



**SERVICE MANUAL**

**CAT 5200/5400R/LT/RHSLT  
LOW TEMPERATURE  
ENVIRONMENTAL CHAMBER**

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# **WARRANTY STATEMENT**

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**CONTHERM Scientific Company will guarantee CONTHERM equipment for a period of twelve months from the date of installation against faulty workmanship and fabricated materials. This guarantee covers the replacement of component parts found to be defective and authorised labour charges during this period.**

**Should a malfunction occur or condition develop beyond reasonable acceptance the company will accept responsibility for returning the unit to its factory specification at no cost to the Purchaser providing that the operating instructions have been observed and the defect is due solely to faulty design, material and workmanship. That the defective part be returned, freight paid to the nearest sales service office. Units outside the warranty period will be accepted and repairs will be covered under an extension of the above for 90 days.**

**In remote installations where it is not possible for the company's or agents' engineers to attend, authority may be given to allow the Purchaser to arrange such service.**

**The Purchaser is required to remit the purchase price of the unit to the supplier within the terms of that supplier's condition of sale. CONTHERM Scientific Company will accept no liability or shall its agents for consequent damage of any kind due to a malfunction or component failure.**

\* \* \* \* \*



## STATEMENT of CONFORMITY

This **CONTHERM** cabinet conforms to the following standards:

- **Electrical Safety:** Designed to NZS6200 / AS3100:1994
- **EMC:** Complies with AS/NZS 2064: 1997

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## **IMPORTANT**

All electrical servicing **must** be carried out by suitably qualified personnel only.

## SECTION 1 DEFINITION OF TERMS

For the purpose of our standard specifications the following definitions shall apply:

- a) **WORKING SPACE**  
That portion of the internal space which is above the lowest shelf and not less than 5cm from any wall (including roof).
- b) **CHAMBER TEMPERATURE**  
That temperature at the centre of the working space.
- c) **SPATIAL VARIATION**  
The difference between the midrange of all measured temperatures obtained at one site and that at another site for those sites which give the greatest difference.
- d) **TEMPORAL VARIATION**  
The maximum value of the temperature range obtained for the standard site with the greatest range throughout the test interval.
- e) **TEMPERATURE OVERSHOOT**  
Any excess of actual over desired chamber temperature during a heating up period.
- f) **TEMPERATURE REPRODUCIBILITY**  
Temperature regained without alteration to controls.
- g) **TEST INTERVAL**  
Interval of time to which the steady state characteristics apply (Max 1 hour).

**NB:** All the above apply with an **empty** chamber.  
For definitions and test methods refer: **AS2853 : 1986** (and Appendices)

## SECTION 2 INTRODUCTION AND SPECIFICATIONS

The CONTHERM CAT R/RLT/RHSLT Environmental Chambers have been expressly designed to give a wide choice of operating conditions consistent with high reliability and low cost, the addition of microprocessor control gives additional versatility and resolution while improving the degree of temperature control.

All specifications are quoted for a cabinet temperature of 20°C with an ambient temperature of 20°C with any lighting off.

- **Construction** - Combination of High quality stainless steel and zinc plated mild steel epoxy coated exterior, fibreglass insulation, High quality stainless steel interior with full access door and magnetic door catch.
- **Safety** - Fitted with an independent factory set Hi-Limit and user adjustable Hi-Limit completely separate from normal controls.
- **Convection** - All units come with mechanical convection fan systems.
- **Electrical** - Designed to NZS6200 / AS3100:1994 240V AC M.E.N
- **EMC** - Complies with AS/NZS 2064: 1997
- All performances quoted at 20°C - PLCS5 Precision Control System.

### PERFORMANCE:

#### a) **Temperature:**

Nominal Range (R Typical)	-10°C	-	+70.0°C
Nominal Range (RHS Typical)	-10°C	-	+70.0°C
Nominal Range (RHSLT Typical)	-40°C	-	+70.0°C
Temporal Variation (Typical)			± 0.3°C
Spatial Variation			± 1.5°C
Initial Overshoot			+2.0°C
Reproducibility			±0.2°C
Dial resolution			0.1°C
Operating Ambient			10°C - 35°C
Mains Voltage Range			220-250 AC 50Hz

**NB:** The lowest temperature performance is only achievable in a maximum ambient of +20°C

**b) Lighting: VIEWING LIGHT** (If Fitted)  
Semi-Automatic control (max ON time limited to 5 minutes) with selection For ON and OFF. Manual Push Button.

**c) Relative Humidity: NB: No Humidity control above +70°C**  
Display Resolution: 1%RH  
Display Range: 0 - 100%RH  
Control Range: (Typical) 40 - 95%RH \*  
Accuracy: (typical @ 20°C, 50 - 90%RH) ± 5%RH

**NB:** Decrease max allowable humidity by 1.5%RH for every 1°C above +50°C  
\* 20 – 95%RH When fitted with low humidity option

**d) Timer:**  
Timing Range: 1 minute - 99hours 59 minutes  
Timing Resolution: 1 minute

Manual or Timed operation:  
**NB:** The symbol ':|' means run continuously.

**e) Refrigeration:**  
Automatic control, Hot and Cold cycle.

Used for Dry temperature control and Dehumidification with automatic Hot Gas Defrost. Defrost may be programmed to occur automatically or manually.

**OPTION:** If fitted with rapid cooling facility (liquid carbon dioxide) – cooling rates up to 5°C/min may be achieved.

**OPTION:** If fitted with low humidity option a 'cold finger' dehumidification coil is energised at humidity set points below 50%RH, this allows humidities as low as 20%RH @20°C to be achieved.

**f) Programmable:**  
Up to nine user programs may be set and run in conjunction with a 999 or continuous cycle counter.

**g) Computer:**  
An RS232c computer connection is provided. Contherm PLCS5 Communications (**PLCSCOMM**) program sold separately.

## SECTION 3 INSTALLATION

The CAT R/RLT/RHSLT Environmental Chambers are designed to be installed into a suitable well ventilated room with a minimum clear space of at least 600mm on all sides to allow access for servicing. Ensure there is CLEAR SPACE between the rear of the cabinet and any rear wall.

The cabinets generally require a 240Volt 50HZ 10Amp Single phase EARTHED electricity supply.

Total electrical load is upto 2.2Kw.

The approximate heat load is 1.8Kw.

The cabinet should be thoroughly inspected for any signs of mechanical damage that may have occurred in transit before any attempt is made to apply power to the unit.

- 1) If your cabinet is supplied with a separate **DEHUMIDIFIER** as the water supply, it is necessary to connect the water supply tubing to the 'WATER INLET' fitting on the rear of the cabinet. Fill the dehumidifier tank initially with distilled/deionised water and connect the dehumidifier to its own socket outlet. NO water tank is fitted to the cabinet with this option. Set the dehumidifier to operate continuously. Ensure that the drain outlet from the cabinet is connected to a suitable drain - if this is **NOT** done **FLOODING** may result.
- 2) If supplied with an **EXTERNAL** 20L water supply tank, connect it to the 'WATER INLET' hosetail at the rear of the chamber, do NOT connect high pressure water to the cabinet. Use **DISTILLED** or **DEIONISED** water **ONLY!** Using any other grade of water will greatly reduce the operating life of the steam injector coil.

When using an external tank OR Dehumidifier, it may be necessary to disable the low water alarm ('06') using DIAG No:44.

**NB:** Ensure that the rear drain outlet fitted to your chamber drains into a suitable container (which is required to be emptied at regular intervals) or into a waste water drainage outlet.

On CAT 5200RLT / 5400RLT models (Non Humidity Models) ensure the Humidity Set Point is adjusted to 0.0%.

## LIQUID CO<sub>2</sub> INJECTION

If the cabinet is fitted with the LIQUID CO<sub>2</sub> Rapid cooling option, a bottle of liquid co<sub>2</sub> may be connected via the supplied solenoid and hose fitting to the stainless co<sub>2</sub> inlet at the rear of the cabinet – ensure the side mounted co<sub>2</sub> injection switch is in the OFF position before attempting to install the bottle and solenoid.

**NB:** The temperature of the liquid co<sub>2</sub> is about **-80°C DO NOT** open the bottle valve or discharge contents near human tissue as severe tissue damage could occur. If the **RAPID COOLING** option (liquid co<sub>2</sub>) is fitted, a special solenoid valve will be supplied, this solenoid will be wired to a special plug which connects to the sealed socket 'CO<sub>2</sub> SOLENOID' at the RHS rear of the chamber. The solenoid is also attached to a mechanical coupling suitable for connection to a bottle of 'FOOD GRADE CARBON DIOXIDE LIQUID'. The recommended bottle size is 33kg.

Ensure that the gas bottle is turned OFF before attempting to fit or remove any gas line couplings. The cabinet end of the gas line goes to a brass fitting labeled 'CO<sub>2</sub> INLET'. At the RHS side of the cabinet there is a switch to allow the solenoid to be operated automatically when required by the chamber, if operation is desired without the use of the external co<sub>2</sub> cooling both this switch and the bottle supply should be turned off. The solenoid will be opened automatically at intervals to attempt to achieve higher cooling rates (>1.0°C/min). When operating the stainless steel supply hose will become very cold, and some condensation will drip from this line.

A rear vent port is fitted to ensure that excess pressure in the cabinet may be safely vented – ensure this port is free to open.

**WARNING:** If the cabinet is fitted with the **LIQUID CO<sub>2</sub>** injection system for rapid cooling the area around the cabinet **MUST** be actively ventilated (by means of a mechanical fan) to ensure sufficient fresh air is available to avoid the possibility of asphyxiation due to raised co<sub>2</sub> concentration in the air.

**WARNING:** To prevent FIRE or SHOCK hazard, DO NOT expose this product to rain or any type of moisture.

## FOR YOUR SAFETY

To ensure safe operation the three-pin plug supplied must be inserted **ONLY** into a standard three-pin power outlet which is effectively earthed through the normal building wiring.

Extension cords are **NOT** recommended.

The fact that the equipment operates satisfactorily does **NOT** imply that the power outlet is earthed and that the installation is completely safe. For your safety, if in any doubt about the effective earthing of the power outlet, consult a qualified electrician.

