbol	Display	Operation
The equipment standby		oFF	Turn the power switch on
The equipment displays the actual temperature		20.0	Press the key for more than 2 s
The equipment displays set temperature		37.0	Press the key for less than 1 s
The equipment displays actual temperature again		20.0	Press the key for less than 1 s, or exit automatically in 4 s

3.1.3.2. Flow chart of key operation, setting the working parameters

Equipment status	Key symbol	Display	Operation
The equipment displays the actual temperature		37.0	
Enter the menu for high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for low limit temperature		Lt	Press the arrow keys for shift upward or downward for review of the menu
Scroll the menu for additional heat percentage		HEAt	Or press  to modify the parameter
Scroll the menu for compressor mode		CooL	Or press  to modify the parameter
Scroll the menu for restart mode after power failure		Auto	Or press  to modify the parameter
Scroll the menu for absolute temperature calibration		Atc	Or press  to modify the parameter
Scroll the menu for timer to automatically startup		AS	Or press  to modify the parameter

Scroll the menu for timer to automatically shutdown		ASd	Or press  to modify the parameter
Scroll the menu for temperature unit of Celsius or Fahrenheit		cF	Or press  to modify the parameter
Scroll the menu for defrost cycle and ending temperature		dEFr	Or press  to modify the parameter
Scroll the menu for default parameters		dEFt	Or press  to modify the parameter
Scroll the menu for exit		ESc	Or press  to exit

3.1.3.3. Set the high limit temperature, for example to 40.0 °C. Note that the setting of working temperature will change this value automatically 5.0 °C higher than the working temperature. For definite high limit temperature, set the value ONLY after setting of working temperature.

Equipment status	Key symbol	Display	Operation
Enter the menu for high limit temperature		Ht	Press the key for more than 2 s to enter the menu
The equipment displays the existing high limit		65.0	Press the key for less than 1 s to modify
The equipment displays the new high limit		40.0	Use arrow keys for desired value
The equipment exits & displays the actual temp		37.0	Press the key for less than 1 s to accept the value and exit

3.1.3.4. Set the low limit temperature, for example to 10.0 °C

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for low limit temperature		Lt	Press the arrow key once downward

The equipment displays the existing low limit		0.0	Press the key for less than 1 s to modify
The equipment displays the new low limit		10.0	Use arrow keys for desired value
The equipment exits & displays the actual temp		37.0	Press the key for less than 1 s to accept the value and exit

3.1.3.5. Set the additional heating power, for example to 50%.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for additional heat power		HEAt	Press the arrow key twice downward
The equipment displays the existing heat power		20.0	Press the key for less than 1 s to modify
The equipment displays the new heat power		50.0	Use arrow keys for desired value
The equipment exits & displays the actual temp		37.0	Press the key for less than 1 s to accept the value and exit

3.1.3.6. Calibrate the temperature, for example to 37.2 °C. Perform the calibration only when the temperature is stablized, by using of calibrated standard thermometer and following standard calibration procedures.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for temperature calibration		AtC	Press the arrow key downward for 5 times
The equipment displays the actual display temperature		37.0	Press the key for less than 1 s to modify
The equipment displays the calibrated temperature		37.2	Use arrow keys for desired value
The equipment exits & displays the actual temp		37.2	Press the key for less than 1 s to accept the value and exit

The equipment stabilized at the set temperature shortly		37.0	Wait for automatic temperature control to achieve a set value

3.1.3.7. Set the startup time for timer, for example in 2:00 (hh:mm) hours.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for automatic startup time		AS	Press the arrow key downward for 6 times
The equipment displays the existing startup time		0.0	Press the key for less than 1 s to modify
The equipment displays the new startup time		2:00	Use arrow keys for desired value
The equipment exits & displays the actual temp		37.0	Press the key for less than 1 s to accept the value and exit

3.1.3.8. Set the shutdown time for timer, for example in 6:00 (hh:mm) hours.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for automatic shutdown time		ASd	Press the arrow key downward for 7 times
The equipment displays the existing shutdown time		0.0	Press the key for less than 1 s to modify
The equipment displays the new shutdown time		6:00	Use arrow keys for desired value
The equipment exits & displays the actual temp		37.0	Press the key for less than 1 s to accept the value and exit

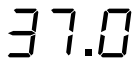
3.1.3.9. Set the compressor mode, for example H9 for hot-gas bypassing.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for compressor mode		CooL	Press the arrow key downward for 3 times

