# AQUARIUM LARGE VOLUME LIQUID BATH MODEL 820

User Maintenance Manual/Handbook

**Isothermal Technology Limited, Pine Grove, Southport, PR9 9AG, England**
**Tel: +44 (0)1704 543830 Fax: +44 (0)1704 544799 Internet: www.isotech.co.uk E-mail: info@isotech.co.uk**

ISOTECH

# CONTENTS

## CE EMC INFORMATION

This product meets the requirements of the European Directive on Electromagnetic Compatibility (EMC) 89/336/EEC as amended by EC Directive 92/31/EEC and the European Low Voltage Directive 73/25/EEC, amended by 93/68/EEC. To ensure emission compliance please ensure that any serial communications connecting leads are fully screened.

The product meets the susceptibility requirements of EN 50082-1, criterion B.

| Symbol Identification | Publication | Description |
|---|---|---|
| ⚠ | ISO3864 | Caution (refer to handbook) |
| (hot surface symbol) | IEC 417 | Caution, Hot Surface |

## ⚠ ELECTRICAL SAFETY

This equipment must be correctly earthed.

This equipment is a Class I Appliance. A protective earth is used to ensure the conductive parts cannot become live in the event of a failure of the insulation.

The protective conductor of the flexible mains cable which is coloured green/yellow MUST be connected to a suitable earth.

The blue conductor should be connected to Neutral and the Brown conductor to Live (Line).

Warning: Internal mains voltage hazard. Do not remove the panels.

There are no user serviceable parts inside. Contact your nearest Isotech agent for repair.

Voltage transients on the supply must not exceed 2.5kV.

Conductive pollution, e.g. Carbon dust, must be excluded from the apparatus. EN61010 pollution degrees 2.

# ⚠ HEALTH AND SAFETY INSTRUCTIONS

1. Read this entire handbook before use.
2. Wear appropriate protective clothing.
3. Operators of this equipment should be adequately trained in the handling of hot and cold items and liquids.
4. Do not use the apparatus for jobs other than those for which it was designed, i.e. the annealing of thermometers.
5. Do not handle the apparatus when it is hot (or cold), unless wearing the appropriate protective clothing and having the necessary training.
6. Do not drill, modify or otherwise change the shape of the apparatus.
7. Do not dismantle the apparatus.
8. Do not use the apparatus outside its recommended temperature range.
9. If cased, do not return the apparatus to its carrying case until the unit has cooled.
10. There are no user serviceable parts inside. Contact your nearest Isotech agent for repair.
11. Ensure materials, especially flammable materials are kept away from hot parts of the apparatus, to prevent fire risk.

# GUARANTEE

This instrument has been manufactured to exacting standards and is guaranteed for twelve months against electrical break-down or mechanical failure caused through defective material or workmanship, provided the failure is not the result of misuse. In the event of failure covered by this guarantee, the instrument must be returned, carriage paid, to the supplier for examination and will be replaced or repaired at our option.

FRAGILE CERAMIC AND/OR GLASS PARTS ARE NOT COVERED BY THIS GUARANTEE

INTERFERENCE WITH OR FAILURE TO PROPERLY MAINTAIN THIS INSTRUMENT MAY INVALIDATE THIS GUARANTEE

**RECOMMENDATION**

The life of your **ISOTECH** Instrument will be prolonged if regular maintenance and cleaning to remove general dust and debris is carried out.

ISOTHERMAL TECHNOLOGY LTD.
PINE GROVE, SOUTHPORT
PR9 9AG, ENGLAND

TEL: +44 (0) 1704 543830/544611
FAX: +44 (0)1704) 544799

The company is always willing to give technical advice and assistance where appropriate. Equally, because of the programme of continual development and improvement we reserve the right to amend or alter characteristics and design without prior notice. This publication is for information only.

# TEMPERATURE CALIBRATION USING STIRRED-LIQUID BATHS

## OPENING REMARKS

Practical thermometry is derived by relating the gas laws (Boyle, Charles, Avagadro) to practically realisable devices such as triple-, freeze- and melt-point cells of various very pure substances.

Calibration is carried out after heat transfer processes have produced thermal equilibrium between apparatus containing the cell and temperature sensors placed in them.

Energy exchange is governed by the laws of thermodynamics. Such has been the difficulty of understanding this area of science that only after the first three laws were discovered was the most fundamental property defined. Consequently, this was called, somewhat incongruously, the zeroth law. It states: "If two systems, in equilibrium, each have the same temperature as a third, then they also have the same temperatures as each other".