This appliance should be regularly tested (or after any service work on the appliance) according to the procedures prescribed in **AS/NZS 3760**. The basic safety checks and tests on electrical appliances required by **AS/NZS 3760** are:

- a) A visual check to ensure that there is no mechanical damage, that controls etc. are in good working order and that no parts are missing.
- b) An earth continuity test. (Maximum allowed resistance is 1  $\Omega$ )  
An insulation resistance test. (Minimum insulation resistance is 1 M $\Omega$ )

## SECTION 4 OPERATING INSTRUCTIONS

This appliance is NOT intended for use by young children or infirm persons without supervision.

To set up unit for operation after unpacking and checking for damage proceed as follows:

- 1) Follow any installation procedures (See SECTION 3).

### OPERATING CONTROLLER:

- 2) Apply power at wall main switch.
- 3) Turn on RCD 'MAIN ISOLATOR' switch at panel on LHS of chamber - The 'MAINS INDICATOR' neon should now be on and the green LED displays on the control panel should be illuminated.
- 4) When power is FIRST applied to the chamber the display will most likely show an '03' (Preset) Alarm. This is due to the fact that power has been removed from the chamber for more than 48 hours. Use the method described on page 11 of this manual to cancel the special '03' Alarm.
- 5) Set program(s) to desired operating parameters.
- 6) Confirm factory calibration by monitoring the temperature, Humidity etc with your own calibrated instruments and make adjustments as per the CALIBRATION section if necessary.
- 7) When setting RAMP rates – please note that some rate settings may be beyond the capability of the chamber to achieve – if very high rates are set there may also be significant overshoot/undershoot. To ramp up/down at the fastest possible rate set the ramp rate to 9.9. For normal operation set the ramp rate to 0.0.

**NB:** When the humidity tank is first filled (or if it has been allowed to empty), the humidity delivery pump may require priming (RHS Models ONLY). This is most easily achieved by using Diagnostic No3.

## Operating with 'LIVE LOADS'

Special precautions **MUST** be taken when operating the chamber with a 'Live Load' inside (A 'live load' is any internal test apparatus that is adding heat to the chamber). In particular the live load **MUST** be disconnected if power to the chamber is lost, or if the chamber turns OFF for ANY reason. Depending on the size of the 'Live Load' **SERIOUS DAMAGE** could occur to either the apparatus under test OR the actual test chamber if the chamber temperature rises above allowable operating limits.

**If damage to the chamber occurs due to heat from a 'live load' any Contherm warranty is voided.**

**EXAMPLE:** A test is being performed on an item of electronic equipment which is powered ON and dissipates 400W. Let's assume the test is being carried out at 0°C. The test is programmed to run overnight and when left the chamber was stabilised at 0°C. Sometime during the night a fault occurs such that the 'RCD' device on the chamber trips disconnecting the chamber from electrical power. The device under test (being powered from a source external to the chamber) continues to dissipate its 400W of heat causing the chamber temperature to rise to 120°C where it stabilises. The apparatus inside thus 'bakes' at a temperature well above its normal operating range and is severely damaged (possibly also resulting in a 'fire' inside the chamber), additionally the chambers foam insulation is impaired due to the excessive temperature rise. (Possibly resulting in the chamber being unable to be repaired.).

The severity of the problem will depend on the terminal temperature reached, determined predominately by the amount of heat being dissipated by the 'live load' in the chamber.

Also note that any refrigeration system while perhaps having the capacity to HOLD the 'live load' at a specified temperature MAY NOT be able to REDUCE the chamber temperature from a higher temperature to a lower one. **I.E** A chamber that may comfortably hold a 'live load' at +10°C may well be UNABLE to lower the temperature (with the 'live load' ON from +50°C to +10°C, this is due to the refrigeration system having less capacity at the higher temperature, additionally if the fridge 'looses' the 'live load' at the higher temperature and instead of the temperature being lowered from +50°C to +10°C it RISES to say +60°C the refrigeration system will TURN OFF resulting in the temperature **rising even further** to a value as high as if the chamber was disconnected.

It is **IMPORTANT** that the above scenario (and others) are carefully considered before leaving any 'live load' unattended in a chamber.

Contherm does offer a 'live load' disconnect feature at additional cost, which offers some protection against the above problems. This option must be fitted to the chamber at time of ordering.

## ALARMS

There are TWO main types of alarm used in the PLCS5 control system.

- a) **STANDARD ALARMS:** 01,02,04,05,06,07,08,10,11,12  
These alarm numbers indicate a problem with chamber control, IE over-temperature, low water, faulty sensor etc.  
To **CANCEL** these alarms press the DIAGNOSTIC select button THREE times. (Some of these alarms can also be cancelled by pressing ANY button). ENSURE that note is taken of the alarm indication and that any indicated problem is attended to.
- b) **03 & 09 ALARMS:** 03,09  
These alarms are SPECIAL and can **ONLY** be cancelled by using the SPECIAL procedure outlined below. These alarms indicate EITHER that the chamber MAY have lost some of its settings ('03') most likely due to being disconnected from the power for more than 48 hours, or that INTERFERENCE ('09') to the chambers internal operating system has occurred, due to external electrical interference or electronic system malfunction.

To ensure that the required settings and CALIBRATION factors are checked it is necessary to EXAMINE **ALL** the program settings and TEMPERATURE and HUMIDITY calibration factors. If there was more than one program running the settings for the additional programs should also be checked but this is NOT essential in order to cancel the alarm.

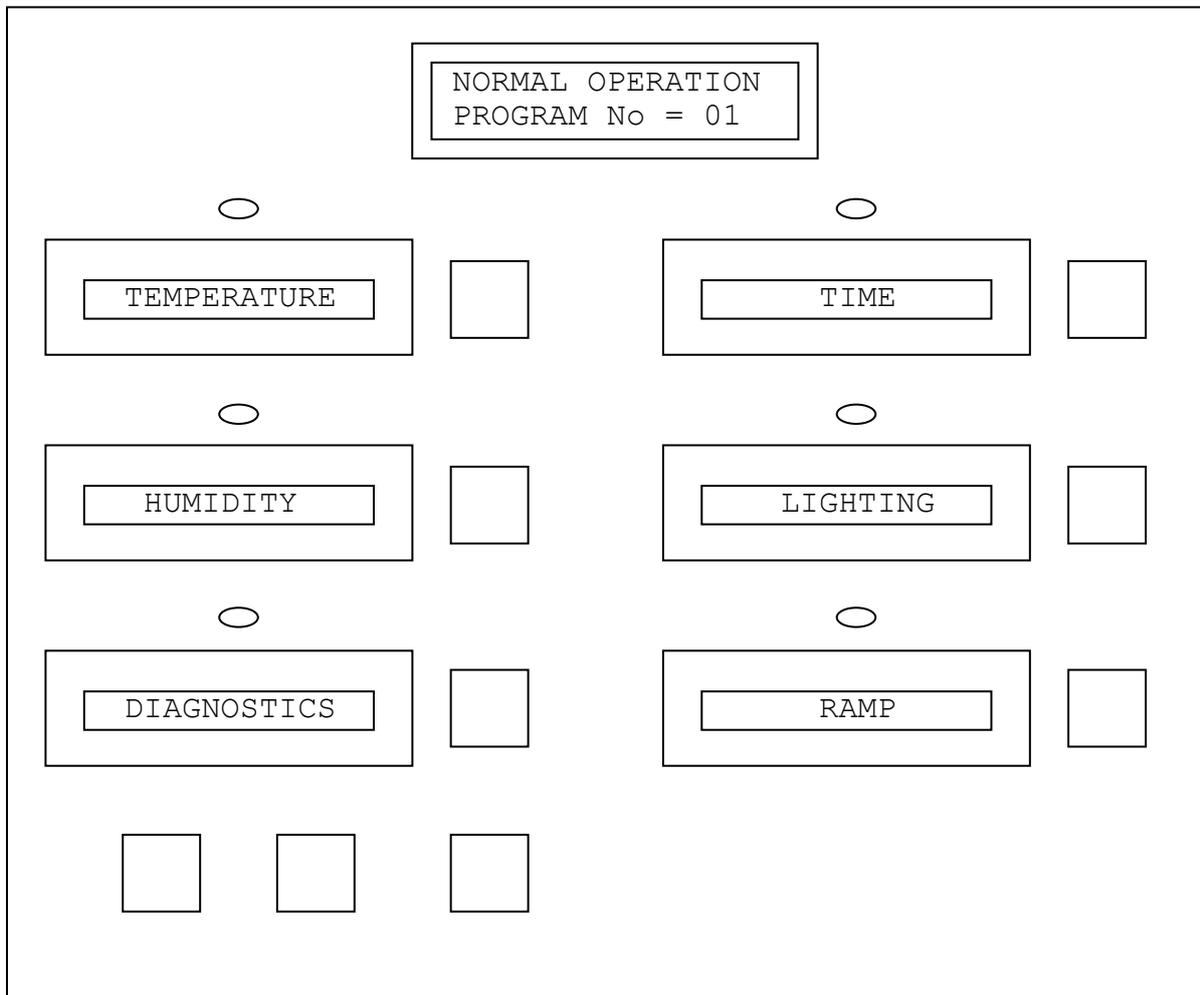
### The following procedure is recommended:

- 1) Press the 'SELECT' button adjacent to the green temperature display and confirm the SET POINT is correct, if not then adjust it using the 'UP' and 'DOWN' buttons. Press 'SELECT' again if the 'SET' LED above the display is ON so that it goes OFF. - REPEAT for all the other Green display parameters (TIME, HUMIDITY, LIGHT, RAMP etc).
- 2) Press the 'SELECT' button adjacent to the red 'DIAGNOSTICS/ALARMS' display and using the 'UP' button obtain diagnostic No20 (Calibrate Temp), check that the current value is correct. (Check against the Factory Cal Factor - on front cover of manual, or other known Cal Factor), if NOT correct press 'SELECT' again and adjust Cal Factor using the 'UP' and 'DOWN' buttons. Press the 'SELECT' button a third time to exit the DIAGNOSTIC routines.

- 3) Press the 'SELECT' button adjacent to the red 'DIAGNOSTICS/ALARMS' display and using the 'UP' button obtain diagnostic No21 (Calibrate RH), check that the current value is correct. (Check against the Factory Cal Factor - on front cover of manual, or other known Cal Factor), if NOT correct press 'SELECT' again and adjust Cal Factor using the 'UP' and 'DOWN' buttons. Press the 'SELECT' button a third time to exit the DIAGNOSTIC routines.
- 4) Press the 'PROG' button adjacent to the 'UP' button and step through the three program settings (Select program, Set cycle counter and Set max prog number).
- 5) Having carried out all of the above pressing any parameter button will now cancel the alarm. (IE, press the 'TEMPERATURE' select button. If the red LED above the 'TEMPERATURE' parameter display is ON press the 'SELECT' button again. The '03' Alarm should now be cancelled.

