User Manual

Product Name:	Humidity Test Chamber
Model Number:	C-H150-SP
Serial Number:	
Internal capacity:	150L
Interior dimension:	D*W*H 500*500*600mm
External dimension:	D*W*H 1580 x 950 x 1745 (mm)
Humidity range:	20 to 98 % RH
Power supply:	AC230V 50Hz, 7.5kW, 30A, 1ph + E

Contents

PREFACE

Liability

CVMS Climatic Ltd assumes NO responsibility whatsoever for accidents or equipment malfunctions arising from the failure to observe the instructions contained herein. Do not carry out any operation or handle the equipment in any way or form that is not described in this User Manual or which is herein specifically prohibited. Careless use may result in damage to the equipment or harm to the user.

Attention

Please retain this user manual for future reference. CVMS Climatic (or the equipment supplier) will replace this manual on request if any pages are found to be missing or out of sequence. (Replacements may be subject to billing). This manual has been written for users of the ozone test chamber and particularly for technicians. Please read it thoroughly to obtain the optimum performance from this test chamber.

This user manual consists from 4 parts as below:

- Preface: Explains the contents of the user manual and the symbols used.
- Installation manual: Explains how to install the chamber. Please be sure to read the instructions on first installation and whenever the chamber is moved or relocated.
- Operation manual: Explains the working theory of the test chamber, operation method, and how to troubleshoot malfunctions. Please read this section thoroughly before using the chamber for the first time. Even the user has experience of operating this type of chamber, please read chapter 1 of the Operation manual headed ‘Warning’ prior to operating the chamber.
- Reference:
  1. TEMI2500 Temperature Controller User Manual
  2. Refrigeration Schematic
  3. Electrical Schematic

Safety Symbols

The following safety symbols are used throughout this manual.

 **DANGER**	This mark means serious or dangerous consequences may arise, with the possibility of death or serious injury to the user. It prohibited to use the equipment in this condition.
 **WARNING**	This mark means there is a possibility of damage to the equipment or test specimens therein.
 **CAUTION**	This mark means the equipment will not be operating in optimum conditions. This can lead to a shorter operating lifetime for the equipment.

Read this manual carefully before using the equipment.
Familiarize yourself with all safety precautions before using the equipment.
Keep this manual handy for future reference.

Installation Manual

READ AND REFER TO THIS SECTION BEFORE USING THE EQUIPMENT

Chapter 1: Inspection of accessories and optional parts

Please carefully check the accessories and spare parts that have been supplied with the chamber and report any shortages or damage as soon as possible. Refer to “Accessories list” below for a list of every part or accessory that should have been supplied with the equipment.

1.1 Accessories list

Name or Part Number	Description	Quantity	Check if included
User manual	To explain the correct use of the equipment	1 set	
Shelves	To hold / support test specimen inside the chamber	2	

Chapter 2: Installation

This chapter explains the installation site and space requirements, electric power supply, water supply, drainage requirements.

2.1 Installation site conditions

Install this test chamber in a place which satisfied the following conditions

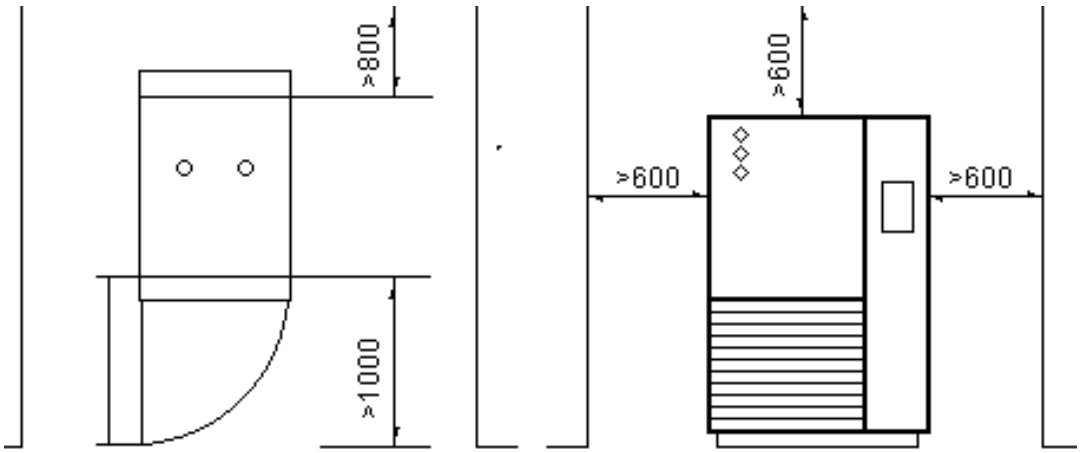
2.1.1 Ambient conditions

Ambient temperature range:	+5 … 35^{o}C
Humidity range:	≤85%RH
Atmospheric pressure:	86 … 106KPa
Air quality:	Dust-free atmosphere without corrosive vapour.
Floor requirements:	Flat, level floor with good ventilation

2.1.2 Space requirements

For the purpose of good ventilation, operation and ongoing maintenance of the equipment, please install the test chamber according to the following requirements:

- Space of at least 600mm from 4 sides of test chamber.
- Sufficient access space to ensure the door can be opened.
- Please do not place any objects at the front of the chamber below the door (where refrigeration systems are installed) as the hot air may cause damage or result in the chamber overheating. For the same reasons avoid blocking any of the chamber's ventilation grilles.