Read the zeroth law a few times and think about it; it is the key factor in being able to make comparison calibrations. Translated, it says that if a calibrated standard thermometer is at the same temperature as a calibration bath and an industrial temperature sensor is also at the same temperature as the bath, then the calibrated standard and the industrial sensor will be at the same temperature as each other.

An intriguing truism also to bear in mind is: "A thermometer measures its own temperature". This, of course, applies to a contact-type thermometer and refers quite specifically to the sensing element within it. Immediately called into question is the manner of application of the thermometer to ensure establishment of thermal equilibrium as defined by the zeroth law. Factors that introduce errors and uncertainties will be discussed later.

## TEMPERATURE CALIBRATION WITH STIRRED-LIQUID BATHS

Calibrating thermometers is done at many levels of accuracy. For highest accuracies, freeze-point cells have been designed, together with Standard Platinum Resistance Thermometers (S.P.R.T.'s) to realise temperatures defined by the gas laws (upon which laws practical temperature scales are based).

Personnel involved at this level of measurement can easily become dismissive of the problems faced daily by plant maintenance engineers whose job it is to ensure that temperature sensors, indicators and controllers are reading correctly. We neglect this area at our peril since it represents the majority of calibrations performed daily and is one of the most important reasons for introducing temperature scales in the first place.

This tutorial acknowledges, and attempts to redress, the omission, albeit in a simplified and generalised manner.

During the past decade there has been an increase in the use of stirred-liquid baths for industrial calibration work. It is to the users and would-be users of these products that this tutorial is addressed.

## BASIC PRINCIPLES

The principle implicit in the operation of calibration baths is that of maintaining spatial and temporal uniformity of temperature in the measuring zone. This represents an ideal situation, although a well-designed bath can provide a close approximation to these conditions. Mechanical and thermal properties of the heat transfer fluid will both have an influence on spatial uniformity of temperature in any given system. Heat sources and cooling devices are necessarily localised and the distribution of energy by way of the thermal transport properties of the fluid will, in general, require to be supplemented by forced convective mixing to achieve the desired aim. A fluid circulating or agitating mechanism in conjunction with a suitable configuration of flow-path can be very effective in producing a sufficiently uniform temperature, provided that the fluid viscosity is low. In practice, different liquids will be employed to cover the total temperature range applicable to calibration baths.

Bath temperatures are normally controlled by a proportional or proportional-integral-derivative (often called 3-term or PID) system, sometimes with an auto-tune facility. The very nature of this type of control (as distinct from, say, the constancy of fixed-point temperatures) inevitably involves the feature of temperature cycling, however small. Typically, there will be short-term fluctuations superimposed upon longer-term, greater amplitude, fluctuations and any measurement technique must take this situation into account.

For carefully-executed comparison measurements, neither small short-term swings nor slow long-term drifts need invalidate the calibration procedure; indeed, making satisfactory calibration measurements is feasible because:

i. The ratios of PRT resistances and emf-deviations between thermocouples of a given type are not particularly sensitive to small temperature changes (of a magnitude easily realisable by thermostatic controllers) provided that these changes apply equally to all thermometers involved (no temperature gradients).

ii. It is not difficult to determine a suitable period of time over which to evaluate meaningful average values, if thought necessary.

iii. Metal blocks of high thermal inertia and conductance can often be used (depending on thermometer size and shape) to attenuate temperature swings in the bath and to provide good thermal coupling between thermometers.

## INFERENCES OF USING SENSORS "NOT DESIGNED FOR CALIBRATION"

Unlike S.P.R.T.'s, which are designed solely for calibration purposes, the great majority of industrial temperature sensors are designed with insufficient consideration of their suitability for calibration.

For example, an engineer wished to measure ambient temperature to an accuracy of $\pm$0.001°C. He proposed the use of a temperature sensor 40mm long. When asked how he proposed to calibrate his sensor, he confessed not have considered this aspect of his measurement.

Most industrial temperature sensors are designed to penetrate a pipe, or to strap on to a surface, or even to fit into the wall of a vessel or into a thermowell attached to it.