### SPECIAL NOTES

- 1) To ensure correct refrigeration operation and longest life, the fridge condenser **MUST** be kept free of dust by regular cleaning, at least once every 3 months (use a nylon brush). When operating in adverse conditions (IE, very dusty environment, corridors etc) it may be necessary to clean the condenser more often (IE, monthly). If the condenser is NOT kept clean the refrigeration compressor may fail and your **WARRANTY** on the refrigeration system may be **VOID**.
- 2) Unless changed by the customer an automatic defrost cycle will be started every four hours when running at low temperatures. This defrost is necessary to keep the refrigeration evaporator free of ice buildup which would otherwise impair the ability of the cabinet to maintain its operating temperatures. The defrost sequence is designed to minimise any changes to the cabinet temperature during the defrost period but some change in conditions cannot be avoided.
- 3) CAT 5200RLT / 5400RLT models do **NOT** have a humidity control system fitted. If a Humidity display is fitted It is essential that the humidity set point is adjusted to 0.0% to avoid **LOW WATER** alarms and any problems with temperature control.



### **CONTROLLER OPERATION:**

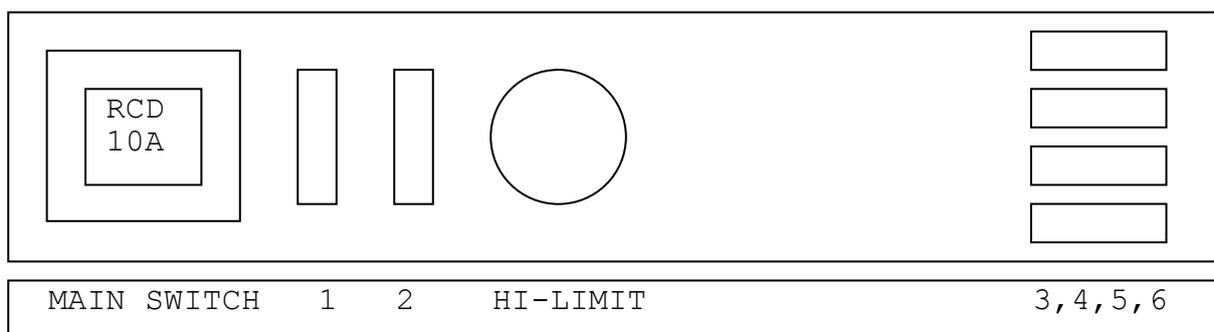
The PLC55 Control System is Contherm's latest offering in a series of Microprocessor based Control Systems. The front control panel is fitted with a two line by 16 character LCD display to allow the controller to be easily setup for all operations. An additional recessed Control/Monitor Panel is fitted at the top RHS of the cabinet.

- 1) The LCD display shows information on the current status of the cabinet (NORMAL OPERATION, DEFROSTING, STOPPED, FAULT etc) and also displays prompts when setting parameters, changing programs etc.
- 2) In NORMAL operation the values displayed in the boxes for the installed parameters represent the current value measured by the Controller.
- 3) The 'UP' and 'DOWN' buttons below the DIAGNOSTIC/ALARM display are used to make any adjustments to the Controller set points.

- 4) The 'SET' led will illuminate above any parameter selected for adjustment.
- 5) The 'SELECT' buttons are used to 'select' a parameter for adjustment.

### CONTROL / MONITOR PANEL

Additional Neon indicators and switches are fitted to the top RHS main control panel to provide overall control of various functions and to give a visual indication of cabinet operation.



- A) **MAIN SWITCH & RCD** allows power to flow to the cabinet. The RED neon (1) will be illuminated when this switch is ON and the cabinet is connected to the Main power supply. Inside the main panel is an RCD (Residual Current Device) which should be tested once per month or at least when the cabinet is about to be setup for the next experimental run. Test the RCD device by pressing the 'TEST' button - the RCD circuit breaker should switch to the OFF position. **NB:** The whole cabinet will be switched OFF. (It is best to conduct this test with the lighting OFF).  
To RESET the circuit breaker push the lever to the 'ON' position. If the lever will not stay in the 'ON' position an electrical fault is present.  
If the RCD trips with the small yellow 'flag' showing this means that the tripping was due to excessive 'earth leakage'. The cause **MUST** be investigated **DO NOT** attempt to BYPASS the RCD device.
- B) **HI-LIMIT & MONITOR NEON.** This RED neon (2) will illuminate when the user HI-LIMIT has tripped. When this neon is on NO POWER will be applied to the HEATING ELEMENT (This acts as an additional safety to prevent cabinet overheating). The HI-LIMIT should be set to trip JUST above the maximum allowable temperature of any samples.

- C) **HOT GAS NEON.** Neon 3 is illuminated when the refrigeration HOT-GAS (HOT CYCLE) solenoid is energised. When this solenoid is energised the refrigeration is trying to HEAT the cabinet, in normal operation this solenoid may be energised on a regular cycle. The solenoid may be tested via the DIAGNOSTIC system by selection number 4 (TEST HOT SOLN).
- D) **COLD LIQUID NEON.** Neon 4 is illuminated when the refrigeration LIQUID solenoid (COLD CYCLE) is energised. When this solenoid is energised the refrigeration system is trying to COOL the cabinet. The solenoid may be tested via the DIAGNOSTIC system by selection number 5 (TEST COLD SOLN). When the refrigeration system is operating it MAY cycle the **HOT GAS** solenoid (Red Neon 3 will come on) OR the **COLD LIQUID** solenoid (Green neon 4 will come on) to achieve the desired temperature and humidity.
- E) **HEATER NEON.** This neon will be illuminated whenever power is being applied to the HEATING ELEMENTS. When the cabinet has stabilised at Temperature this neon is usually pulsing at a steady rate.
- F) **HUMIDITY NEON** .(If HUMIDITY CONTROL FITTED). The GREEN neon will be illuminated whenever power is applied to the humidity delivery system. The delivery system will inject a very fine mist of water/steam into the internal fan circulating air which will then be rapidly dispersed into the chamber in order to RAISE the Relative Humidity level. The HUMIDITY delivery system may be tested via the DIAGNOSTIC system by selection number 3 (TEST RH INJECT).
- G) **LIGHTING.** (For viewing)  
If fitted with a viewing light, the light is controlled by setting the lighting to either 'ON' or 'OFF'. If set to 'ON' the viewing light will automatically turn OFF after 5 minutes.
- H) **RS232 PORT.**  
This is a simplified RS232 Communications interface - suitable for connecting to a standard IBM compatible PC.  
Software for use with this port is available from CONTHERM at extra cost.

## SETTING UP

The following example shows how to set the chamber for the shown conditions:

### Program No 1

Temperature = 20.0°C  
Humidity = 70.0%  
Time = 6:00 (SIX HOURS)

### Program No 2

Temperature = 15.0°C  
Humidity = 70.0%  
Time = 6:00 (SIX HOURS)

No of Cycles = 10

- 1) Press the button marked 'PROG' (adjacent to the UP & DOWN buttons), the LCD display will say 'SELECT PROGRAM', use the UP & DOWN buttons to adjust the Program Number to '01'. Press the 'PROG' button AGAIN, the LCD display will then say 'SET CYCLE COUNT', use the UP & DOWN buttons to set the cycle counter to '00'. (This ensures that the chamber will stay OFF until we are ready to run it!). Press the 'PROG' button a third time, the LCD display will say 'SET MAX PROG No'. Since we are going to have TWO Programs, use the UP & DOWN buttons to set the MAX PROG No to '02'. This will allow only Programs 1 & 2 to be considered when running the chamber. Press the 'PROG' button once more (or just wait for 20 seconds) to return the Controller to its 'NORMAL OPERATION' mode.

**NB:** The number of cycles is the number of times the Controller will swap from Program No 1 to Program No 2. After each Program swap the number of cycles is decremented. When the Cycle Counter reaches 00 the Controller will switch the chamber OFF.

When the Program advances from one Program to the next it continues to select the next highest Program number until it EXCEEDS the MAXIMUM SET PROGRAM number at which time it DECREMENTS the Cycle Counter and selects Program number 1 again.

All of the selected parameters change SIMULTANEOUSLY when the Program changes from one to the next, and the TIME setting for each Program starts to DECREMENT IMMEDIATELY.

## SET UP PROGRAM NUMBER 1:

### a) Set TEMPERATURE

Press the `SELECT' button adjacent to the TEMPERATURE display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET TEMPERATURE'.

Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the Set Point to 20.0oC. When the adjustment is complete you can exit the Temperature Set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

### b) Set TIME

The TIME display shows how long the chamber will run this Program before it changes to the second Program.

Press the `SELECT' button adjacent to the TIME display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET TIMER'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 6:00. When the adjustment is complete you can exit the Timer Set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

**NB:** The `|:' symbol means `run continuously' and if this symbol is selected the Timer will stay at this setting INDEFINITELY.

### c) Set HUMIDITY. (If HUMIDITY CONTROL option fitted).

Press the `SELECT' button adjacent to the HUMIDITY display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET HUMIDITY'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 70.0.

When the adjustment is complete you can exit the humidity set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

**NB:** To set the HUMIDITY to OFF (ie NO Humidity Control attempted) set the RH set point = 0.0, this will also disable the LOW WATER alarm from sounding again even if the water level is LOW. This MUST be done on CAT 5200RLT / CAT 5400RLT Models.

d) **Set LIGHTING.**

Press the `SELECT' button adjacent to the LIGHTING display. The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET LIGHTING'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 'OFF'. When the adjustment is complete you can exit the Lighting Set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

**NB: The viewing light on these chambers will AUTOMATICALLY turn OFF after 5 minutes.**

**RAMP**

The 'RAMP' parameter allows the user to set the desired rate at which the cabinet attempts to change from one program temperature to another. Effective control can only be obtained at very low RAMP rates (0.1 to 0.3°C/minute). If it is desired to move AS QUICKLY AS POSSIBLE from one temperature to another (for example STRESS TESTING of components) the RAMP rate may be set to 9.9. NB: This will result in considerable overshoot at some settings.

The RECOMMENDED rate for all normal modes of operation is 0.0. This means RAMPING is effectively DISABLED.

