




**MERCURY APPARATUS MODEL  
17725 INCLUDES MERCURY  
CELL MODEL 17724**  
User Maintenance Manual/Handbook

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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.

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## 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)
	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.

## 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 calibration 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 without disconnecting it from the supply and leaving time for it to reach ambient temperature.
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.
12. Ensure adequate ventilation when using oils at high temperatures.
13. Each apparatus is protected by an over temperature circuit. Please consult handbook for details.

## **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.



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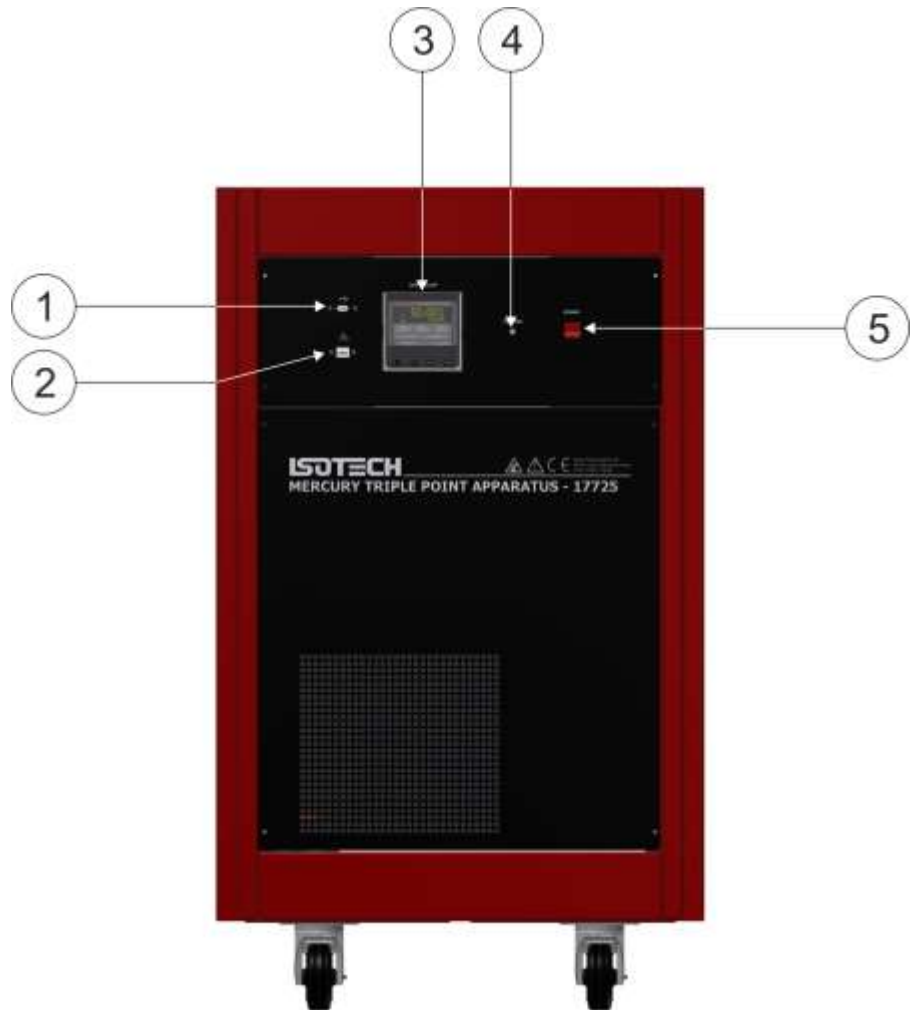
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## GENERAL LAYOUT