The equipment displays the existing compressor mode		on	Press the key for less than 1 s to modify, on means compressor cooling with counter heating
The equipment displays alternative compressor mode		HG	Use arrow keys to shift between different modes, HG means compressor cooling and hot-gas bypassing heating
The equipment displays alternative compressor mode		nF	Use arrow keys to shift between different modes, nF means ON/OFF operation of the compressor. In this case, OFF threshold for compressor off and ON threshold for compressor on need to be set at the same time.
The equipment displays alternative compressor mode		oFF	Use arrow keys to shift between different modes, oFF means no cooling by compressor
The equipment displays alternative compressor mode		HG	Press the key at desired compressor mode, for example hG, for less than 1 s to accept the setting and exit
The equipment exits & displays the actual temperature		37.0	

3.1.3.10. Set the restart mode after power failure. For long term uninterrupted operation, it is recommended to use Aon mode for automatic resuming.

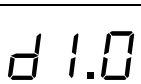
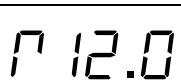
Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		HL	Press the key for more than 2 s to enter the menu
Scroll the menu for restart mode		Auto	Press the arrow key downward for 4 times
The equipment displays the existing restart mode		AoFF	Press the key for less than 1 s to modify, AoFF means standby mode
The equipment displays alternative restart mode		Aon	Use arrow keys to shift between different modes, Aon means resuming automatically after power failure

The equipment exits & displays the actual temp			Press the key at desired restart mode, for example Rün, for less than 1 s to accept the setting and exit

3.1.3.11. Set the temperature unit of Celsius or Fahenheit. Note the change of displayed unit for identification of the unit, c or F.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature			Press the key for more than 2 s to enter the menu
Scroll the menu for temperature unit			Press the arrow key downward for 8 times
The equipment displays the existing unit			Press the key for less than 1 s to modify, c means unit of Celsius
The equipment displays alternative unit			Use arrow keys to shift between different units, F means unit of Fahrenheit
The equipment exits & displays the actual temp with unit of Fahrenheit			Press the key at unit of F for less than 1 s to accept the setting and exit

3.1.3.12. Set the defrost mode, d means date between defrost cycles, n means temperature to terminate the defrost cycle.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature			Press the key for more than 2 s to enter the menu
Scroll the menu for defrost mode			Press the arrow key downward for 9 times
The equipment displays the existing date between defrost cycles			Press the key for less than 1 s to modify
The equipment displays the new date between defrost cycles			Use arrow keys for desired value. d 1.0 means defrost cycles of 24 h. The range of the setting is 0.0, 0.5, 1.0...7.0
The equipment displays the existing defrost ending temperature			Press the key to accept the change for d and for modification of the defrost ending temperature

Chapter 3 Controller descriptions and operation

			r
The equipment displays the new defrost ending temperature		r 15.0	Use arrow keys for desired value. The range of the setting is 12.0~20.0
The equipment exits & displays the actual temp		98.6	Press the key for less than 1 s to accept the setting and exit

3.1.3.13. Set the default value.

Equipment status	Key symbol	Display	Operation
Enter the menu to display high limit temperature		Ht	Press the key for more than 2 s to enter the menu
Scroll the menu for default setting		dEFt	Press the arrow key downward for 10 times
The equipment warns the mode of default by flashing		dEFt	Press the key for less than 1 s to do the default setting
The equipment displays the mode of default done		donE	Press the key for more than 3 s until donE is displayed
The equipment exits & resumes to standby		oFF	

3.2 Put into operation

1) Connect the power by inserting the power plug, or engage the circuit breaker of switch board.

2) Turn on power switch and the controller runs self-check to display: 88888, all LEDs on, software version number u6 02, AoFF (Aon will show up if Auto is set to Aon) settings for Ht、Lt. Refer to 3.4 for procedures about Aon and AoFF setting. The software version number may change with technical updates.

3) Set working temperature, refer to 3.1.3.1.

4) Set high limit temperature, refer to 3.1.3.3.

5) Set low limit temperature, refer to 3.1.3.4.

6) With display oFF and circulating fan off , press  for more than 2 s to initiate the circulating fan.

With delay of about 3 s, heating is enabled, and delay of about 3 min, the compressor is enabled.