When the cabinet is running the RAMP display shows the AVERAGE temperature change (°C/minute) over the last TWO minutes.

If ramp rates are set above 1.0°C/min and the chamber is fitted with the special RAPID COOLING option – the chamber will automatically attempt to use external carbon dioxide cooling to achieve the higher rates.

## SETUP PROGRAM NUMBER 2:

Before the Set Points for the next Program can be entered the Program number must be changed to Program number 2.

### SELECT PROGRAM No 2

Press the `PROG' button (at the bottom of the panel adjacent to the `UP' and `DOWN' buttons) and look at the LCD display (top of the panel), the display will show the words `SELECT PROGRAM'. Use the `UP' and `DOWN' buttons to adjust the Program number (shown on the lower line of the LCD display) until it reads `No = 02'.

Press the `PROG' button AGAIN. The top line of the LCD display will now show `SET CYCLE COUNT' and the lower line will show the number of cycles on the Cycle Counter. The number of Cycles was set earlier and so the LCD should display `No CYCLES = 00'. Press the `PROG' button TWICE to return to normal operation, you should now adjust the set points for Program Number 2 in the same way as for Program Number 1.

You must now decide which Program (1 OR 2) that you wish the chamber to START on, let us say it is Program No 1.

Press the `PROG' button and use the Up & Down buttons to select Program Number 1. Press the `PROG' button again and set the number of cycles = `10' (using the Up & Down buttons), press the `PROG' button twice more and the chamber should start running from Program Number 1.

The chamber will run Program Number 1 for the Set Timer duration and then change to Program Number 2 and run it also for its Set Timer duration, after which the Cycle Counter will be decremented by one and the Cycle repeated until the Cycle Counter becomes = `00' when the chamber will turn OFF.

If HUMIDITY CONTROL is NOT fitted or desired the HUMIDITY set point **MUST** be set to 0.0%RH to avoid any attempt by the refrigeration system to control the humidity.

## **SPECIAL PROGRAMMING HINTS**

It is possible to use one of the Programs ABOVE the maximum program number to act as a PRECONDITIONING Program. If say, the MAX PROGRAM NUMBER is set at 02, this would mean that as the Program changes from one program to the next any Program number ABOVE 02 would NOT be selected. We could, therefore, setup Program Number 3 as a PRECONDITIONING Program and when starting the Program run, start with this Program Number. This Program would run and stabilise the chamber at its selected settings and when the timer for Program Number 3 expired the Controller would automatically select Program Number 1 to run, Program Number 3 would NOT RUN AGAIN however, because its number is ABOVE the MAX program number.

When setting up Program Set points from the Controller it is best to FIRST set the Cycle Counter to `00' to ensure the Program does NOT change as you are entering the new settings.

## SECTION 5 CALIBRATION

Final calibration for the PLCS5 range of chambers is achieved by adjusting the CALIBRATION FACTORS for TEMPERATURE and HUMIDITY, these adjustments are made through the front panel DIAGNOSTIC section.

The CAL FACTORS are stored in the internal memory of the controller and are held up by a SUPERCAP which will store the factors for a maximum of 72 hours in the absence of power, if power to the controller has been interrupted for a prolonged period (more than 48 hours) the CAL FACTORS should be checked to see if they are still valid, this should ALWAYS be done if a PRESET alarm (**03**) has occurred.

If the CAL FACTORS are lost the controller will set them to the default value (50). This could result in a temperature error of up to  $\pm 5.0^{\circ}\text{C}$  or a humidity error of up to  $\pm 5\%$  RH.

The factory CAL FACTORS for the chamber are noted on the inside front cover of the instruction manual and also on the test report that comes with the chamber.

To CALIBRATE the control system use the DIAGNOSTIC controls. These services are attained by Pressing the `SELECT' button adjacent to the `DIAGNOSTICS/ALARMS' display and following the instructions on the LCD (top of panel) display.

When first entered the `DIAGNOSTICS/ALARMS' display may be blank indicating that no diagnostics features have yet been selected, by using the `UP' and `DOWN' buttons various diagnostic tests may be carried out.

When you have made your selection - Press the 'SELECT' button again to move to the 'ADJUST VALUE' mode, and if required adjust the CAL FACTOR value, press the 'SELECT' button a THIRD time to exit the DIAGNOSTIC mode.

**20 - CALIBRATE TEMPERATURE.** This selection will allow the internal calibration VALUE to be changed, this in turn will change the temperature calibration for the chamber, the minimum value is `00' and the maximum value is `99' when calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0°C too low, then INCREASE the calibration value by 20 (20=2.0°C) to obtain the correct calibration. ALWAYS calibrate with any lighting set to OFF.

**21 - CALIBRATE HUMIDITY.** This selection will allow the internal humidity calibration VALUE to be changed, this in turn will change the HUMIDITY calibration for the chamber, the minimum value is `00' and the maximum value is `99' when calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0% too low, then INCREASE the calibration value by 20 (20=2.0%) to obtain the correct calibration. This calibration value is normally 50, and must only be used to make SMALL adjustments to the humidity calibration. ALWAYS calibrate with any lighting set to OFF.

**NB:** Ensure that the Humidity Probe OFFSET correction factor (See DIAG No 42) has been set. (Standard Hycal = 1, VAISALA sensor = 0).

\* **22 - CALIBRATE CARBON DIOXIDE.** Co2 measurement is not usually fitted to this range of chambers.

The temperature should be recorded on a daily basis by placing a thermometer in the work space so that it can be read and the long term temperature performance can then be plotted to give an assurance of correct temperature performance.

## SECTION 6 THEORY OF OPERATION

The key to the versatility of operation of the PLCS5 controller is based on the use of a Microprocessor Control System and multiplexed analog inputs controlled by this system.

Analog input information is amplified by conventional circuitry and filtered before being sent to a multi-channel multiplexer/AD converter.

The Microprocessor, on direction of its ROM based program, selects an input to be converted by the A/D converter to digital form. The information obtained is then acted upon to up-date the display, control heaters, solenoids, etc and the next input is then selected. This sequence of events is repeated continuously unless interrupted by a special event or by user intervention.

Time pulses for timed events are obtained from the internal crystal controlled microprocessor clock.

All of the precision cabinets using the PLCS5 control system operate in the same basic manner. An internal circulating fan (which is usually turned OFF when the outer door is open) mixes air within the chamber by drawing it in through the top mounted sensor box and refrigeration evaporator, then over the heating elements and past the humidity injection point to where it is then discharged down the rear wall behind a false back and back into the chamber. The chamber WILL NOT operate correctly if the fan is not running OR if the airflow is heavily impeded by placement of product within the chamber.

Temperature is controlled by HEATING the air via a sheathed element (typically 400-1200watts) and by COOLING the air via the refrigeration system evaporator. The temperature of the refrigeration evaporator is controlled by altering the on/off ratio of the HOT-GAS and COLD LIQUID solenoid valves.

The typical ON/OFF cycle is about 10 seconds, if the HOT valve is on for 5 seconds (50%) then it is OFF for the other five seconds and the evaporator temperature is at a medium level. On all models except the RLT the cold valve is continuously energised whenever the fridge is running, on RLT models the cold valve turns OFF when the HOT valve turns ON. When the cabinet has stabilised at the desired temperature (within  $\pm 0.3^{\circ}\text{C}$ ) then the temperature of the evaporator may be varied (by changing the solenoid ON/OFF ratio) to help achieve the desired humidity. The temperature of the fridge evaporator sets the DEW POINT for the humidity (the temperature at which water condenses out of the air). Raising the temperature of the evaporator (by HOT-GASSING for LONGER) raises the DEW point and therefore helps to RAISE the humidity in the cabinet.

The main source of water for humidity control is via the humidity injection system (either a water spray nozzle or an open small steam pipe).

In the earlier systems humidity injection was by water mist spray. This system sprays a VERY FINE CONICAL mist of water using a special MIST injection water nozzle. The fine mist of water is taken up and mixed into the air by the fan and this raises the humidity level inside the chamber. The pump spray on time is very short (about 1 second) every 30 seconds.

If a system is fitted with the water mist injection and is struggling to raise the humidity, first ensure that the temperature is stable (within  $\pm 0.5^{\circ}\text{C}$ ), and if so lower the top inside cover and using DIAGNOSTIC No3 (water inject) test spray the nozzle (it is best to do this with the system TIMER set to OFF so that the cabinet is stopped). A FINE conical mist of water should be seen (almost as fine as smoke). If the water just dribbles out or is a small JET of water then the nozzle is BLOCKED and must be cleaned (using compressed air) or replaced to get the humidity working correctly.

On later systems a Steam Injection method is used. A small pump (usually located under the chamber on the RHS), pumps a jet of water through a stainless steel injector pipe which is coiled inside a heating block. The pump 'injects' a shot of steam lasting about 1 second every 20-30 seconds.

Whenever a problem is encountered with the humidity system, ALWAYS make sure that the TEMPERATURE control is correct first, because if the TEMPERATURE control is not right the humidity system will not control correctly.

Temperature is measured by the chamber air being drawn (at about 0.5M/S) through the sensor box mounted at the top RHS attached to the refrigeration evaporator cover. The actual temperature sensor is a solid state device (LM35DZ) which is a linear temperature to voltage converter at  $+10\text{mV} / ^{\circ}\text{C}$ . To cope with the offset due to operating at negative temperatures ( $-50^{\circ}\text{C}$ ) there is an OFFSET voltage to this device of 500mV ( $50^{\circ}\text{C}$ ). The output of this sensor at a chamber temperature of  $+20^{\circ}\text{C}$  is about 700mV ( $500\text{mV} + 20 \times 10\text{mV} = 700\text{mV}$ ).

Humidity is usually measured using a capacitive humidity sensor. The earlier units use a Philips Sensor mounted on a small PCB (ZP10a). The scale factor of the ZP10a PCB is factory set, but an offset may be made by adjusting the small trimmer capacitor (adjustable through the small hole on the sensor box). Later units use a Honeywell sensor which is laser trimmed when supplied and the only offset adjustment is via the PLCS5 Diagnostic No21.

Both humidity sensors are extremely reliable unless they have actual water condensing on them, in which case usually allowing them to dry out fixes the problem.

If a problem is encountered where the temperature is a very long way out of calibration and cannot be corrected by the Diagnostic Calibration Routines – check for any moisture deposits on the pcb surface.