In a perfect world the industrial temperature sensor would be long enough to calibrate without errors caused by heat transfer along the stem. Thermocouples and bead thermistors, because of their small size, not only measure temperature essentially at a point but, also, can be contained in a thermometer tube of small diameter. On the other hand, sensing elements of industrial platinum resistance thermometers have a length of, typically, 25mm and require envelopes of relatively large (e.g. 6mm) diameter to contain them; both dimensions constrain the magnitude of minimum acceptable immersion length to enable a given level of temperature measurement accuracy to be attained.

In practice, sensors can be as short as 40mm, or can even be surface-mounted, with no immersion. These devices do not fulfil the zeroth law's requirement that they be in thermal equilibrium with no nett heat transfer occurring when readings are steady.

At some shortness, the sensor ceases to be a thermometer in the normally accepted sense of the word. This applies to many industrial temperature sensors.

The short sensor assumes a temperature somewhere between that of the process it is supposed to measure and ambient temperature.

Our works engineer faces a true dilemma with such a device. Should he calibrate the sensor according to traditional practice by immersing it sufficiently into a medium for it to assume the medium's temperature? Should he, more controversially, immerse it only to the same length as it was in normal use? Or, should he calibrate it in situ?

The last solution is the correct one, if some way can be found to measure the true process temperature (once or twice a year, say), with a calibrated and properly-immersed sensor, whilst recording the reading of the normal measuring instrument. This will give the most representative results. Commonly, it is not possible to carry out this procedure. Removal of the sensor and immersion in a calibrator to a similar length as that in use is the next best solution.

## SOME THOUGHTS ABOUT CALIBRATORS

Ideally, the calibrator's heat transfer characteristics should match those of the normal measuring situation. One important factor affecting calibration accuracy is the contact between the sensor and the calibrator.

For example, most removable temperature sensors fit into a pocket or thermowell; hence, there is an air gap, however small, between sensor and inside wall of the pocket. The calibration of such a sensor in a metal block calibrator can provide conditions that simulate those of the sensor in its pocket.

Conversely, a very short sensor normally directly immersed into a liquid will not give the same results in a metal block calibrator. It should be calibrated in a stirred-liquid bath.

## SUMMARISING PART 1 OF THIS TUTORIAL

Ideally, an industrial temperature sensor should be long enough so that, when immersed in a calibration bath, errors due to stem conduction can be ignored. (A means of evaluating stem conduction error is given in the Appendix.)

If the sensor is unlikely to meet this criterion (and it cannot be calibrated in situ) it should be calibrated in a system which, as nearly as possible, simulates the sensor in its working environment.

## TWO WRONGS CAN MAKE A RIGHT (APPROXIMATELY)

Many industrial temperature sensors are too short to be calibrated satisfactorily because of stem conduction errors. Arranging the standard so that its sensing element is at the same level as that of the short sensor subjects the standard to more nearly equal stem conduction errors and thus provides a measure of compensation that enables a more realistic appraisal to be made of the short sensor's characteristics.

Calibrating using external standards offers many advantages.

# CAN SENSORS BE DAMAGED BY THE LIQUIDS IN A STIRRED LIQUID BATH?

The extent of chemical attack will depend on the liquid and on the sensor sheath material. However, liquids can be selected (e.g. water, many oils, alcohol, silicone fluids) that produce virtually no observable corrosion for all normally used thermometer sheath materials.

Thermometer sheaths should be cleaned using chlorinated solvents before and after calibration.

Molten salts can be used for high temperature calibration but they can attack many materials, including quartz! Hence austenitic stainless steel pockets must be used to protect sheaths from the fluid.

# APPENDIX; THERMOMETER IMMERSION

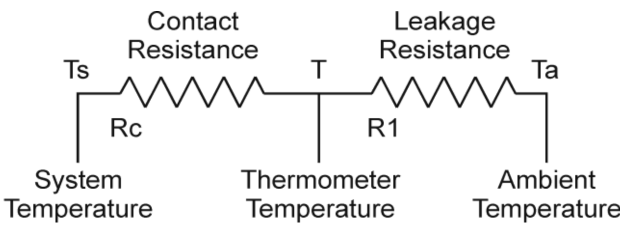
A Definition:

"A thermometer is sufficiently immersed in a system when there is no heat flow between the sensing element and its environment through the leads or sheath that extend to the ambient environment".