2.2 Power supply

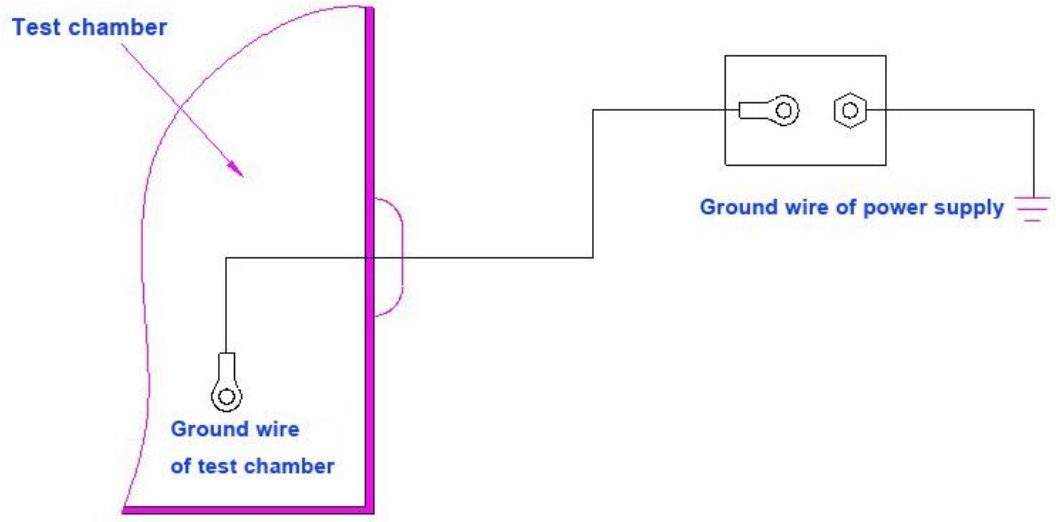
Check that the main power supply service (the diameters of electrical wire, power switch etc.) complies with the following requirements:

- Frequency and fluctuation: 50Hz ±0.5Hz
- Voltage and fluctuation: AC230V ±10%
- Power: 7.5kW
- Current: 30A

CAUTION	During test chamber operation, if the power supply exceeds the limit by more than 10%, the chamber will alarm.

2.2.1 Earth (ground) wire

Connect the test chamber to earth (ground) to avoid electric shock and reduce the noise caused by improper operation. There is an earth (ground) terminal on the power supply plug of test chamber as shown in Picture 1 below:



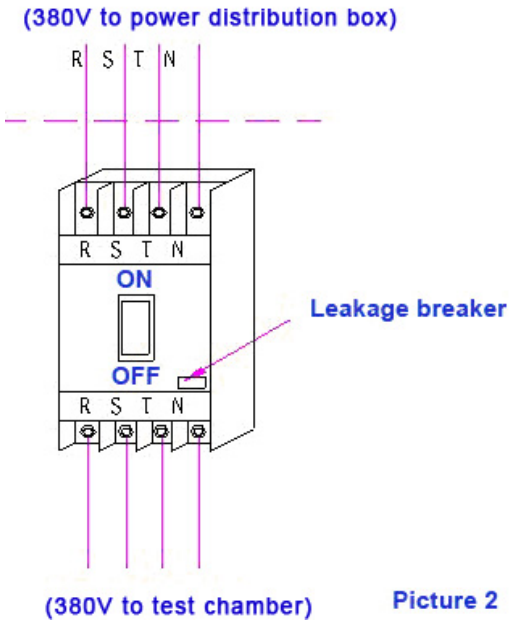
Picture 1

CAUTION	Test chamber must be connected to earth (ground) prior to operating. Unless the equipment is grounded, the leakage breaker will not trip in the event of current leakage, possibly resulting in electric shock. Do not connect the earth (ground) wire to gas pipelines. Do not share the earth (ground) wire with other equipment.

CAUTION	If a grounding terminal is not available, ensure a max. 100Ωresistance against earth (ground) or according to local building codes and regulations.

2.2.3 Connection of electric cable (3-phase)

Connect the mail power supply cable of test chamber to the electrical outlet as Picture 2 showed:



Picture 2

DANGER

Electric wire terminal must be secured by a screw, otherwise there is a risk of the wire becoming loose and increasing contact resistance. This can cause overheating and the risk of catching fire.

DANGER

1, Do not apply 'POWER ON' to the test chamber under the following circumstances:

- When the Power Distribution Box cover is open.
- When fault-finding, maintaining and repairing the test chamber.

2, When the user is connecting a test specimen power supply cable to Power Distribution Cabinet of the test chamber.

Operation Manual

READ AND REFER TO THIS SECTION BEFORE USING THE EQUIPMENT

Chapter 1: Warning

This chapter explains the warnings and precautions that must be taken before using the test chamber. In order to prevent harm to users, anyone else, specimens, please read this chapter carefully before using the test chamber.

1.1 List of harmful substances

DANGER

DO NOT introduce the following explosives, combustibles or substances which contain them into the equipment. Moreover, keep these substances away from the equipment and the immediate area. When exposed to excessive heat, these substances may cause fires and/or explosions.

Explosive Substances

- Nitroglycol, nitroglycerine, nitrocellulose, and other explosive ester nitrates.
- Trinitro-benzene, trinitrotoluene, picric acid, and other explosive nitro compounds.
- Peracetic acid, methyl ethyl ketone peroxides, benzoyl peroxide, and other organic peroxides.