Hi-Limit and Safety Capillary Thermostats: There are two additional mechanical levels of safety to prevent the chamber overheating.

On the RHS of the cabinet monitor panel there is a user adjustable 'HI-LIMIT' thermostat, this should be set to operate just above your normal operating temperature. When this control is interfering with the normal operation (as when the cabinet overheats) the red 'monitor' neon will come on and the 'HEATER' neon will turn off as this control prevents power from reaching the heating elements. If the monitor neon is coming on also check that the internal circulating fan motor is running.

The second overtemperature limit is a factory adjusted manual reset limit which when activated will remove power from the cabinet electronics. The small red button must be depressed to reset this device.

On models fitted with a refrigeration system the fridge compressor runs all the time unless the timer is set to '0:00' when BOTH the HOT & COLD valves will be turned OFF and the fridge system will shut down a few minutes later on the LOW PRESSURE cutout.

The temperature in the cabinet is sensed by a solid state temperature sensor and controlled by a PID algorithm to a resolution of 0.1°C.

The humidity conditions are sensed by a capacitive sensor probe (ZP10a, HYCAL/HONEYWELL or VAISALA).

After first turning on power to the unit a RESET operation is performed, this operation tests the condition of retained data in the RTC RAM (Random Access Memory) which contains any set points, correct factors, etc and by computing a CHECKSUM determines if the data has been held by the SUPERCAP or corrupted (if cabinet has been turned off for more than 48 hours).

If the data is incorrect, all the control points are set to their "Preset" values.

## SECTION 7 DIAGNOSTICS

The PLC5 controller has a limited number of diagnostic services inbuilt. These services are attained by Pressing the `SELECT' button adjacent to the DIAGNOSTICS/ALARMS' display and following the instructions on the LCD (top of panel) display.

When first entered the `DIAGNOSTICS/ALARMS' display will be blank indicating that no diagnostics features have yet been selected, by using the `UP' and `DOWN' buttons various diagnostic tests may be carried out.

When you have made your selection - Press the `SELECT' button again to move to the 'ADJUST VALUE' mode, and if required adjust the test value, press the 'SELECT' button a THIRD time to exit the DIAGNOSTIC mode and execute the selected test.

**01 - Test CO2 INJECT.** This selection will force the CO2 solenoid (if fitted) to turn on for a duration of 10 seconds to enable its operation to be confirmed.

**02 - Test FAN PAUSE.** This selection will stop the internal circulating fans (and the heating elements) for a period of 30 seconds.

**03 - Test RH INJECT.** This selection will run the HUMIDITY delivery system continuously for a period to enable the pump system to fully prime. The length of time the pump will run for may be changed by `adjusting' the value, a value of 30 represents about 5 seconds of spray time.

**04 - Test HOT SOLN.** This selection will cause the HOT refrigeration solenoid to be energised for a period of ten seconds, the COLD solenoid will be turned OFF during this period.

**05 - Test COLD SOLN.** This selection will cause the COLD solenoid to be energised for a period of ten seconds, the HOT solenoid will be turned OFF during this period.

**06 - Test DEFROST.** This selection will set the next defrost to occur immediately, the defrost will work as an entirely standard defrost. When a defrost occurs the internal circulating fans will stop and the refrigeration system will enter a 'full hot gas' cycle for 4 minutes, during this time the 'HOT GAS SOLENOID' will be energised. After the 4 minutes the 'COLD LIQUID' solenoid will be energised for 30 seconds to PRE-COOL the evaporator, the fans will then start and normal operation will resume. The LCD display will alternate between 'NORMAL OPERATION' & 'DEFROSTING NOW' during the defrost period.

**07 - Test FRIDGE PULLDOWN.** This selection will cause the fridge to turn the COLD solenoid on and keep the circulating fan running, all other functions (except for lighting which can be turned on or off as desired) are inhibited. The fridge will continue to pull down to its lowest possible temperature until this test is cancelled!. When the test is running the LCD display will show `FRIDGE PULLDOWN' and a warning `BEEP' will sound every minute until the test is cancelled. To run this test, CHANGE the VALUE to 01. To CANCEL the test change the value to 00. The default value is 00 and this will be set whenever the mains power is turned off.

**08 - Test FRIDGE GAS CHARGE.** This selection will cause the fridge to turn the COLD solenoid ON and STOP the internal circulating fan!. ALL other operations are INHIBITED!. The fridge evaporator will go as cold as possible and the gas charge can be observed after a period of 20 - 30 minutes by how far the evaporator has frosted. **NB:** The cooling coil drain tray must be removed to clearly see the evaporator. (See refrigeration charging section). When this test is running the LCD display will show `FRIDGE GAS CHARG' and a warning `beep' will sound every minute until the test is cancelled. To run this test change the VALue to 01. To CANCEL the test change the VALue to 00. The default VALue is 00 and this will be set whenever the mains power is turned off. (Do NOT use on RLT/RHSLT Models).

**09 - TEST ELECTRONICS.** This selection will allow various components on the PLCS5 INTERFACE and DISPLAY PCB's to be tested. The particular test performed depends on the VALue selected.

VALue	Test carried out	FAIL ALARM
00	No tests carried out	none
01	Test real time clock tick (IC 8583)	91
02	Test RTC RAM storage (IC 8583)	92
03	Test CPU RAM storage (IC 68HC705C9)	93
04	Test EEROM storage (IC 24C02 or 2814)	94
05	Test A/D Converter (IC 145051)	95
06	Test Output porta (IC 2803,OPTO's)	none
07	Test LED displays - VISUAL TEST ONLY	none
08	Test RS232 Computer port	none
09	Test AUDIBLE alarm	none
10	Perform ALL of the above tests	various
11	Test serial printer	none

If a test with a fail alarm is performed and the test fails the fail alarm code will be displayed on the DIAGNOSTIC led's.

If there is more than one failure mode (running test value 10),the intermediate fail alarms will be only displayed briefly and the last failure alarm will stay on the display.

If a test fails the operation of the IC in that area should be investigated, IE a **91** FAIL ALARM could mean that the crystal for the RTC clock chip (8583) has broken OR that the chip itself is faulty.

**10 - RAW CO2 VOLTAGE.** This selection will place the value of the RAW voltage coming from the CO<sub>2</sub> sensor (same as test point #6) onto the CO<sub>2</sub> display for about 1 second, **NB:** A reading of 56.1 represents a voltage of 0.561 Volts DC. The value should be between 0.400 Volts (40.0) and 1.600 Volts (160.0).

To run this test, CHANGE the VALUE to 01.

**20 - CALIBRATE TEMPERATURE.** This selection will allow the internal calibration VALUE to be changed, this in turn will change the temperature calibration for the chamber, the minimum value is `00' and the maximum value is `99'. When calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value. (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0°C too low, then **INCREASE** the calibration value by 20 (20=2.0°C) to obtain the correct calibration.

**21 - CALIBRATE HUMIDITY.** This selection will allow the internal humidity calibration VALUE to be changed, this in turn will change the HUMIDITY calibration for the chamber, the minimum value is `00' and the maximum value is `99'. When calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0% too low, then **INCREASE** the calibration value by 20 (20=2.0%) to obtain the correct calibration. This calibration value is normally 50, and must only be used to make SMALL adjustments to the humidity calibration, if larger adjustments are required they should be performed using DIAG No42 to set the OFFSET VALUE (HYCAL/HONEYWELL sensor ONLY).

**NB:** Ensure that the Humidity Probe OFFSET correction factor (See DIAG No 42) has been set. (Standard setting = 1).

\* **22 - CALIBRATE CARBON DIOXIDE.** Co<sub>2</sub> measurement is not usually fitted to this range of chambers.

**30 - AUDIBLE ALARM** - This selection allows the AUDIBLE alarm to be DISABLED or ENABLED. A value of 00 = DISABLED, 01 = ENABLED.

The DEFAULT setting is ENABLED (01).

**31 - DEFROST INTERVAL** - This selection allows the DEFROST INTERVAL to be varied, or DISABLED altogether.

The DEFAULT value is 04, this give a defrost lasting four minutes every at 4HR intervals.

The INTERVAL may be set from 01 to 99 hours.

The defrost may be INHIBITED altogether by setting the VALUE to 00.

**32 - DOOR HEATER?** - This selection allows the glass DOOR HEATER(s) to be ENABLED or DISABLED. A VALue of 00 = DISABLED, 01 = ENABLED. The default setting is ENABLED (01).

**33 - DOOR SWITCH?** - This selection allows the DOOR AJAR SWITCH to be ENABLED or BYPASSED. A VALue of 00 = BYPASSED/DISABLED, 01 = ENABLED.

The DEFAULT setting is ENABLED (01).

**34 - ALLOW RH ALARM** - This selection either enables (01) or disables (00) the  $\pm$  5% humidity alarm. If enabled an alarm (No10) will sound after the humidity has been outside the current set point by more than  $\pm$  5% for more than 10 minutes. This alarm should ONLY be enabled when operating for long periods at a single temperature/humidity setting. The Default setting is DISABLED (00).

**35 - SETUP PASSCODE** - This selection allows the user to prevent unauthorised access to the chamber's set points by using a PASSCODE (00 - 99). If the chamber has been removed from the mains power for more than 72 hours the current passcode will be 00 (This will allow access without entering a PASSCODE).

**TO SETUP A PASSCODE:** Use this selection to select your desired passcode BEFORE changing or examining a SETPOINT, once this is done that same number MUST be entered before any future access will be allowed to change any settings. The PASSCODE number will be automatically returned to 00 two minutes after any buttons have been pressed. Once a PASSCODE is in effect it will remain so until cancelled (using Diagnostic routine 36) **or** by discharging the SUPERCAP backup device (This occurs after 72 hours without power).

**36 - CANCEL PASSCODE** - This selection allows the user to REMOVE a passcode from use and revert back to a no passcode condition. To use this selection the original passcode (if any) must be known.

TO CANCEL A PASSCODE: Set the value = 01.

**37 - SET REAL CLOCK** - This selection allows the user to SETUP the internal REAL TIME CLOCK to the true time of day. Use the UP & DOWN buttons to set the value to the correct time. (MUST be done before using REAL TIME MODE).

**38 - SET TIMER MODE** - This selection allows the user to choose between ELAPSED (mode 0) time and REAL (mode 1) time. REAL time settings are ONLY applicable to programmable chambers (NOT CO2). When using the REAL TIME mode the program changeovers can be synchronised to the actual time of day.