Heat flowing through the thermometer from or to ambient temperature is absorbed or replaced by the system in the form of conduction, convection and radiation. The simple heat flow equation:

$$\Delta T = qR$$

(temperature difference = rate of flow x thermal resistance) can be interpreted by comparison with Ohm's law, which relates potential difference to current and electrical resistance in a perfectly analogous fashion.




i. The greater the immersion length, the greater is the leakage resistance; therefore, the thermometer should be immersed as far as is practicable.

ii. The greater the immersion length, the smaller the contact resistance is likely to be.

iii. The contact resistance depends also on the thermal conductivity of the system and if a fluid is present, on how fast it is flowing.

A simple formula giving the measurement error caused by finite immersion length is:

$$T_e = T - T_s = (T_a - T_s)k \exp(-L/D_e)$$

where:

$T_e$ = Temperature Error

$T_a$ = Ambient Temperature

$T_s$ = System Temperature

k = Constant (approximately equal to, but less than, unity)

L = Immersion Length of the thermometer

$D_e$ = Constant, called the effective diameter of the thermometer

The over-riding influence on $T_e$ is L; by making L large enough, $T_e$ can be reduced to an insignificant value.

The length of the sensing element (assumed to be inserted to the bottom of the thermometer sheath) must be added to the calculated minimum immersion length to give the total immersion length required for the thermometer tip.

As a rule of thumb, for immersion in a liquid, if the accuracy of temperature measurement required is expressed as the percentage p of the deviation of the system temperature from ambient, the total immersion length required is n thermometer-diameters plus the sensing element length, where:

$$n = 2.3 \times (2 - \log_{10} p)$$

e.g. for $p = 0.01$, $n = 9.2$ (10, say)
for $p = 1$, $n = 4.6$ (5, say)

It is prudent to add a further 3cm to the immersion length if the thermometer is to be sited in a well (implying the presence of an air-gap) rather than being exposed to liquid-contact.

## PRACTICAL APPLICATIONS

In instances where the conductivity of the system is poor, or where high precision in the measurement is desired, a simple exercise can be carried out to determine $D_e$ and $T_s$. At least 3 measurements must be made.

Suppose measurements are made at each of the immersion lengths $L_1$, $L_2$, $L_3$, where $L_1 - L_2 = L_2 - L_3 = \Delta L$ and the resulting temperatures are $T_1$, $T_2$, $T_3$ respectively.

It follows that:-

$$T_s = T_1 + \frac{T_2 - T_1)^2}{2(T_2 - T_1) - (T_3 - T_1)}$$

and

$$D_e = \Delta L / \ln \frac{(T_s - T_1)}{(T_s - T_2)}$$

### Example

Suppose 3 measurements made at immersion lengths of 3, 4 and 5cm give measured temperatures of 115°C, 119°C and 121°C. What is the value of system temperature and of the effective diameter of the thermometer?

$$T_s = 115°C + \frac{(119 - 115)^2}{2(119 - 115) - (121 - 115)} °C = 123°C$$

and

$$De = (4 - 3)/\ln \frac{(123 - 115)}{(123 - 119)} \text{ cm} = 1/\ln(2) \text{ cm} = 1.4\text{cm}$$

# INTRODUCTION

The Aquarium has been designed to provide a liquid calibration bath with a volume large enough to hold many temperature probes simultaneously.

The liquid in the bath is controlled to a temperature selected on the microprocessor based temperature controller. The temperature may be set and read to a resolution of 0.1°C.

## On Arrival

Check that you have the following parts:

1. Bath Assembly
2. Equalising Block (optional)
3. Handbook
4. Liquids (optional)
5. PC communications lead

# GENERAL LAYOUT

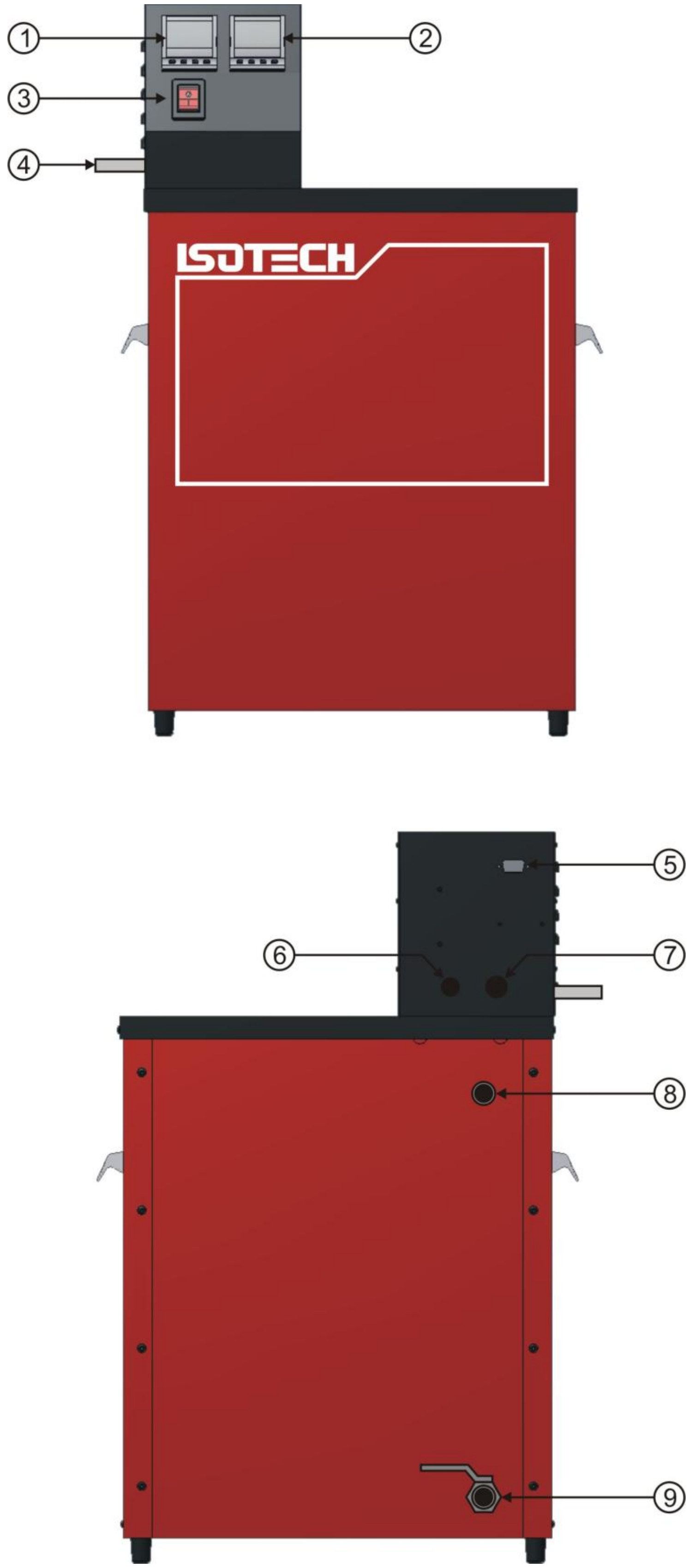



**Figure 1**

1. Controller
2. Overtemperature controller
3. Main power switch
4. Cooling coil
5. PC comms socket
6. Main Fuse
7. Main supply lead
8. Overflow pipe
9. Drain Tap

# LIQIUD LEVEL

The liquid level is important for successful operation of the bath. Normal running level would be approximately 90mm below the top panel of the bath. The exact level is not critical but should be monitored regularly to ensure that it either:

- Does not drop too low and cause problems with stirring or expose the lower level of the heater
- Does not rise too high and overflow via the overflow pipe fitted to the rear of the bath

Pay particular attention when the bath is heating or cooling as the liquid will either expand or contract.

# CHANGING LIQUIDS

1. Drain using the drain tap on the rear of the bath.

2. Fill to the prescribed level with water and a non foaming detergent. Run at 40°C for 5 minutes. Drain this out.

3. Repeat with clean water.

4. Dry

5. Fill with next liquid.

The above applies where the liquids are non miscible such as water and oil.

Where one is changing from one viscosity oil to another, it is only necessary to drain out and refill, a small amount of cross contamination is not a problem.

## ⚠ CAUTION

If you change from water to oil without drying the tank, the water will boil in the oil at around 100°C with sometimes catastrophic results.