Inflammable Substances

Combustible Substances

- Metal lithium, metal potassium, metal sodium, yellow phosphor, phosphor sulfide, red phosphor, celluloids, calcium carbonate (also called carbide), calcium phosphate, magnesium powder, aluminum powder, metal powders other than magnesium powder and aluminum powder, hydrosulfite and other organic peroxides.

Oxides

- Potassium chlorate, sodium chlorate, ammonium chlorate, and other chlorates.
- Potassium perchlorate, sodium perchlorate, ammonium- perchlorate, and other perchlorates.
- Potassium peroxide, sodium peroxide, barium peroxide, and other inorganic peroxides.
- Potassium nitrate, sodium nitrate, ammonium nitrate, and other nitrates.

Ignitable Substances

Ignitable Substances

- Ethyl ether, gasoline, acetaldehyde, propylene oxide, carbon disulfide and other substances with an ignition point of -30°C (-22°F).
- Normal hexane, ethylene oxide, acetone, benzene, methyl ethyl ketone and other substances with an ignition point above -30°C (-22°F) and below 0°C (32°F).
- Methanol, ethanol, xylene, pentyl acetate amylacetate and other substances with an ignition point above 0°C (32°F) and below 30°C (85°F).
- Kerosene, light oil, turpentine oil, isopentyl alcohol (also called isoamyl alcohol), acetic acid and other substances with an ignition point above

Combustible Gases

- Hydrogen, acetylene, ethylene, methane, ethane, propane, butane, and other combustible substances that are in a gaseous state at a temperature of 15°C (60°F) and at a pressure of 1 atmosphere.

CAUTION

- **DO NOT introduce corrosive substances into the equipment.**

Specimens which generate substances that corrode stainless steel, copper or silicon rubber can drastically shorten service-life of internal parts, including the refrigeration system and the chamber insulation.

Corrosive substances include but are not limited to chlorine, chlorides and acids. Even if apparently harmless at ambient temperature, these substances can accelerate the corrosion of circuit boards and other parts when the equipment is run at high temperature.

1.2 Precautions

DANGER

- **Ground the equipment WITHOUT FAIL.**

ELECTRIC SHOCK! Unless the equipment is grounded, the leakage breaker will not trip in the event of current leaks, possibly resulting in electric shock.

- **BEFORE using the equipment, test the leakage breaker and make sure it is working properly.**

ELECTRIC SHOCK! If the breaker is not working properly, shut OFF the primary power supply and contact the manufacturer. Using the equipment in anything but good working condition could result in electric shock.

- **Use only the specimen power supply control terminal (option) to apply voltage to specimens.**

Specimens generate heat as they are charged. The specimen power supply control terminals are interlocked with the cabinet control circuit, so electrical power to specimens is turned OFF when the test chamber is not running. Using other methods to apply electrical power to test specimens leaves the specimens 'live' in the event of chamber malfunction. This can drive up the temperature inside the chamber which can cause damage to test specimens and, in the worse cases, result in fire.

- **Do not use or leave the equipment outside.**

Not only can extreme outdoor environments adversely affect performance and functioning of the equipment, but also electrical parts exposed to moisture or water can lead to short-circuit, fire, electric shock and equipment breakdown.

- **Do not disassemble, remodel or service the equipment.**

Unauthorized action can lead to malfunction, fire, electric shock, personal injury and breakdown. Only trained professionals should be allowed to provide service. If in doubt, contact the manufacturer or equipment supplier.

CAUTION

- **HOT AIR BLAST WHEN OPENING THE DOOR! Use caution when opening the door during and shortly after chamber operation at high temperature.**

HOT air can be blown from inside the chamber when the door is opened.

- **HOT SURFACES ON THE INSIDE! During and shortly after operation above 55°C, the cabinet will be HOT on the inside (specimens, shelves, door gasket, test area walls and all internal surfaces).**

Direct contact may result in burns. Wear heat resistant gloves.

- **DO NOT introduce electrically conductive test specimens which might easily be disturbed by air currents inside the chamber.**