If the actual temperature is lower than the setting, the heater tends to heat with longer ON duty and shorter OFF duty resulting in temperature rising. With the actual temperature closer to the setting, the heater tends to heat with shorter ON duty and longer OFF duty resulting in stable temperature. At the time the actual temperature equals to the setting, the ON and OFF duty cycle tends to be constant with minor changes, dependent on how stable the line voltage and heat load are.

Refrigerating system is intended to operate when working temperature close to or lower than ambient is desired. The temperature control is achieved by continuous operation of the compressor if CooL is set to H9, and by modulation of hot-gas bypassing heating, where a stepper valve closes or opens to the extent propotional to the flow of refrigerant vapor as calculated by PID algorithm. If the actual temperature is higher than the setting, the stepper valve tends to close with more cooling and less heating resulting in lower temperature. With the actual temperature closer to the setting, the stepper valve tends to open with more heating and less cooling resulting in stable temperature. At the time the actual temperature equals to the setting, the open degree of the stepper valve tends to be constant with minor operation, dependent on how stable the line voltage and heat load are.

For other compressor working mode, refer to 3.1.1 and 3.1.3.9.

7) To terminate the temperature control, press  for more than 2 s. The circulating fan stops, the compressor and the heater are disabled. The LEDs go off, and the display shows oFF.

Connect the power from behind the equipment. Plug in and remove the cable by directly holding the plug. No dragging of cable in any part. Protect the cable from being damaged by contacting with hot surface of the equipment or mouse etc!

Chapter 3 Controller descriptions and operation

	Regular check of the air tightness of the door gasket and the ventilator is necessary for efficient and safe operation of the equipment. Intervals of 3 months for normal use, or the first time powering up after repairing or standstill for long period, are recommended. Refer to 4.2 for detailed procedures.
	Keep clear of inlets of top plenum and outlets of back plenum for the circulating air. Excessive hoarding of specimen or blockage of the air circulating may cause frost accumulation on surface of the evaporator, localized temperature distribution and degraded performance!

3.3 Absolute temperature calibration, AtC

1) If the temperature display is deviated from the actual temperature as measured by standard thermometer, the display temperature needs to be calibrated by this function.
2) Set the equipment at temperature of 37.0 °C for calibration. Put a standard thermometer within the cabinet and the sensor in the center of the working space. Wait until temperature is stabilized. Read the temperature of the standard thermometer, for example, 37.2 °C.
3) Refer to 3.1.3.6 for calibration of the display.

	The temperature in the equipment must be kept in constant and the standard thermometer be kept in the center of the working space for at least 30 min, before performing the calibration. During heating up or cooling down, the temperature distribution is not even and the readings both from thermometer and the controller are not typical thus not appropriate for calibration.

3.4 Setting for restart mode after power failure, AutO

1) You may choose between power-on modes of standby and auto-restart after power failure for additional safety and uninterrupted operation. Refer to 3.1.3.10 for setting of restart mode after power failure, Aon and AoFF
2) For long term uninterrupted operation, it is recommended to use Aon mode for automatic resuming. In this case, the equipment will automatically resumes to the status before power being interrupted.
3) Sometimes, automatic resuming is not safe after power interruption. In this case, it is recommended to set the equipment to standby mode, or AoFF for restart mode. Then the

equipment will go in standby mode with no heating/cooling function after a power interruption.

3.5 Timer for automatic startup, AS

1) Refer to 3.1.2.7 for setting of automatic startup time, AS. The time range for AS is 00:00~99:59.

2) When the equipment is in standby mode, press  at the same time and then release to initiate timing.

3) The timer starts to count down. When the time of AS elapses, the circulation fan will start automatically to initiate constant temperature control. Heating, cooling and constant temperature control executed according to the difference between SEt value and actual temperature.

4) The equipment may be initiated immediately if  is operated regardless of the remaining AS time.

3.6 Timer for automatic shutdown, ASd

1) Refer to 3.1.2.8 for setting of automatic shutdown time, ASd. The time range for ASd is 00:00~99:59.

2) When the equipment is in operating mode, press  at the same time and then release to initiate timing.

3) The timer starts to count down. When the time of ASd elapses, the circulation fan and compressor will stop automatically to terminate constant temperature control.

4) The equipment may be terminated immediately if  is operated regardless of the remaining ASd time.