# COOLING COIL

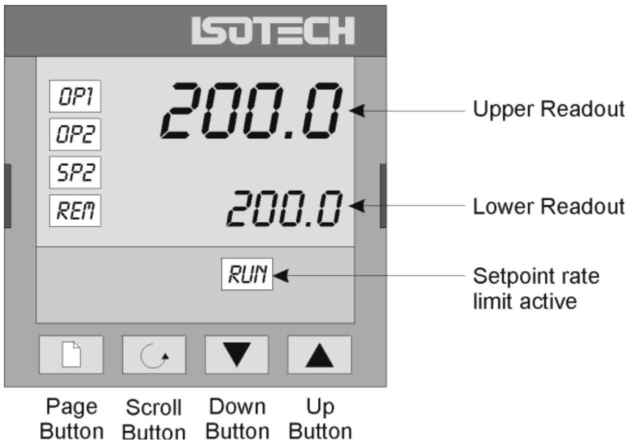
## USING THE COOLING COIL

The 820 has an internal cooling coil fitted. Access for the cooling coil is via two pipes on the controller box side panel (see fig 1 item 4).

Water passed through the coil will substantially reduce the cooling time. To avoid any hazard from the expansion of water to steam do not use water at temperatures in excess of 100°C and ensure water is drained from the coil before setting the 820 above 100°C.

# OPERATING THE CONTROLLER

## FRONT PANEL LAYOUT




### The Temperature Controller

The controller has a dual display, the upper display indicates the nominal block temperature, and the lower display indicates the desired temperature or setpoint.

### Altering the Setpoint

To change the setpoint of the controller simply use the UP and DOWN keys to raise and lower the setpoint to the required value. The lower display changes to indicate the new setpoint.

## ADVANCED CONTROLLER FEATURES

### Setpoint Ramp Rate

By default the Dry Blocks are configured to heat (and cool) as quickly as possible. There may be some calibration applications where it is advantageous to limit the heating (or cooling rate).

An example might be when testing bimetallic thermostats; by forcing the Dry Block to heat at a controlled rate it is easier to determine the temperature at which the thermostat changes state.

The Dry Block can have its heating rate limited with the Setpoint Ramp Rate feature. This feature is accessed from the Scroll key. Depress the key until the display shows,

SPrr

On the Upper Display, the lower display will show the current value from OFF (default) to 999.9. The desired rate is set here with the UP and DOWN keys, the units are °C/min.
When the SPrr is active the controller display will show "RUN", the lower setpoint display will now automatically update with the current value, known as the working setpoint. The setpoint can be seen by pressing either the UP and DOWN key.

The Setpoint ramp rate operates when the bath is heating and cooling.

### Instrument Address

The controller has a configurable "address" which is used for PC communications. Each instrument has an address, this allows several instruments to be connected in parallel on the same communications bus. The default value is 1. This address would only need to be changed if more than one Dry Block is connected to the same PC port.

To check the Address value press the scroll key until the top display indicates,

Addr

The lower display will show the current value that can be modified with the UP and DOWN keys.

### Monitoring the Controller Status

A row of beacons indicate the controllers status as follows,

| | |
|---|---|
| OP1 | Heat Output |
| OP2 | Cool Output (Only for models which operate below 0°C) |
| REM | This beacon indicates activity on the PC interface |

### Units

Momentary pressing the Scroll key will show the controller units °C or °F.

## OVERTEMPERATURE CONDITION

In the unlikely event of an overtemperature or under temperature condition the 820 will go to Alarm condition. Depending which of the alarms has been triggered the unit will either disable the heater or the cooler accordingly.

The Temperature Policeman controller will identify which alarm has been triggered by the scrolling lower display. The message will read as follows:

**OVERTEMPERATURE CONDITION – ATTENTION REQUIRED**
**UNDERTEMPERATURE CONDITION – ATTENTION REQUIRED**

The respective illuminated beacon will also switch off.

To reset the heater or cooler, the condition must be removed, that is the temperature must be restored to the correct value by either waiting for the temperature to normalize, or by resetting the controller to a more suitable value.

The controller will need to be reset manually, even if the controller is switched off, it will still power up again in the alarm condition until reset.

To reset the controller, ensure the temperature for both over and under temperature is safe then press both the PAGE button and the SCROLL button simultaneously. The scrolling warning display will disappear and the illuminated beacon light up.

# DIAGNOSTIC ALARMS

These indicate that a fault exists in either the controller.