**ELAPSED TIME MODE:** Set the value = 00 (Default setting).

**REAL TIME MODE:** Set the value = 01.

**39 - LIGHT RAMP RATE** - This selection allows the user to SETUP the rate at which the lighting (If Fitted!) will be turned ON or OFF (in  $\mu\text{E} / \text{min}$ ). A higher setting for this value will cause the lights to come on (or go off) at a faster rate.

A value of 00 means DO NOT turn the lights ON.

**40 - SET LIGHT MODE** - If set to 00 the lights will switch to the amount set in one step, if set to 01 the lights will RAMP up or down to the desired setting at the RATE set by DIAG routine No 39.

**41 - USE FRIDGE?** - This selection allows the user to DISABLE the refrigeration system. When the fridge is DISABLED there will be NO DEHUMIDIFICATION as this function is handled by the refrigeration system, the chamber will also take a much longer time to drop in temperature and the lowest achievable temperature will depend on the ambient room conditions. A value of 00 means DISABLE the fridge, a value of 01 means ENABLE the fridge. The default is ENABLED (01).

**42 - RH PROBE CORRECT** - This selection allows the user to set an OFFSET CORRECTION factor for the HYCAL/HONEYWELL Capacitive Humidity Probe. The factor may be set from 0 to 5. The recommended setting for the standard probe is 1. If the VAISALA humidity probe is fitted, this setting should be left at 0.

**43 - CPU VERSION No** - This selection allows the user to view the current FIRMWARE version fitted to the CPU. This is a READ ONLY value and is set into the CPU when it is programmed in the factory.

**44 - USE FLOAT SWITCH** - This selection allows the Internal Water Tank (if fitted) float switch to be enabled or disabled so that water can be supplied externally. A value of 00 = DISABLED, 01 = ENABLED. The DEFAULT setting is DISABLED (00).

**45 - DELAY TIMER STRT** - This selection allows the user to delay the elapsed timer from running until the chamber is within  $\pm 2^{\circ}\text{C}$  of the desired set point. 0=Timer starts immediately, 1= Timer is DELAYED until set point is reached.

## SECTION 8 TROUBLESHOOTING AND MAINTENANCE

If a FAULT/ALARM code is displayed on the RED led display, consult the FAULT CODE section first to see if there is an easy remedy.

### 1) NO MAINS NEON WHEN MAINS ISOLATOR TURNED ON.

- Chamber not connected to mains
- Main ISOLATOR/RCD breaker tripped. If trip is due to excessive earth leakage ensure cause is investigated.
- No power at electrical supply.
- Call Service Engineer

### 2) MAINS NEON ON - No LCD/LED Display.

- Internal preset HI-LIMIT tripped (inside chamber RHS panel)
- Interface power supply failure.(look at LED's)
- Cable to display unit broken/damaged.
- Call Service Engineer

### 3) CONTROLLER ON - But will not operate correctly

- Check that SET POINTS are correct.
- Check for INTERNAL fan operation.
- Check that Fridge is ENABLED (DIAG No 41)
- CHECK DETAILED TROUBLESHOOTING SECTION

4) **NO LIGHTS** - Lights must be set for normal operation, check that the lighting switch is in the ON position and that the light intensity is set to other than 00. Check that if the lighting mode is 01 (DIAG No 40) then a light ramp rate (DIAG 39) is set to other than 00.

If fitted - The Humidity Water Spray pump system should be cleaned out and checked for leaks and wear every 12 months. Also ensure that the water tank and hoses are kept free of bacterial contamination. **ALWAYS** remove **ALL** power from the cabinet **BEFORE** working on the Humidity Spray System Pump.

**NB:** When the need arises to contact a Service Engineer always note the type of Cabinet, i.e., CAT 5400RHSLT, and Program Version, i.e., VERS7.8, also Cabinet Serial Number. (Appliance No).

(The Program Version, etc. will be indicated on the inside front cover of this manual. and also via Diagnostic No 43)

## DETAILED TROUBLESHOOTING SECTION

### NO DISPLAYS OR LEDS (Mains NEON on)

- MANUAL-RESET Hi-Limit Tripped (inside RHS chamber side panel)
- Power Supply Failure on Interface PCB.

1) Check NON-RESET Hi-Limit (small RED button)

if Hi-Limit is OK then look at interface board. The heartbeat led (nearest 40pin IC) should be pulsing at about a two second rate, if not then look at the power supply leds.

**Both** Red power supply LEDs should be on, if not, then one of the power supplies has failed - if **NO LEDS** are on then Check the 100mA transformer fuse on the interface PCB. REMOVE ALL power from chamber BEFORE checking any fuses.

### DISPLAY ON BUT NOTHING ELSE WORKING

- Check that chamber has not turned OFF (Look at LCD display). If so ensure TIMER has been set for a time (also program counter if running multiple programs).
- PLCS5 INTERFACE PCB Fuse has blown. REMOVE ALL POWER from chamber and remove RHS cover check 2Amp fuse on interface PCB.

### DISPLAY ON BUT SHOWING RUBBISH!

The only power supplied to the display PCB comes from the 5 volt regulator on the interface PCB. If the LED displays are illuminated it is a good indication that the 5v power supply is present.

- Bad connection in cable from interface pcb.
- Ingress of moisture onto display PCB.

There are two separate data links to the display PCB, the SPI data link (works the led displays) and the IIC data link (works the LCD display). The SPI link uses the connections SLT, MOS, SCK, the IIC link uses SCL & SDA. Check the wiring connections for the appropriate area. The chamber should be able to operate without the display PCB connected.

- If the TOP line of the LCD is showing ALL segments and the BOTTOM line is blank, suspect either the SCL or SDA wires between the Interface PCB and the display PCB.

- Faulty Reset (turn Mains power off for 10 sec)

## ALARM SOUNDING AND FAULT LED DISPLAYING '01'

- Hi/Lo limit alarm
- Measure temperature inside chamber and ensure temperature is less than 2°C above/below set point. Could be caused by faulty triac or heater element, this condition can also be caused by addition of any `live' load addition to chamber interior. Check also that fridge evaporator has not iced up.

## CHAMBER WILL NOT HEAT/COOL TO TEMPERATURE

- Door open, OUTER DOOR AJAR.
- Check for correct SET POINTS esp timer (|:|=manual)
- Faulty element/fridge
- Already at temperature
- Look at state of CONTROL panel neons.
- Check that element is coming on (look at `Heat' NEON on chamber ).

## REFRIGERATION PROBLEMS

Ensure Fridge condenser is kept free from dust build-up.

Ensure main chamber internal circulation fan is running!

- Main Fridge does not come on:  
(Under normal circumstances the CONDENSER fan motor will be on when the fridge is running)
- Ensure Fridge is ENABLED (See DIAG No 41)
- Chamber not in use (Timer = 0:00 OR cycle counter set to 0).
- Refrigeration evaporator has ICED UP.
- Faulty fridge solenoid  
**NB:** At least ONE of the refrigeration solenoids **MUST** be ON in order for the refrigeration system to operate. Look at the state of the neons on the CONTROL panel.
- Faulty low pressure cutout in fridge compartment.
- Refrigeration system has lost some/all refrigerant.
- Fault on interface board.

Use DIAGNOSTIC No7 (fridge pulldown) to test the operation of the refrigeration system. When on fridge pulldown the COLD solenoid should be energised and the Internal circulating fan running. The cabinet should cool down to 0.0°C within 1 hour from ambient.

### FRIDGE IS ON BUT LITTLE/NO COOLING EFFECT

- Check that power is not being applied to main heating element. (Look at heater NEON)- if so is Temperature set point correct?
- Check that Internal fan is operating.
- Check that refrigeration evaporator is not ICED UP.
- Check that COLD solenoid is ON and HOT solenoid goes OFF.
- Check fridge condenser for dust buildup.
- Possible loss of refrigerant.
- Compressor not working (Thermal overload)

### FRIDGE DOES NOT GO OFF

**NB:** The refrigeration SHOULD be on under most circumstances unless the refrigeration has been DISABLED via DIAGNOSTIC No41 or the temperature is above 62°C.

The fridge will NOT turn off unless BOTH refrigeration solenoids (HOT & COLD) are OFF. (Both neons should be off!).

- Allow more time for Fridge to pump down. (esp low temps)
- Faulty low pressure cutout in fridge compartment
- Faulty fridge solenoid(s) (Check using DIAGNOSTIC No4 & No5)
- Faulty interface board

### CONTROL PARAMETERS NOT RETAINED AFTER MAINS FAILURE

- Supercap discharged. (After 48 hours with no power)

The SUPERCAP will keep the real time clock chip (RTC) and any set points in memory for about 48hours without external power being supplied.

### TEMPERATURE CONTROL NOT TIGHT ENOUGH

- Circulation Fan stopped or airflow impaired
- Check that refrigeration evaporator has not ICED UP.
- Sensor faulty or airflow through sensor box impaired.

Sensor unit relies on good airflow for correct operation, unit must be correctly attached to front of inside refrigeration evaporator.

### UNABLE TO ACHIEVE DESIRED HUMIDITY (RHS MODELS)

- Check that desired humidity is achievable (Min=40%, Max=90% and only between temperatures of 15 to 60°C)
- Use Diagnostic No3 (Inject RH) to see if delivery system is working.
- Check that VENT at rear of chamber is sealing fully (to obtain high humidities)
- Ensure sufficient time is allowed for chamber to stabilise at desired humidity.
- May not be able to achieve higher humidities with lights on, especially in higher ambients.

### INACCURATE READINGS ON ANY PARAMETER

- Not correctly calibrated
- Out of range (% RH only between 15-60°C)
- Faulty sensor
- Component failure

**NB:** If the TEMPERATURE is NOT correctly calibrated see the DIAGNOSTIC tests (TEST No 20) to calibrate the chamber, the calibration should be carried out EITHER at 20.0°C OR for CRITICAL APPLICATIONS at the temperature of interest. **NB:** All lighting MUST be off.

In particular the calibration factors should be checked if power has been removed from the chamber for more than 48 hours.

The chamber may have difficulty achieving some HUMIDITY settings (especially if the ambient temperature is high and the lights are ON) if in doubt reset the chamber for more easily achieved Temperatures/Humidities.