3.7 Setting of defrost mode, dEFr

1) For lower temperature control, the evaporator temperature has to be at least 10~15 °C lower than the working temperature, dependent on ambient temperature and humidity, heat load and water content of the specimen. At working temperature of 10 °C and lower, the evaporator temperature will be below zero. Frost and ice will build up over the

evaporator, thus degrading the cooling efficiency of the evaporator and air flow of the circulating. In worst case conditions, the evaporator will be damaged by expansion of the ice, and the working temperature will get loss of control. If the frost or ice were not removed properly, it is difficult to keep the working temperature at set point.

2) Defrost is intended to temporary terminate the operation of the compressor so that the temperature of the evaporator rises over 0 °C. Intervals between defrost cycles and temperature to terminate the defrost process are 2 parameters to determine an automatic defrost procedure. The longer the time between 2 defrost cycles, the more frost or ice will build up , and the longer it will take to get to the ending temperature, an indication of completed defrost, resulting in severer interruption of the working temperature. For this reason, appropriate defrost cycles and ending temperature of the defrost has to be evaluated on case-by-case basis to determine if the effect of defrost on working temperature and the application is acceptable and minimized.

3) For setting of defrost cycles and the ending temperature of the defrost process, refer to 3.1.3.12.

4) Defrost will take place automatically according to the setting, for example every 24 hours if d is set to 1, and terminate automatically if the temperature of the evaporator resumes to for example, 12 °C.

5) It takes about 30~50 min to execute one defrost cycle, dependent on the setting of the defrost, working temperature and ambient temperature. During the defrost process, the compressor and circulating fan are disabled, the temperature of the cabinet is monitored for termination of the defrost process.

3.8 Set to default, dEFt

1) This function may be used to recover data and functional parameters when system halts or any other abnormal situation occurs.

2) Refer to 3.1.2.13 to perform the default setting. All the data in the operator menu, except the Atc setting will be recover to their defaults. Atc value and the data in factory menu cannot be recovered. Once done, the data settings will be recovered to default values as follows:

   a) working temperature, SEt=25.0 °C;

b) high limit temperature, HE=65.0 °C;

c) low limit temperature, LE=-1.0 °C;

d) Additional heating, HERE=20%;

e) Compressor mode hot-gas bypassing, CooL=HG;

f) Thresholds for compressor mode, nF, H=0.5, L=-0.5;

g) Restart mode after power failure, standby mode, AuEo=AoFF;

h) Timer for automatic startup, AS=0.0;

i) Timer for automatic shutdown, ASd=0.0;

j) Unit of temperature, Celsius, cF=c

k) Automatic defrost, disabled, dEFr, d=0.0, n=15.0;

l) RS232, ID=1, Baudrate=9600;

m) Circulating fan, disabled, oFF

3) The following values are not recovered:

a) Absolute temperature calibration, AEc;

b) Maximum temperature for active cooling control, Acc=40

c) Temperature control PID value;

d) Offset of temperature linear calibration;

e) Full scale of temperature linear calibration.

3.9 Terminate equipment operation

1) Press  for more than 2 s. The circulating fan and the compressor are stopped and the display shows oFF .

2) Disconnect the power by turning off the power switch, removing the power plug, or disengaging the residual current circuit breaker (RCD) on the switch board.

Pull the operating temperature of the equipment as close as possible to the ambient before attempting to shut down the equipment.

Chapter 4 Maintenance

Chapter 4 Maintenance

4.1 General

The maintenance of the equipment may include:

- Regular maintenance (4.2)
- checking and replacing of the fuses (4.3)
- checking and cleaning of the condenser (4.4)
- checking and charging of refrigerant (4.5)
- Clear of sensor errors, Er01 and Er02 (4.6)
- Clear of temperature limit warnings, HE and LE (4.7)
- Clear of overheating alarm, ourh (4.8)
- Regular check and clear of over temperature alarm, StB (4.9)

4.2 Regular maintenance

Regular maintenance includes the following:

- Clean the interior and exterior of the equipment periodically to keep the equipment clean.
- Decontaminate cabinet interior and shelves on case-by-case bases if necessary.
- Check for air tightness of the door gasket and the ventilator. Put a light torch in the middle of the cabinet over the shelf. Close the door, and shield the observation window if equipped. Spy the gasket around the gap between the door and cabinet exterior for any gasket leakage.
- Check for air tightness of the ventilator. Rotate the cover of the ventilator for 360° to see if this is tight enough.
- Check intake of the condenser if there is any dust or foreign items collected. If yes, clear the dust or foreign items following steps of 4.3 and 4.4.
- Check if any obstacles in the condensate draining connection, and if yes, clear the connection.