## CONTROLLER ERROR MESSAGES

The instruments include powerful diagnostics and in the unlikely event of an internal failure, or a sensor error, one of the following error messages may be displayed.

| **Display shows** | **What it means** | **What to do about it** |
|---|---|---|
| EE.Er | *Electrically Erasable Memory Error:*<br>The value of an operator or configuration parameter has been corrupted | For Controller: Contact Isotech<br>For Indicator: Check Config Against Data in Appendix |
| S.br | *Sensor Break:*<br>Input sensor is unreliable or the input signal is out of range. | For Controller: Contact Isotech<br>For Indicator: Check a sensor is connected. Check that only a PRT or a TC is Connected (Not both) |
| HW.Er | *Hardware error* :<br>Indication that a module is of the wrong type, missing or faulty | Contact Isotech |
| LLLL | *Out of Display range, low reading* | For Controller: Contact Isotech<br>For Indicator: Check Sensor and Connections |
| HHHH | *Out of Display range, high reading* | For Controller: Contact Isotech<br>For Indicator: Check Sensor and Connections |
| Err1 | *Error 1: ROM self-test fail* | Consult Isotech |
| Err2 | *Error 2: RAM self-test fail* | Consult Isotech |
| Err3 | *Error 3: Watchdog fail* | Consult Isotech |
| Err4 | Error 4: Keyboard failure<br>Stuck button, or a button was pressed during power up. | Switch the power off and then on without touching any of the controller buttons. |
| Err5 | *Error 5: Input circuit failure* | Consult Isotech |
| Pwr.F | *Power failure*. The line voltage is too low | Check that the supply to the controller is within the rated limits |

# NORMAL RUNNING

Fill the bath with the appropriate liquid.  Set the controller and overtemperature controller to the required temperature and wait for the bath to stabilise.  Place a suitable container beneath the over-flow pipe.  The normal way to use the bath is by comparing a known calibrated standard to the unknowns being calibrated.

The equalising block options allow for the convenient support of temperature sensors, and also helps to reduce temperature swings in the bath, see tutorial.

# CAL NOTEPAD

Cal Notepad can be used to log and display values from the Dry Blocks and an optional temperature indicator.

## MINIMUM SYSTEM REQUIREMENTS

CNP requires Windows 95/98, a minimum of 5Mb of free hard drive space and free serial ports for the instruments to be connected.

## DEVELOPMENT

CNP was developed by Isothermal Technology using LabVIEW from National Instruments.

### License

Use of the Cal NotePad software program "CNP" is as granted in this license agreement. In using the CNP software the user "licensee" is agreeing to the terms of the license. You must read and understand the terms of this license before using CNP.
1, This license permits licensee to use CNP software on a single computer. The user may make copies for backup and archival purposes freely as long as the software is only ever in use on a single computer at any one time. Please enquire about multi-user licenses.
2, CNP is protected by international copyright laws and treaties. CNP must not be distributed to third parties.
3, CNP must not be reversed engineered, disassembled or de-compiled. Licensee may transfer the software to a third party provided that no copies or upgrades of CNP are retained.
4, It is the responsibility of the user to ensure the validity of all stored results and printed certificates. Isothermal Technology Ltd accept no responsibility for any errors caused by inappropriate use, incorrect set up or any other cause; including defects in the software.
5, Limited Warranty. Isothermal Technology warrants that CNP will perform substantially as described in this manual for a period of 90 days from receipt. Any distribution media will under normal used be guaranteed for a period of 90 days.

NO OTHER WARRANTIES, EXCEPT AS STATED ABOVE. The software and documentation is provided "as is" without warranty of any kind and no other warranties (either expressed or implied) are made with regard to CNP. Isothermal Technology does not warrant, guarantee or make any representations regarding the use or results of the use of the software or documentation and does not warrant that the operation of CNP will be error free.

In no event will Isothermal Technology, its employees, agents or other associated people be liable for direct, indirect, incidental or consequential damages, expenses, lost profits, business interruption, lost business information or other damages arising out the use or inability to use CNP. The license fee reflects this allocation of risk.

CNP is not designed for situations where the results can threaten or cause injury to humans.

# CAL NOTEPAD

Cal Notepad can be used to log and display values from the Dry Blocks and an optional temperature indicator.

## Minimum System Requirements

CNP requires Windows 9X, XP, a minimum of 5Mb of free hard drive space and free serial ports for the instruments to be connected.

## Development

CNP was developed by Isothermal Technology using LabVIEW from National Instruments.