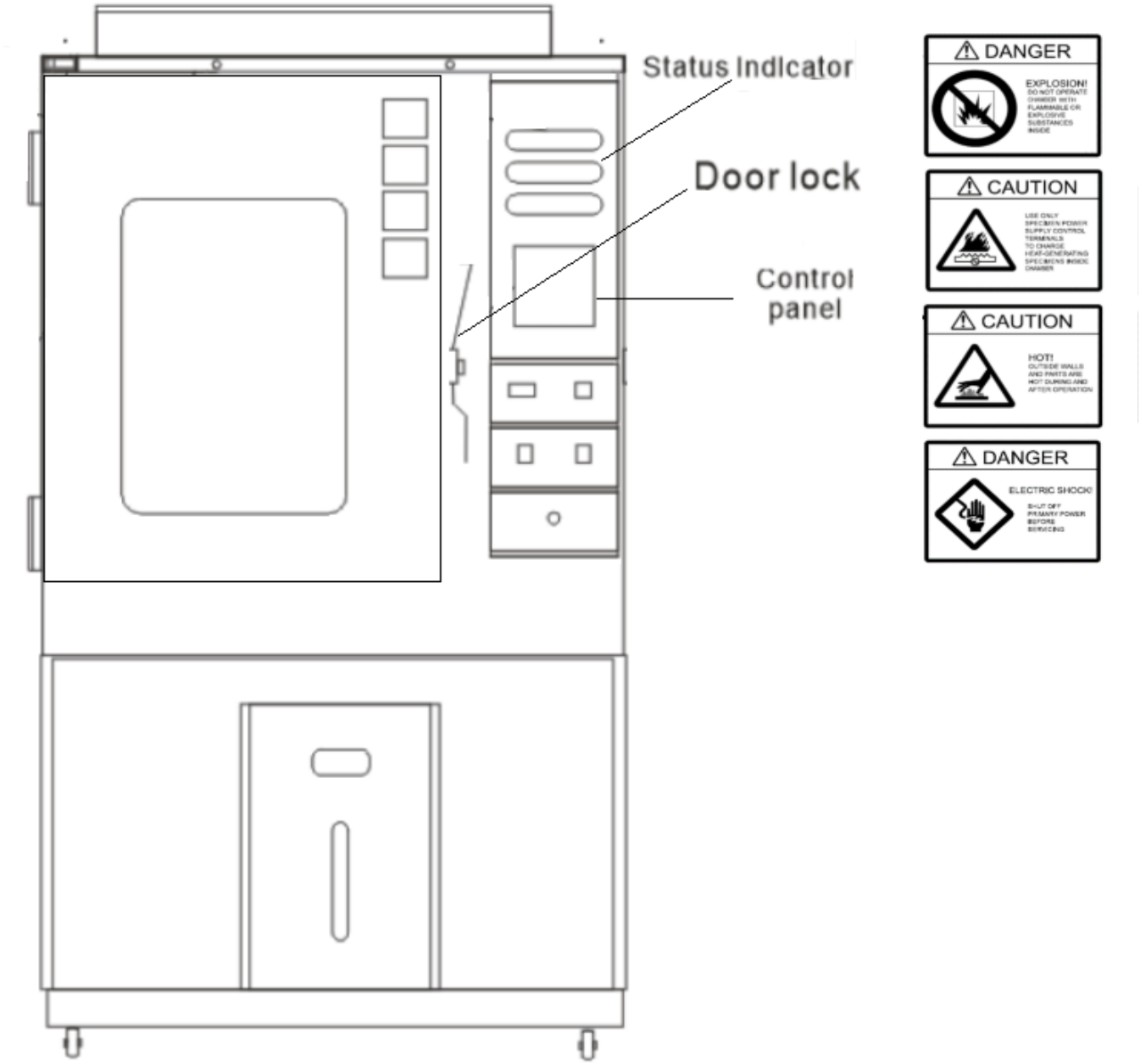
Specimens of this sort can cause current leaks or short circuits in the heaters if they infiltrate the air handling compartment inside the chamber.

- **Do not stack chambers on top of one another.**
- **Do not place objects on top of the chamber.**

Note:

- Blot up or otherwise remove any moisture from wet specimens before introducing them into the chamber.
- Try to spread the load by distributing specimens across the specimen shelves rather than concentrating them in any one place.

1.2 Warning labels



For Additional Labels

If labels are damaged, lost or become otherwise illegible, contact the manufacturer or chamber supplier for replacements. (Replacements may be subject to billing.)

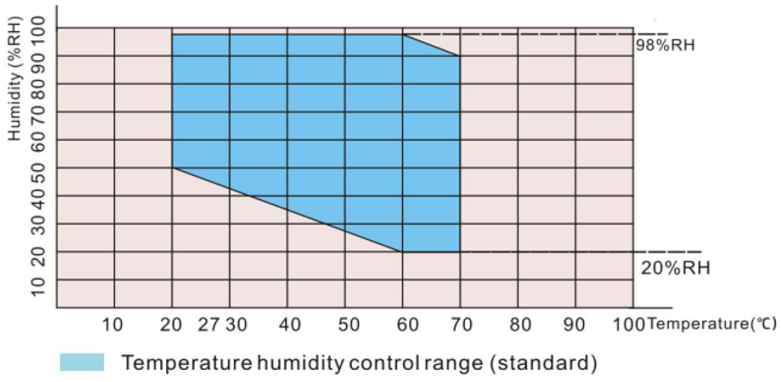
Chapter 2: Functions and operations

This test chamber can perform many operations and provide a range of comprehensive tests to the customer's specimen. The chamber operator can either set a manual temperature set point or programme a complex set of profiles according to the required test regime. Please refer to the controller manual for full details and explanation. All the chamber's functions are managed by the controller

2.1 Technical data

Model: C-H150-SP

1	Internal chamber capacity	150L
2	Internal dimension	D*W*H 500*500*600mm
3	External dimension	D*W*H 1580*950*1745mm
4	Temperature range	-20℃ … +180℃
5	Ramp rate	1℃/min (No load)
6	Heating time	-20℃ to +180℃ within 60min
7	Cooling time	+20℃ to -40℃ within 60min 8
	Power supply	AC230V, 1-phase, 50Hz
9	Power consumption	7.5kW, 30mps
10	Humidity range	20% ~ 98% RH
11	Temperature humidity control range	



2.2 Structure

The chamber interior (working space) is manufactured from Stainless Steel SUS304 and mounted on thermal breaks and insulated from outer cabinet by hard urethane foam. The chamber cabinet (exterior) is made from box section steel and painted steel panels (RAL9018). Access to the working space is by way of a full-opening hinged door (RAL9003) with a heated viewing window and internal illumination. Four specially manufactured flanges (2 on the left and 2 on the right) are fitted to the side walls of the chamber to allow for bespoke connection

The chamber comprises the following main sections:

- Test Area (working space)
- Air handling (evaporator, heaters and fans) located behind the Test Area
- Electrical Cabinet
- Refrigeration System (Compressor, condenser, expansion devices)

*Supplied as standard. Check 'Accessories List' (page 6) for actual quantities supplied.