Chapter 4 Maintenance

4

– Check fixing screws periodically, and if any loose, fix it.

⚠	Remove the plug from mains supply before cleaning. Use soft dry tissue to clean the interior of the equipment and avoid any splashing or washing! If any water or other materials fall into the equipment containing electric and/or electronic parts and components, disconnect the power supply immediately. Power on only after water is completely evaporated or removed.
⚠	Regular check of the air tightness of the door gasket is necessary for efficient and safe operation of the equipment. Intervals of 3 months for normal use, or the first time powering up after repairing or standstill for long period, are recommended.

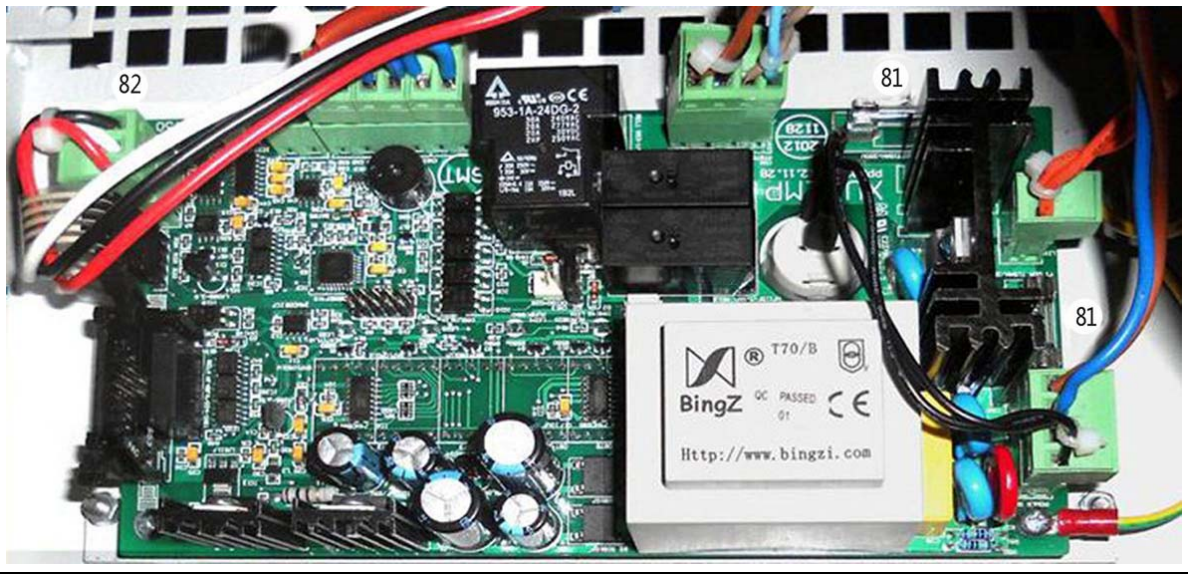
4.3 Checking and replacing of the fuses

The procedures for checking and replacement of the fuse are as follows:

– Make sure the mains plug has been removed.

– Remove the top cover and controller compartment and find the fuse on the PCBA.

– Check the fuse by inspection or measurement, and if not blown, replace and secure the fuse.



81 Fuses 82 Connector for Pt100

Fig 4 Main PCBA

- If blown, use a fuse with the same size and capacity as rated, replace and secure the fuse.
- Replace the controller compartment, the top cover and fasten the screws as were removed.

Do not disassemble or exchange assembly parts and electric circuits! Hazard of possible electric shock!

Except for replacing the fuse, there is no other part necessary for customer to disassemble or repair. If repairing is desired, contact with authorized engineer.