Ensure that if any Humidity probe Temperature Correction Factor required has been entered. (See DIAG No 42)

### INSUFFICIENT COOLING WITH CARBON DIOXIDE

If the rapid cooling is fitted and fast pulldown rates (upto 5°C/min) cannot be achieved, check that the solenoid opens periodically (typically for 1 second every 5-10 seconds) and that the inlet line is cold, if the solenoid is operating but the inlet line is not cold then check that the bottle is turned on and is not empty.

## MAINTENANCE for STEAM INJECTION MODULES

If the cabinet is fitted with the Steam Injection System for humidity control there will be a Steam Module located at the rear of the cabinet. The water used must be distilled or deionised to minimise the risk of blockage to the injector coil. Water that has been through the humidity system not be recirculated. The steam injector coil should be replaced every 12months.



Steam Injection

OUTLET

Module (P2003) INLET



Long Injector coil (P2005)

To replace the Steam Injector Coil: Turn ALL power to the cabinet OFF. Wait for the steam injector to cool down (about 1 hour). Ensure the unit has cooled enough to be safe to handle. Remove the two screws securing the injector module cover and lift the cover clear, (lugs retain the top cover position).

Undo the hose clips holding the inlet and outlet tubing to the injector coil and pull the tubing clear. Lift out the top piece of fiberglass insulation to expose the coil retaining plate. Remove the two screws holding the coil retaining top plate to the heating block

and carefully lift the plate upwards drawing the centre column out of the heating block. If necessary gently tap the injector coil from the bottom to knock it upwards and out of the heating block. Reverse the procedure to replace the coil.

Ensure all hoses are correctly connected and held on with the retaining clips. If any of the steam hoses have become brittle they should be replaced.

The old steam injection coil should be discarded.

Prime the Humidity Injection System using Diagnostic No3.

### **MAINTENANCE SCHEDULE No1**

This schedule should be carried out at intervals of about **2000** running **hours**, in adverse conditions the cleaning procedures should be carried out more frequently. After 2000 hours of running a maintenance alarm (No13 or 14) may occur. Cancel the alarm and then carry out the following procedures.

- Turn the chamber **OFF** using the '**TEST**' button on the **RCD** circuit breaker, this checks operation of the **RCD** device.
- Remove the chamber power cable from the wall socket.
- Open the front lower door and using a brush or vacuum cleaner, clean any dust buildup from the refrigeration condenser fins (the water tank may have to be removed to gain clear access to the condenser).
- Drain any water from the water reservoir system and clean and inspect the tank and hoses for leaks and deterioration, replace / clean as necessary. Ensure **ONLY** distilled or Deionised water is used.
- If water spray pump system then remove pump main inlet filter, inspect and clean then replace.
- If water spray pump system then lower top internal element cover tray, remove spray nozzle, remove and clean nozzle filter.
- Restore power to the system.
- if water spray pump system fitted : with nozzle removed use DIAGNOSTIC No3 to FLUSH the humidity system with clean water (the water tank and hoses must be restored first).
- If water spray pump system then replace spray nozzle and filter, use DIAGNOSTIC No3 to test spray delivery system. A fine conical mist of spray should be seen from the nozzle.

### **MAINTENANCE SCHEDULE No2**

At intervals of about 8000 running hours the following procedures should be carried out in **ADDITION** to the procedures listed above.

- If a water spray pump type delivery system is fitted the pump should be **OVERHAULED** (brushes, diaphragms etc) to ensure ongoing reliability. If steam injection replace the injector coil (P2005).
- All plastic hoses should be **REPLACED**.

## **REFRIGERATION SYSTEM**

The Refrigeration System is designed to operate continuously.

The System is started when either the HOT or COLD solenoid valves are opened by the PLCS5 control system. Opening either of these valves will allow refrigeration Pressure into the Cooling Coil and Low Pressure Switch which will close and allow the Refrigeration Compressor and Condenser Fan Motor to start up.

After the initial start up period (approx one 20 seconds) depending on whether a cooler or warmer temperature is required the Hot Gas Solenoid Valve will open and close to help in achieving the required Chamber Temperature.

The Hot Gas solenoid operates on a 16 second cycle, ie., if the Hot gas solenoid is on for 10 seconds it will be off for 6 seconds. When the Hot gas solenoid is on for 16 seconds it will stay on ALL the time (Off time = 0 seconds), this is FULL HOT GAS.

If the fridge is DISABLED via DIAGNOSTIC No41 then both Solenoid Valves will close and the Refrigeration Compressor will automatically pump down and turn off on the Low Pressure Switch. This could take up to 5 minutes.

It is also possible should the Pressure inside the Cooling Coil rise during a Hot Chamber temperature period for the Refrigeration System to turn on automatically and pump itself out and stop again on the Low Pressure Switch (neither Solenoid Valve will open).

### **IMPORTANT**

As the Refrigeration Unit located under the Chamber is Air cooled it is essential that an unimpeded Air Flow over the unit is maintained.

Allow **AT LEAST** 100mm of clear space **ON ALL SIDES** of the chamber.

Air is drawn through front and left hand side Grilles of the chamber over the Condenser Fins, through the Fan, over the Compressor and exhausted through the rear of the chamber.

Dust and dirt will collect on the Air Entry side of the Condenser Fins so it is essential that once every three months the Lower front door is opened and the Condenser Fins brushed downwards with a small hearth brush.

If the chamber is located in a dusty position this procedure should be carried out more regularly. **FAILURE** to keep the **CONDENSER CLEAN** will result in the overheating of the Refrigeration Unit and may **VOID YOUR WARRANTY**.

The refrigeration system is charged with **R404a** refrigerant, for a quick check of the refrigeration gas charge a moisture indicating sightglass is located in the liquid line in the refrigeration unit compartment, this is only intended as an indicator and an accurate reading should be undertaken by a qualified refrigeration engineer.

The air cooled condenser is located behind the lower front door (grille), to properly clean or inspect open the door, the condenser fins should be brushed vertically with a soft brush (hearth type) with the excess dust/dirt being vacuumed away.

### **HI-LOW SAFETY PRESSURE CONTROL**

This control is wired in Series with the Refrigeration Compressor and condenser fan motor, and the low part as such is only used as a pump- out control when the PLCS Controller is set outside the refrigeration limits. Its function is not to cycle the Refrigeration Compressor to maintain cabinet temperature.

Temperature control is achieved by the PLCS Controller pulsing the Hot Gas Valve.

The HI part as such is used as a high pressure safety cutout in the event of a high pressure buildup (IE, condenser fan motor failure, clogged condenser).

TYPICAL Pressure Control Settings should be –

<b>LOW PART</b>		<b>HIGH PART</b>	
Cut In	25 psi	Cut Out	300psi
Differential	30 psi	Differential	FIXED

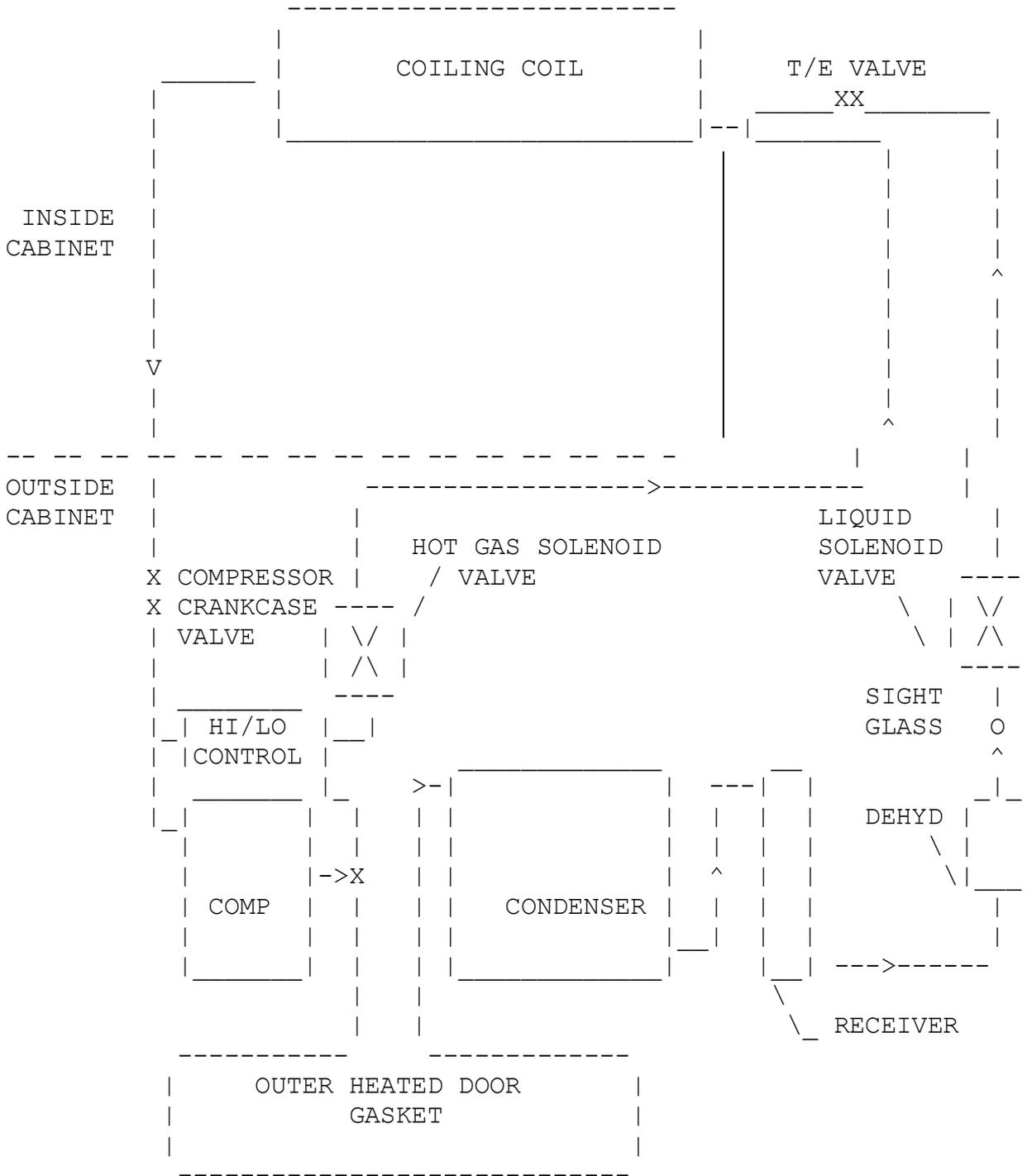
### **REFRIGERATION COMPONENTS**

**The actual components fitted depend on the type of cabinet, consult the original manual for the chamber.**

UNIT:	1HP AIR COOLED SEALED HOT GAS
COMPRESSOR:	L'UNITE CAJ 2446Z
FAN MOTOR:	EBM PAPST
REFRIGERANT CHARGE:	2.5Kg R404a
REFRIGERANT CONTROL:	Danfoss TUAE4N
LIQUID LINE DEHYDRATOR:	SPORLAN Model 032 ¼ ODS
CONDENSER:	MAKSAL C5506
LIQUID RECEIVER:	CARLY F0264
LIQUID SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
HOT GAS SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
COMPRESSOR PRESS VALVE:	SPORLAN CRO 6
HI/LOW SAFETY CONTROL:	RANCO model 017/8701