Working theory of test chamber

The chamber controller manages all aspects of the chamber operation, including heating, cooling, the rates of change and length of dwells. The controller can be operated in 'manual mode', where the operator selects a target temperature, the chamber ramps to that temperature and controls at that point until another set point is entered. Alternatively, the chamber can operate in 'programme mode' where a temperature profile can be entered and run automatically. The controller also monitors the chamber's safety and alarm systems and notifies the operator in the event of a problem or malfunction.

Heating of the Test Area is provided by electrical elements and cooling by an integral refrigeration system. The heaters and refrigeration evaporator are built into the air handling section where centrifugal fans circulate the treated air throughout the Test Area. The air circulation is by way of a forced cross-ventilated method to ensure the uniformity of temperature throughout the Test Area; the supply air enters the Test Area at the top, passing over the temperature control sensor and return air is drawn from the bottom.

2.3 Theory of refrigerating system:

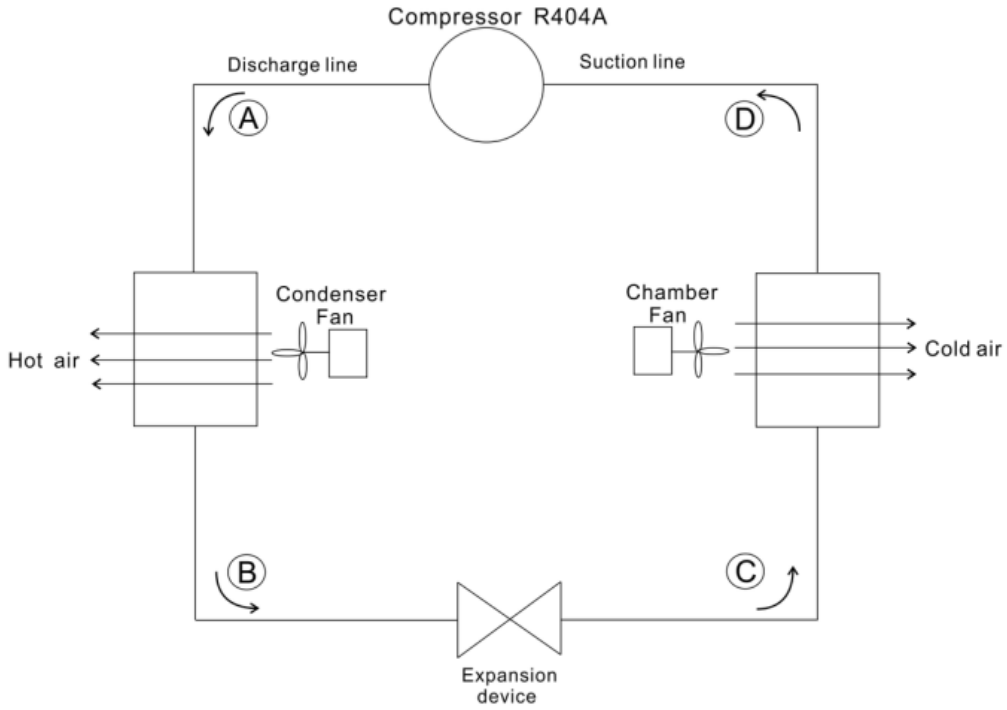
SINGLE STAGE REFRIGERATION CYCLE

The cooling system uses a circulating refrigerant which absorbs and removes heat from the space to be cooled (the chamber) and rejects that heat outside. The system comprises four components: a compressor a condenser, an expansion (or throttling) device, and an evaporator. The refrigerant enters the compressor as a saturated vapour and is compressed to a higher pressure, which results in a higher temperature. This superheated vapor is at a temperature and pressure at which it can be condensed with cooling air (or in some cases cooling water). The hot vapor passes through a condenser where it is cooled and condensed into a liquid; the rejected heat is carried away by the air (or water).

The liquid refrigerant is then passed through an expansion valve where it undergoes an immediate reduction in pressure resulting in evaporation of part of the liquid refrigerant. This causes the temperature of the liquid and vapor refrigerant mixture to become much colder than the temperature of the enclosed space (the chamber working area) which is to be cooled.

The cold mixture passes through the evaporator. A fan circulates the warmer air in the chamber across the coil carrying the cold refrigerant liquid and vapor mixture. That warm air causes evaporation of the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled thus lowering the temperature of the enclosed space to the required temperature. The evaporator is where the circulating refrigerant absorbs and removes heat which is then rejected in the condenser and transferred elsewhere by the air (or water) in the condenser. The refrigerant vapor from the evaporator is once again a saturated vapor which is returned to the compressor where the refrigeration cycle is completed.

This system works well for target temperatures down to approximately -40°C.