### License

Use of the Cal NotePad software program "CNP" is as granted in this license agreement. In using the CNP software the user "licensee" is agreeing to the terms of the license. You must read and understand the terms of this license before using CNP.
1, This license permits licensee to use CNP software on a single computer. The user may make copies for backup and archival purposes freely as long as the software is only ever in use on a single computer at any one time. Please enquire about multi-user licenses.
2, CNP is protected by international copyright laws and treaties. CNP must not be distributed to third parties.
3, CNP must not be reversed engineered, disassembled or de-compiled. Licensee may transfer the software to a third party provided that no copies or upgrades of CNP are retained.
4, It is the responsibility of the user to ensure the validity of all stored results and printed certificates. Isothermal Technology Ltd accept no responsibility for any errors caused by inappropriate use, incorrect set up or any other cause; including defects in the software.
5, Limited Warranty. Isothermal Technology warrants that CNP will perform substantially as described in this manual for a period of 90 days from receipt. Any distribution media will under normal used be guaranteed for a period of 90 days.

NO OTHER WARRANTIES, EXCEPT AS STATED ABOVE. The software and documentation is provided "as is" without warranty of any kind and no other warranties (either expressed or implied) are made with regard to CNP. Isothermal Technology does not warrant, guarantee or make any representations regarding the use or results of the use of the software or documentation and does not warrant that the operation of CNP will be error free.

In no event will Isothermal Technology, its employees, agents or other associated people be liable for direct, indirect, incidental or consequential damages, expenses, lost profits, business interruption, lost business information or other damages arising out the use or inability to use CNP. The license fee reflects this allocation of risk.

CNP is not designed for situations where the results can threaten or cause injury to humans.

## Installing Cal NotePad

1. Insert Isotech Support CD into the CD drive.
2. Allow CD browser to open and install version of Cal NotePad required.
3. Follow the prompts which will install the application and necessary LabVIEW run time support files.
4 Should you ever need to uninstall the software then use the Add/Remove Programs option from the Control Panel.

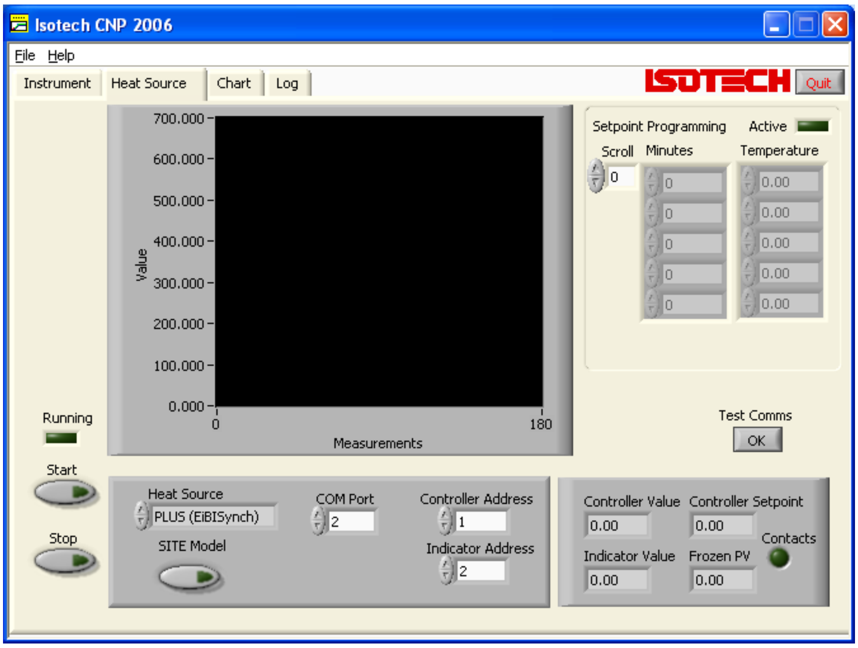
## Starting Cal NotePad

From a Standard Installation:

Click the START button

Highlight PROGRAMS

Select Isotech - Select Calpad




## Protocol

The instruments use the "Modbus Protocol"

If required, e.g. for writing custom software the technical details are available from our website at, [www.isotech.co.uk/refer.html](http://www.isotech.co.uk/refer.html)

# OPTIONAL ACCESSORIES

| | |
|---|---|
| Standard Resistor Holder | 820/01 |
| Standard Equalising Block | 820/02 |
| Medium Viscosity Oil - 40°C to 180°C | 915/07 |
| High Viscosity Oil - 150 to 250°C | 915/08 |
| VH Temperature Oil - 50°C to 288°C | 915/09 |
| Standard Resistor Oil | 932-19-72 |

## EQUALISING BLOCK (optional)