4.4 Checking and cleaning of the condenser

The procedures for checking and cleaning of the condenser as follows:

- According to the environment conditions for equipment installation, the checking and cleaning of the condenser is recommended to be made at 3~6 months intervals.
- Start the circulating fan and compressor.
- Set the operating temperature at 20 °C, while keeping the compressor running and door opened (to the extent that no door alarm is triggered). This is meant to keep the compressor working at full capacity.
- Use two pieces of A4 size paper and put them on both sides of the equipment where fresh-air inlets locate for checking intake of the fresh air. If the papers are hold by the intake air, it is indication of free air inlet.
- Remove the papers and keep the compressor running continuously for at least 20 min. Feel the air flow and temperature at the back of the equipment where exhaust air outlets locate. Strong air movement and warm or hot temperature mean free heat removal from the condenser.
- Whether reduced air intake or discharge, it is evidence of blocked condenser or stalled axial fan(s).
- Stop the equipment and remove the mains plug from the power socket. Remove the top cover of the machine compartment.
- Use vacuum cleaner and followed by compressed dried air to clean the condenser. Make sure not to have any residual dust left in any electric, electronic or refrigerating

parts and components.

- Replace the axial fan if any fault or damage and where necessary.
- Replace the top cover and fasten the screws as were removed.

4.5 Checking and charging of refrigerant

The procedures for checking and charging of the refrigerant as follows:

- Follow steps as for the checking and cleaning of condenser (4.4). Feel the air flow and temperature at the back of the equipment where exhaust air outlets locate. Strong air movement but mild or cold temperature mean possible leakage of the refrigerant.
- Stop the equipment and remove the mains plug from the power socket. Remove the top cover of the machine compartment.
- Use a compound pressure gauge or equivalent, with hosing for charging of refrigerant and connection to the compressor. Connect the hosing of low pressure to the suction side of the compressor, and check for pressure.

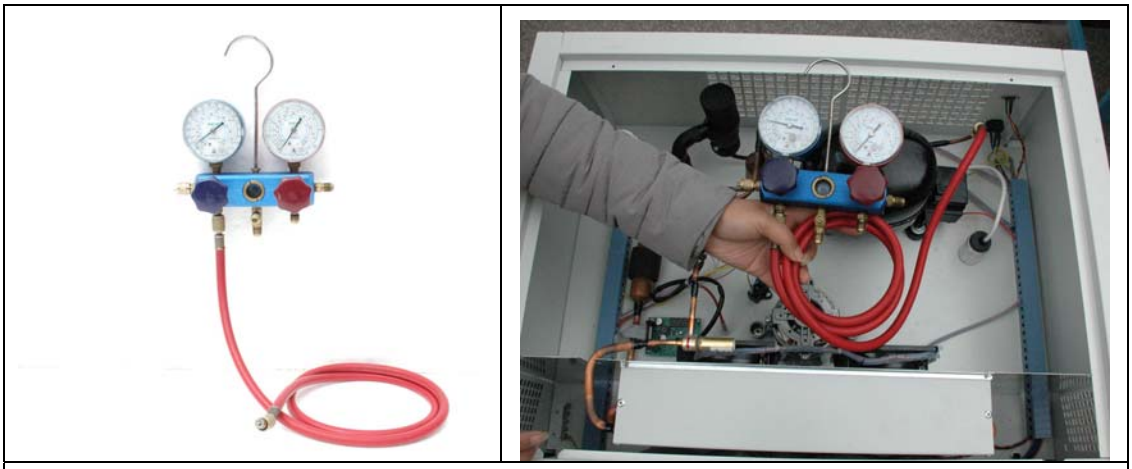


Fig 4 Checking and charging of the refrigerant

- If suction pressure during deep cooling is lower than rated, this is indication of serious leakage refrigerating system, usually meaning a cracked joint or damaged connection or, blockage of the capillary tube or filter drier. Test the refrigerating system for leakage or blockage location by using of Nitrogen:

  ✓ Connect the charging hosing to Nitrogen source of 99.99% purity to a pressure of 10 bar.

- ✓ Keep the pressure for at least 2 h and record the pressure change during the period. Note the effect of ambient temperature on pressure fluctuation.
- ✓ Spy the leakage source by using of soap water. The leakage usually happens at joint of brazing, but sometimes seal of a schrader valve or refrigerating component.
- ✓ Braze the joint where leakage occurred or replace the leakage part and component. Evacuate the system for at least 2 h. Use the same refrigerant, quantity and type, as indicated in the name plate.

– If pressure of refrigerant is no less than atmosphere, the higher the pressure, the less the extent of potential leakage. Flush the hosing and compound gauge by internal residual refrigerant. Charge the same refrigerant to a pressure resulting in rated cooling capacity.