A Hot high pressure vapour
B Cool high pressure liquid
C Cold low pressure liquid
D Cold low pressure vapour

2.4 Working theory of Electrical system

2.4.1 Control system

The controller used is a Samwontech TEMI2500. The main features and specifications are below:

1. Detachable display and control unit

2. Heating and Cooling Control Support
3. Touch screen operator interface
4. High quality colour display
5. 18bit A / D converter with high precision control
6. 80 programs and 120 programme segments available to operating various programs
7. DI 16 points, DO 12 + 20 (option) points built in
8. Synchronous / asynchronous operation modes
9. SYNC as a master controller for driving
10. Users screen configuration support
11. SD memory card support
12. Laptop / PC interface software provided free of charge
13. VESA Mounting Support
14. English, Chinese, Korean language support

For detailed operating instructions please refer to the attachment: TEMI2500 Temperature controller user manual

2.5 Operation of test chamber

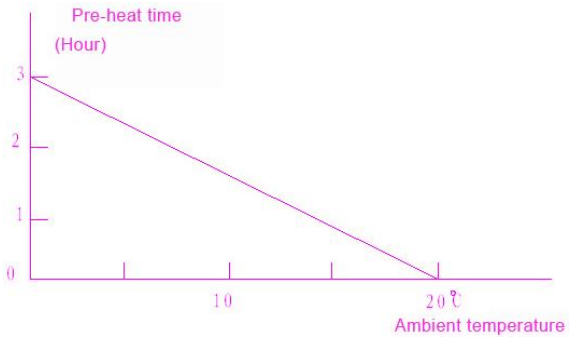
Working theory, method of operation and situations to be aware of during chamber operation.

2.5.1 Operating theory

Pre-heat of refrigeration system

When the ambient temperature is lower than 20°C, to prevent potential damage to the refrigeration system, it is necessary to pre-heat the refrigerator before using the chamber. This is not necessary if the ambient temperature is at or above 20°C. The procedure for pre-heating the refrigerator is set out below:

1. Power on the external power supply for test chamber at the mains isolator.
2. Power on the test chamber but do not set or run any programs
3. After the chamber is powered on the oil in the refrigeration system will start to warm up. Use the graph below to determine the correct time to warm-up the refrigerator.



Pre-heating the refrigeration system will also prevent a condition called ‘oil hammer’. This is a hammering noise that comes from the compressor and it can happen when the chamber has not been used for some time and the ambient temperature is low. It is caused by refrigerant mixing

with lubrication oil and causing 'bubbles' or 'foam' which when entering the compressor can lead to oil hammer. To avoid this and to prevent possible damage to the compressor, pre-heat the refrigerator, before running the chamber, using the above procedure.

Connecting the test specimen to a power supply terminal

Any cables or wires within the test area should hang loosely under the test specimen. Otherwise it is possible that any dew forming could drop onto the specimen leading to possible damage or short-circuit of the test item.

Once external connections to the test specimen have been made make sure the port hole is sealed effectively using the plug provided. If the test port hole is not seal properly, ambient air outside of test area will be drawn into test area, affecting the temperature within test area. It is also possible that moist ambient air from outside the chamber can condense and freeze on the evaporator and reduce the efficiency of the cooling system over time. If large diameter cables and wires are used and they are too thick to plug effectively then holes or slots can be cut into the rubber plug.

Please be aware that different types of cable have different temperature tolerances so make sure the appropriate materials are used. Some different kinds of cable according to their different temperature tolerance are listed below:

Cable insulation type and temperature tolerance

Cable type	Max temperature (^{o}C)
Polyethylene (PE) Polypropylene (PP)	80
Polyvinyl Chloride (PVC)	105
Styrene Butadiene Rubber (SBR)	90
Polytetrafluoroethylene (PTFE)	204
Silicone	180
Fibreglass	482

Procedure for starting the test chamber

1. Power on the external power supply to the chamber at the mains isolator.
2. Load the test specimen and make any connections (as required), close the chamber door. When placing the test specimen(s) ensure that they are evenly distributed throughout the chamber, using the shelves supplied where appropriate. Do not place items close to the wall and ensure that vents for air supply and return are not blocked or impeded. This is extremely important as restricted airflow will affect temperature uniformity inside the test area and this can adversely affect test results. Do not overload the chamber; for best practice, maintain a load volume: chamber volume ratio of at least 1:4

3. Press “Power On” on the chamber control panel.
4. Set the test temperature set point, press “Start” to run the chamber

Procedures for stopping the test chamber

1. If the program is not finished, press “STOP” the button on controller TEMI2500, the test chamber will stop running. If the test temperature is much lower than the ambient temperature, please heat the chamber temperature to the same as the ambient temperature before powering off the chamber and opening the door.
2. If the temperature inside the chamber is very low (following a low temperature set point or a long dwell at low temperature) and the internal chamber structure is extremely cold, then it is best practice to power on the test chamber and heat it to 70-80^{o}C followed by a dwell for at least 30 minutes. The door can then be carefully opened to discharge the heat and the chamber powered off.
3. After tests are completed and the chamber has stopped running, cut off power supply at the mains isolator.
4. If the test chamber is not to be used for a long time carry out the following procedure:
   Dry the test area by running the chamber at 70-80^{o}C for 60 minutes.
   Power off the test chamber, and turn off the power supply at the mains isolator.

Control panel:

Name	Functions	Included: Yes/No
TEMI2500 Programmable controller	Input temperature set point or edit and run program for temperature profiles. Diagnostics and alarm explanation in the event of a problem or malfunction. For details please refer to the controller manual.	Yes
Over-heat protector for specimen	To protect the test item, the chamber operator can set (limit) the maximum temperature within test area. If the chamber temperature exceeds this set temperature, the controller will stop running and an alarm will sound. Normally, the over-heat protector temperature should be set at 10^{o}C above the maximum test temperature that will either be set manually or is in the test profile. Check this over-heat temperature before commencing each test.	Yes
Illumination lamps switch	Control the lamps which illuminate the test area. It is advisable only to switch on the lamp when viewing the test area is required and then switch them off afterwards.	Yes
Reset function	After an alarm sounds, investigate according to the displayed condition. After the problem or malfunction is corrected, the controller will reset automatically.	Yes
Alarm	When a problem or malfunction occurs, the red alarm indicator will light and an alarm will sound.	Yes

Remark: Please refer to the detailed description for each function in the controller user manual.