# REFRIGERATION SCHEMATIC DIAGRAM



## SECTION 9 PARTS LISTS

<u>DESC</u>	<u>CONTHERM REF</u>
Micro Parts PLCS5 SET	CPU - RHS
Shelves: Pressed Stainless	P1056
Fan Motor:	P1007
Elements: 1x 870W or 1x 1250W (LT)	P1013
**Vaisala Humidity Sensor HMM30C	SENSOR 4
HONEYWELL/HYCAL Humidity Sensor HIH-4000-001	SENSOR HUM1
*Humidity Pump - Flojet 2100-131 – <b>12Volt</b>	P1188
*Pump Pressure switch - 02095-101	P1183
*Filter -	SPRAY HUM 9
*Spray Nozzles - SF2TIP	P1184
Steam Injection Module	P2003
Steam Injection Pump	P2004
Steam injection coil (Swaged – Long)	P2005
Hi-Limit Switch (non-Reset)	P132
Hi-Limit Switch (Resetable)	P021
Fuse 2Amp (Controller)	FUSE 2AMP
RCD Circuit Breaker 10A (30mA Leakage trip)	CIRCUIT BRK1
*If water spray pump delivery system fitted.	
**If VAISALA sensor fitted	

## SECTION 10 FAULT/ALARM CODES

These codes will be shown on the Controller ALARM Display, the RED DISPLAY will come on and the buzzer will sound. Read the information to see if further action is required. To cancel the alarm, Press the 'DIAGNOSTIC/ALARM' button.

<b>Code Problem</b>	<b>Remedy</b>
<b>01</b> Over/Under Temp fault - temperature in chamber more than 2°C above/Below the set point.	Alarm will stop when fault is removed.
<b>02</b> Low CO <sub>2</sub> in Chamber - Not enough CO <sub>2</sub> to maintain CO <sub>2</sub> set point.	Check bottle, hoses, for blockage or faulty solenoid.
<b>03</b> Chamber now running on <u>Preset Values</u> . (Most likely due to power being removed for more than 48 Hours).	If Preset values are your working values, cancel the alarm else update the set points. CHECK CAL FACTORS.(See CAL SECTION)
<b>04</b> Main temperature sensor (in sensor box) broken or damaged.	Call Service Engineer. Check sensor with meter. Could also be electronic fault in controller, or broken sensor wire, etc.
<b>05</b> Humidity sensor (in sensor box), broken or damaged.	Call Service Engineer. Check sensor with meter. Could also be electronic fault in controller or broken sensor wire, etc.
<b>06</b> Low water level in Humidity Reservoir.	Top up level in Humidity Reservoir, open bottom door to top up.
<b>07</b> CO <sub>2</sub> Sensor. Damaged or broken,	Not normally fitted.

- |  |  |
|--|--|
| <b>08</b> Moderate Noise   | Check wiring of Mains.<br>If only very occasional<br>alarm will not cause any<br>problems. |
| <b>09</b> Severe Noise on Mains<br>check mains wiring and<br>outside interference. | As above but serious,<br>earthing. Look for<br><b>CHECK CAL FACTORS.</b>                   |
| <b>13</b> Maintenance Service<br>No1 Due (Occurs every<br>2000 running hours).     | Carry out Standard<br>Maintenance Schedule<br>And cancel alarm.                            |
| <b>14</b> Maintenance Service<br>No2 Due (Occurs every<br>8000 running hours).     | Carry out Comprehensive<br>Maintenance Schedule<br>And cancel alarm.                       |

**CONTHERM SCIENTIFIC LTD**  
CERTIFICATE OF CONFORMANCE



This certifies that the CONTHERM equipment specified below has passed quality and performance tests according to our standard methods and procedures and has been approved for despatch to our customers. Contherm calibration equipment is traceable to a YSI Model 60 gallium melting point temperature standard.

**CAT. No: 5200/5400 [RLT] [RHSLT]      APP No:      Date: ...../...../.....**

**TEST RESULTS**

**CALIBRATION FACTORS**

Test Temperature: ..... Temperature [    ]  
Probe Position: ..... Humidity [    /    ]  
Date of Test: .....  
Actual Recorded Temperature .....  
Temporal Variation ..... Passed [    ]

**ELECTRICAL TESTS**

Earthing: [    ]  $\Omega$       Insulation: [    ]  $M\Omega$   
Flash: [    ]      Leakage: [    ]  $Ma$

The electrical tests are satisfactory: [    ]

Signature of Test Personnel .....

**CONTHERM SCIENTIFIC LIMITED**  
**NEW ZEALAND**

**CONTHERM SCIENTIFIC**  
CUSTOMER INSTALLATION REPORT



Please fill in and return to:

**CONTHERM SCIENTIFIC LIMITED**  
**DEVELOPMENT SECTION**  
**P.O. BOX 30605**  
**LOWER HUTT**  
**NEW ZEALAND**

1) Did your chamber arrive in good condition? **YES / NO**

2) Any difficulties experienced in setting up? **YES / NO**  
Comments:

3) Is this your first CONTHERM purchase? **YES / NO**

4) Any previous problems of a specific nature with CONTHERM products? **YES / NO**  
Comments:

5) Any suggestions for improvements or special features you would like to see -  
Comments:

6) Chamber Details    Catalogue No: **CAT 5200/5400 [RLT]/[RHSLT]**

**Appliance No:** .....

**Date Installed:** .....

**Company:** .....

.....

.....

**COUNTRY:** .....

**Contact Name:** .....

**PHONE:** ..... **Email:** .....

**PACKING INSTRUCTIONS**

Installation Quality Check List (IQ)  
(Leave with Cabinet & Retained by customer)



**CAT.No: 5200/5400 [RLT]/[RHSLT]**  
(Environmental Chamber)

**App No:**

**Date: ...../...../.....**

<u>Accessories Supplied</u>	<u>Qty</u>	<u>(IQ)Checked</u>
Operating Manual	[ ]	[ ]
Shelf Runners (pairs)	[ ]	[ ]
Shelves	[ ]	[ ]
IEC Mains Lead	[ ]	[ ]
20L Water Tank	[ ]	[ ]
Other.....	[ ]	[ ]

Cabinet Undamaged when Packed <i>(No dents, scratches or obvious damage)</i>	[ ]	When Received	[ ]
Certificate of Conformance Completed <i>(Factory test sheet attached)</i>	[ ]		[ ]

Ensure cabinet has been fully tested and approved for packing .	[ ]		[ ]
---	-----	--	-----

Ensure data plates are fitted.	[ ]		[ ]
--------------------------------	-----	--	-----

Interior and exterior clean.	[ ]		[ ]
------------------------------	-----	--	-----

Cabinet Installed as per installation Instructions: (See SECTION 3 of the operating manual)			[ ]
--	--	--	-----

Installation Verification (IQ) Satisfactory: [Y][N]

PACKED BY .....

(IQ)CHECKED BY .....

Date: ...../...../.....

Date: ...../...../.....

**OPERATION VERIFICATION INSTRUCTIONS**

Operational Quality Check List (OQ)

(Retained by customer)



**CAT.No: 5200/5400 [RLT]/[RHSLT]**  
(Environmental Chamber)

**App No:**

**Date: ...../...../.....**

<u>Operation.....</u>	<u>(OQChecked)</u>	<u>Comments</u>
LED & LCD Displays working <i>(Manual SECTION 4)</i>	[ ]	
Check operation of RCD device <i>(Use the 'TEST' button – Manual Section 4)</i>	[ ]	
Able to adjust SET POINTS <i>(Manual SECTION 4 – set for 20.0°C)</i>	[ ]	
Check door switch operation <i>(Open outer door – LCD shows 'door ajar')</i>	[ ]	
Check operation of Viewing light <i>(If fitted)</i>	[ ]	
Temperature within ±0.5°C @ 20°C <i>(Allow cabinet to stabilise at temperature for 1 hour)</i>	[ ]	
Check HI-LIMIT Control <i>(Manual SECTION 4 – turn anticlockwise when stabilised)</i>	[ ]	
Check Alarm Operation <i>(Bypass door switch, Open door for 30mins after cabinet stabilised)</i>	[ ]	
Check Alarm Cancellation <i>(Manual SECTION 4 – Press 'temp' button until 'set' led on)</i>	[ ]	
Calibrate at temperature at 20°C <i>(Manual SECTION 5 – Calibration @ 20 or temperature of interest)</i>	[ ]	
Calibrate Humidity at 20°C, 80% RH <i>(Manual SECTION 5 – Calibration @ 20 or temperature of interest)</i>	[ ]	
Check Low Temperature Operation <i>(Set cabinet for –40°C, NO Humidity, allow 4hours @20°C ambient)</i>	[ ]	

Operational Performance (OQ) Satisfactory: [Y][N]

(OQ)CHECKED BY .....

Date: ...../...../.....

**PERFORMANCE VERIFICATION INSTRUCTIONS**

Performance Quality Check List (PQ)

(Retained by customer)



**CAT.No: 5200/5400 [RLT]/[RHSLT]**

**App No:**

**Date: ...../...../.....**

(Environmental Chamber)

**Operation.....**

**(PQChecked)**

**Comments**

Check Temporal Variation @ 20°C [ ]

*(Refer manual for specification, cabinet empty, lights OFF, center only)*

Check Spatial Variation @ 20°C [ ]

*(Refer manual for specification, 8 points as per diagram)*

[6R] [4C] [3R] TOP

[8C] [1C] [ ] CEN

[2F] [7C] [6F] BOT

*(Where F=Front, C=Center, R=rear Lights OFF, NO Humidity)*

Performance Verification (PQ) Satisfactory: [Y][N]

(PQ)CHECKED BY .....

Date: ...../...../.....