– For locating of blockage of the system, the high and low pressure side have to be separated.

Use refrigerant only as indentified on the nameplate of the equipment! Mixed or over charging of the refrigerant may degrade performance or result in over pressure of the refrigerating system!

Slow cooling down doesn't mean failure of the cooling system. There are reasons and causes that may reduce cooling down speed and minimum temperature, for example:

1. Leakage of the door gasket;
2. Reduced or blocked air movement within the equipment because of improper hoarding or heat dissipation of the specimen;
3. High ambient or poor air ventilating around the equipment;
4. Failure of the controller leading to abnormal heating or hot-gas bypassing.

4.6 Clear of sensor errors, Er01 and Er02

Er01 and Er02 are indications for short-circuit and open-circuit of the temperature sensor PT100. When the equipment displays Er01 or Er02, check the connections CN8 for Pt100 where necessary.

For inspection, remove the top cover and controller compartment. Check the wirings connected to the terminals CN 8 of the main PCBA, and make sure no short-circuit or open-circuit occurs. If necessary, a multimeter may be used for the resistance of the

Pt100. The resistance of Pt100 is 100 Ω@0°C and +0.385 Ω/°C. At 26 °C ambient, the resistance of the sensor is about 110 Ω.

In most cases, loose wiring and terminating rather than open-circuit of the Pt100 sensor could trigger an error and alarm. Once fixed, such alarms will disappear when switching on the power supply again.

4.7 Clear of temperature limit warnings, HE and LE

HE and LE are warnings against temperature overshooting beyond limits of HE and LE setting.

Either warning can be cleared by manual operation of the  key, or will disappear automatically if the temperature comes within the limit setting. The warning is triggered only if the temperature is stabilized at the set point and later deviated from the setting. This is usually resulted from door operation, loading of specimen with higher or lower temperatures. The proper setting of the limits is highly advised so that no HE or LE is triggered during normal use.

4.8 Clear of overheating alarm, oUrH

oUrH is alarm for overheating of the cabinet over 80°C . Disconnect the power switch and leave the door open for some time until the temperature of the cabinet drops close to the ambient. Set the temperature to 20 °C , and start the circulating fan and compressor again. oUrH alarm will disappear automatically once the actual temperature drops to below 60 °C.

Check if LED for heating is in accordance with the temperature difference of the setting and the display. Make sure no heating up possible with LED for heater off. Wait until cabinet is stabilized at setting temperature of 20 °C before entry of the expected temperature would be made. Otherwise, reset the controller by dEFE setting. If not recovered, then fault of the main PCBA is possible and replacement is necessary.

4.9 Regular check and clear of over temperature alarm, StB

Regular check of the StB (cabinet Klixon) for protection against overheating of the cabinet is required for safe operation. Intervals of six months for normal use, or the first time powering up after repairing or standstill for long period, are recommended for regular check of the functionality. Check the StB as follows:

– Set the temperature of the equipment at the highest temperature, start up the

equipment with full power heating to 60 °C;

- Use a tool to disable the operation of the circulating fan. The air circulation is at the fault and the temperature around the heater within the top plenum becomes high. Caution: risk of overheating!
- The Klixon (09) will be triggered in about 200~300 s, if functional, with 5Eb displayed, beeping and  flashing of the controller; If the Klixon is not triggered in 360 s, stop the testing and troubleshoot for reason.
- Recover the circulating fan and wait until the temperature within the top plenum goes down. Reboot the controller by switch it off and on.
- Check the motor Klixon the similar way to the inspection of the cabinet Klixon. Either of the Klixon activation will trigger a 5Eb alarm. Inspection for the actual failure once 5Eb is triggered.

Chapter 5 Equipment overview and specifications

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Chapter 5 Equipment overview and specifications