Chapter 3: Checks and Maintenance

This chapter explains equipment checks and maintenance. To keep the chamber in good working condition, perform checks and maintenance periodically. We recommend a preventative maintenance regime is taken up with an approved and qualified contractor.

3.1 Check list

Check item	**When to check**
Main power switch (leakage breaker) trip test	Once monthly
Over-temperature protector trip test	Before long test runs Before unmanned tests

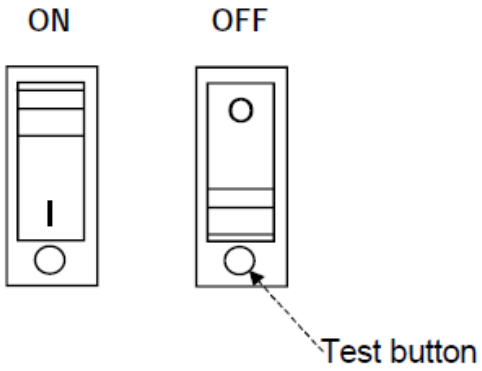
3.2 Maintenance list

Maintenance item	**When to perform**
Condenser cleaning	Once monthly
Test area cleaning	Before every test
Shut-down preparation	When chamber is not being used for long periods

Main Power Switch (leakage breaker) Trip Test

Once a month and before long test runs, test-trip the main power switch (leakage breaker). The switch is found at the rear of the chamber cabinet.

With the main power switch in the ON position, press the grey test button. If the switch's lever falls to the middle position, the breaker is working properly.



Reference: When the leakage breaker in the main power switch trips, the switch's lever falls halfway between the ON and OFF positions. To turn power back ON again, first set the switch to the OFF position and then to the ON position.

3.4 Overheat Protector Trip Test

Before every test, test-trip the overheat protector.

Procedure:

1. Check the main power switch at the isolator is in the ON position.
2. Press the “POWER ON” to power on the chamber. The current temperature will appear on the display.
3. Press either “Run” on the controller to run the chamber.
4. Set the overheat protector about 5°C lower than cabinet temperature. If the overheat protector is working properly, a buzzer will sound and the Alarm screen will appear on the display when temperature inside the cabinet reaches the overheat protector setting.
5. If the alarm doesn’t sound, there is a malfunction. Contact the manufacturer of equipment supplier.
6. To silence the alarm, reset the over-temperature protector.

3.5 Maintenance

Cleaning the condenser

Dust, dirt and foreign matter can accumulate in the condenser between the cooling fins. Over time this can reduce the cooling efficiency and cause the refrigeration system to overheat and eventually trip. Once a month the condenser should be cleaned by brushing between the fins to clear debris.

Cleaning the Test Area

Dirt and foreign matter inside the test area can adversely affect test results.
Clean the test area before every test.
Procedure:
1. Open the chamber door.
2. Wipe walls and chamber interior clean with a soft cloth or brush.

3. Close the door.

Shut-down preparation

If the chamber is not to be used for 3 or more days, carry out the following to prevent mildew or scale formation. Failure to do this can affect test results and shorten equipment service-life.

1. Dry the test area (by the procedure below).
2. Set the main power switch in the OFF position and shut OFF primary power supply.

Drying the test area

The cabinet is run to dry the test area.

1. Check the main power switch is in the ON position.
2. Set target temperature to 70°C.
3. Press “Start” buttons on controller.

Run the equipment for about 60 minutes with the door closed, then for 15 minutes with the door slightly ajar.

Power OFF

Set the main power switch in the OFF position, then shut OFF the primary power supply

Chapter 4: Troubleshooting

This chapter explains possible equipment problems and how to remedy them. When a problem is detected by one of the diagnostic features, the problem is displayed on the instrumentation panel and an alarm is sounded. For problems undetected in diagnostics and maloperation (which can be easily mistaken as a problem) this chapter also includes malfunction information for operators.

4.1 Detectable Troubles

DANGER

- **ELECTRIC SHOCK! Before working on the power circuits on the primary side of the main power switch (leakage breaker), shut OFF primary power supply and check the line is dead. Also, take measures to prevent accidental charging.**
  Working with primary power supply ON runs the risk of electric shock.
- **Shut OFF power from the main power switch BEFORE detaching the electric parts compartment door.**

This chamber is equipped with an alarm that sounds when problems are detected as well as self-check features which display the problem on the controller display. Displayed alarm codes and their content are given in the alarm table on the following pages. Remedial action is also described therein.

Alarm code on controller:
DI2, Over Temp
DI3, Over pressure
DI4, Over current
DI5, Water short

4.2 Common problems and remedies

There are 2 categories of malfunction for this test chamber:

Type A：
This may possibly result in damage to the test chamber or serious injury to the user. The control system will shut down the test chamber or the affected part of test chamber, and the alarm will sound when this category of malfunction is detected. A test chamber engineer can identify the cause of the malfunction by the alarm codes and their content displayed on TEMI2500 controller.

Type B：

This is unlikely to cause damage to the test chamber or injury to the user, but may result in the test chamber not running, or losing some functionality. The alarm may not sound for this kind of problem, but the experienced operator will be aware of an issue by the way the chamber is functioning.

Possible examples are shown below:

No.	Problem	Possible causes
1	Very slow heating rate	1. SSR or AC contactor malfunction in heating circuit. 2. Protector for heater tripped, check for possible short-circuit. 3. Heater circuit short or break, check the heater current.
2	Large temperature fluctuation at steady-state setting	1. SSR out of function on heater circuit. 2. Loss of refrigerant. 3. Capillary blocked or magnetic valve malfunction. Check refrigerator current.
3	Very slow cooling rate or temperature arise during cooling	1. SSR out of function on heater circuit. 2. Loss of refrigerant. 3. Capillary blocked or magnetic valve malfunction. Check refrigerator current. 4. The door is opened frequently or has been left open for a long time 5. The evaporator is frosting or the temperature of the cooling water is too high. 6. Condenser fan has malfunctioned. 7. Expansion valve has malfunctioned. 8. Specimen heat load is excessive.
4	Dew has formed on door hinges and around the door frame and viewing window.	1. Trace heaters around viewing window have malfunctioned. 2. The door is opened frequently or has been left open for a long time
5	Test chamber has stopped running	1. Current breaker malfunction. 2. Current leakage or short in one or more electrical components; check the insulation resistance for each suspect component.
6	Set test temperature is inaccurate	1. Temperature sensor within test chamber has malfunctioned. 2. The temperature sensor cable has bad or intermittent connection to the temperature detector terminal.

		3. Chamber requires calibration / offset adjustment.

In the event that the test chamber can't be powered on but there is no 'alarm condition', check the phase sequence indicator for correct wiring. Power off and correct the phase wire.

4.3 Preventative Maintenance

To keep the test chamber in good working condition, perform checks and maintenance periodically. In some cases a mandatory refrigerant 'leak test' must be carried out an annual basis.

1. The test chamber should always be operated and maintenance by specialist technicians and qualified engineers.
2. The user should keep record of daily operation for test chamber. This record should include the test time, test type and ambient conditions. Problems / Alarms should also be logged and include details of date, time, nature of the problem and remedial action taken: this must include all work undertaken on the refrigeration system and particularly include a log of refrigerant gas charge and removal must be maintained. Calibration results should be retained along with details of any offset adjustments.
3. Keep the chamber in a clean and tidy condition and maintain a safe and tidy area around the chamber. Take care not to block any ventilation grilles and do not place any objects on the top of the chamber.
4. The life-time of the test chamber will shorten if it is run very infrequently. It will be beneficial to power on and run the test chamber every 10 days or so at least.
5. Please do not stop and restart the test chamber frequently. Keep within the maximum stop / start cycle for the test chamber of not more than 5 times within one hour. The minimum time between stopping the chamber and restarting it is 3 minutes.
6. Do not open the door during cooling tests or cold dwells to prevent damage to the door seals.
7. Take care to protect the test area from accidental damage (impacts, dents or cuts)
8. To prolong the life-time of the illumination lamp, switch off the lamp when not required.
9. Once a month and before long test runs, test-trip the main power switch leakage breaker. With the main power switch in the ON position, press the test button. If the switch's lever falls to the middle position, the breaker is working correctly.

When the leakage breaker in the main power switch trips, the switch's lever falls halfway between the ON and OFF positions. To turn power back ON again, first set the switch to the OFF position and then to the ON position.

The leakage, over-load, short-circuit functions of breaker is set by the manufacturer. To avoid risk of damage or harm to the chamber operator do not adjust them for any reason.
If the breaker operates or malfunctions, please check the contact terminal, if the terminal is damaged replace the breaker.

11. Clean out any dust on debris in the power distribution compartment and water circuit

compartment by vacuum cleaner regularly and at least every 12 months.

12. Carry out the overheat protector trip test. Set the overheat protector about 5°C lower than cabinet temperature. If the overheat protector is working properly, an alarm will sound and the Alarm screen will appear on the display when temperature inside the cabinet reaches the overheat protector setting. If the alarm doesn't sound, there is a malfunction which will require investigation and repair.

After finishing the overheat protect trip test, reset the temperature before proceeding with the next test

Instructions for safe operation of the controller:

1. If the power supply wire requires re-connection (such as if the controller is replaced), please check the voltage of controller is same as voltage supplied.
2. Please do not use this controller where explosive substances, inflammable substances and vapor are present in the environment.
3. If there is smoke, or a strange odor, or strange noise emitting from controller, please power off the controller immediately and contact the manufacturer or equipment supplier.
4. Do not allow the controller to come into contact with magnetic objects, and not install the controller near a strong electromagnetic field.

Routine maintenance of controller:

1. If ambient temperature is more than upper and lower limits specified, the controller will not function.
2. Only use a soft damp cloth to clean the LCD panel and buttons. Do not use any solvents to clean the LCD.
3. Do not spray volatile substances or solvents on to the controller.
4. Power off the chamber at the mains isolator before long periods of inactivity.
5. To prolong the life-time of the LCD, please use the screen protection function.
6. The life-time for the LCD will be shorten if it is operating in high temperatures for prolonged periods. Adjust the contrast of the LCD if operating at more than 40^{o}C ambient temperatures

Chapter 5: Reference

As there are different configurations and different models available, there are few points that need to be made clear:

1. The controller for this test chamber is TEMI2500, the user manual for TEMI2500 is as attached.
2. If the test chamber has any special options or functions, the working theory description for those special options and functions will be included within this manual or in separate attachments.
3. The attachments for this user manual are as set out below:

Attachment 1 Refrigeration Schematic
Attachment 2 Electrical Schematic
Attachment 3 TEMI2500 User Manual