5.1 Equipment overview

- ✓ Patented stepper valve hot gas bypassing and PID temperature control guarantee precise temperature regulation over the range for stability up to ±0.2 °C, as well as for accurate control of the cooling capacity which significantly improves the efficiency of the refrigeration system
- ✓ Optimized for continuous operation at +37 °C, +25 °C and +4 °C at 20 °C ambient, perfect for incubation at +15~+37 °C
- ✓ Silent long shaft circulating fan and the unique design of air circulation provide uniform air movement, improved temperature distribution, minimize the effect of localized temperature changes and protect seeding, seeds, insects or small animal from being blown
- ✓ Equipped with name brand compressor, SUS plate-type evaporator and environment friendly refrigerant of R134a for cooling. Reliable and efficient operation is guaranteed
- ✓ Safety features include independent cabinet over temperature protection, motor overheating protection, maximum and minimum temperature cutout and alarm
- ✓ Choose between power-on modes of standby and auto-restart after power failure for additional safety and uninterrupted operation
- ✓ Automatic defrosting for long term, lower temperature uninterrupted operation
- ✓ Coated cabinet interior and adjustable shelves of stainless steel make the daily clean easy for corrosive-resistant long life operation and, for flexible space and heights
- ✓ Absolute temperature calibration (ATC)
- ✓ Standard RS232 interface for data acquisition and remote monitoring and control of the equipment. Communication protocol is available but no software is provided
- ✓ Accessories for shelves with clips, fuse and mains plug for different countries

Chapter 5 Equipment overview and specifications

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5.2 Technical data and specifications

Models		RI-150CN	RI-250CN
Chamber volume	L / cu ft	150 / 5.30	250 / 8.8
Temperature range	°C	+4 ~ +60	
Heat up / cool down time from ambient of 22°C	min	to 4°C: ca.35 to 37°C: ca.35 to 60°C: ca.40	to 4°C: ca.70 to 37°C: ca.40 to 60°C: ca.70
Recovery time at 60°C/25°C (door opening 30 s, mid of workspace to DIN12880)	min	<15	<25
Temperature stability (mid of work space to DIN12880)	±K	at 20°C ≤ ±0.3 at 37°C ≤ ±0,3 at 60°C ≤ ±0,7	
Temperature uniformity (Ambient temperature of 22 °C ±3 °C, to DIN 12880)	±K	at 20°C ≤ ±0.8 at 37°C ≤ ±0,7 at 60°C ≤ ±1,7	20°C ≤ ±0.8 37°C ≤ ±1,0 60°C ≤ ±2.2
Interior dimension W x D x H	mm / in	550×450×615 / 21.65 × 17.72 × 24.21	550×450×1015 / 21.65 × 17.72 × 39.96
External dimension W x D x H*	mm / in	652 × 605 × 1050* / 25.67 × 23.81 × 41.34*	652 × 605 × 1450* / 25.67 × 23.81 × 57.09*
Footprint	m^2 / ft^2	0.39 / 4.2	0.39 / 4.2
Number of shelves Supplied / maximum	units	2 / 4	3 / 5
Number of shelf positions	positions	34	66
Shelf size (W x D)	mm / in	545 x 445 / 21.46 x 17.52	
Loading capacity per shelf**	kg /lbs	15 / 33	15 / 33
Loading capacity of unit**	kg /lbs	60 / 132	75 / 165
Maximum shelf loading area	%	30 (for optimal airflow)	
Weight of unit	kg / lbs	95 / 209	115 / 254
Shipping weight	kg / lbs	115 / 254	135 / 298
Power line voltage (±10%) / frequency	V / Hz	230 / 50	
Power rating measured at ambient temperature of 32 °C / 90 °F	W	900	
Maximum current	A	3.9	

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Maximum BTU output	W	500	550
Refrigerant R134a	kg	0.32	0.35
Access port diameter	mm / in	50 / 1.97	
Plug type		CN	CN
Interior material		SUS 430 stainless steel coated white	
Housing material		Coated SPCC sheet metal	
Safety features and functions		Temperature sensor open/short cut off and alarm Independent STB cutoff and warning High-temperature cut off and low temperature alarm Door-open alarm Standby or auto-restart after power failure	
Installation conditions		Indoor use Altitude: 2,000 meters Ambient Temperature Range: 16°C to 32°C (class N) Humidity: 75% RH at or below 32°C Mains supply fluctuations: Rated Voltage ±10% Installation category: II *** Pollution Degree: 2 **** Class of Equipment: I	

* Including feet / casters

** Maximum shelf and unit capacity is based on mechanical capabilities. Note that with heavy load the heat-up/cool-down time of the unit will increase, and temperature performance might be impacted. A load below 30% of max. capacity, with even distribution in the chamber will provide optimal conditions.

*** Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 250V for a 230V supply and 150V for a 120V supply.

**** Pollution degree describes the amount of conductive pollution present in the operating environment. Pollution degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

Specifications are subject to change without notice!