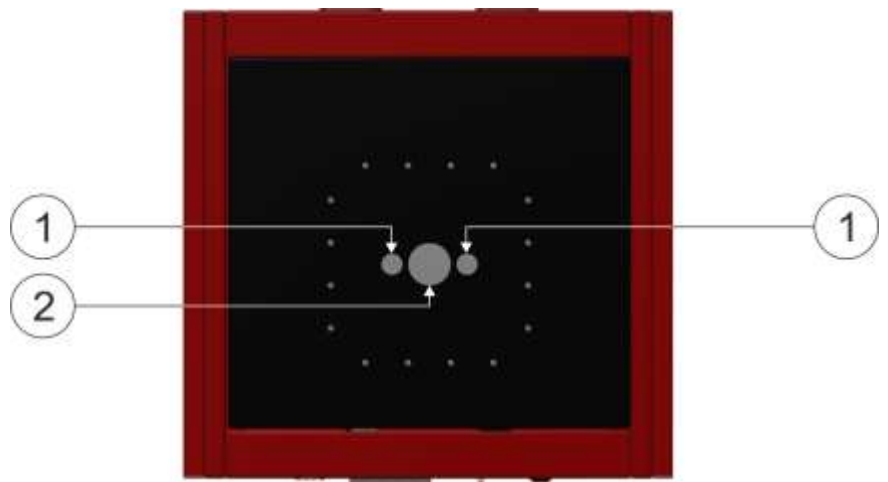
### Front View

1. USB Host Port
2. Ethernet Socket
3. Temperature Controller
4. Cooling Beacon
5. Illuminated Power Switch



### Top View

1. Pre-chill Pockets
2. Well for Cell



## GENERAL INFORMATION

### SYSTEM DESCRIPTION

A temperature standard based upon the triple point of Mercury consists of two essential elements, a cell containing high-purity Mercury and a cryostat in which to initiate a freeze or melt under triple-point conditions and then to maintain the triple point for a useful period of time. The Isotech Mercury Triple Point Temperature Standard provides both of these facilities. The Isotech Model ITL-M-17724 is a hermetic stainless steel cell as described by G Furukawa, et al. in NBS Special Publication 260-77. The Isotech Model ITL-M-17725 Cryostat is a self-contained, mechanically-refrigerated, system with a main well to house one cell and two auxiliary wells for pre-chilling of thermometers. The cryostat temperature is adjustable from  $-36^{\circ}\text{C}$  to  $-42^{\circ}\text{C}$  with scale-divisions of  $0.1^{\circ}\text{C}$  and 24-hour stability better than  $\pm 0.05^{\circ}\text{C}$  measured by an SPRT in the well of a Mercury Cell inside the Cryostat.

The cryostat has several unique features providing outstanding convenience and safety. The refrigeration system has sufficient capacity to bring a cell to operating temperature in about 1 hour. At operating temperature, the cooling rate is about 1 kelvin/minute and the heating rate is about 2 kelvin/minute. This permits rapid changes to be imposed on the temperature of the cell environment to avoid excessive demands on the (low) heat-of-fusion energy of the Mercury within the cell. In addition, all temperature control is accomplished through control of refrigerant flow, providing inherently fail-safe operation. Indicators provided for the cryostat are "POWER ON" and "COOLING". The cryostat provides convenient conditions for operating Mercury fixed point cells both in heating and in cooling mode.

### OPTIMAL CELL SPECIFICATION

**Size:** Overall height: 488mm (19.25in.)  
Outside diameter: 40mm (1.58 in.)  
Well inside diameter: 7.75mm (0.305 in.)  
Active zone: bottom 200mm (8 in.) of well



## CRYOSTAT SPECIFICATION

**Cabinet size:**

970mm (38 in.) high, 610mm (24 in.) wide. 570mm (22.4 in.) deep

**Weight:**

96kg (212lb.)

**Power Requirements:**

220 to 240 VAC, 50Hz or 60Hz (individual units), 3A (15A starting current for less than 1 second)

**Well Dimensions:**

All wells have a depth of 380mm (15 inches) with cooling applied to the lowest 300mm (12 inches). Internal diameters are:

Main well (for cell): 40mm (1.6 inches)

Pre-chill wells: 14mm (0.55 inch)

**Tolerable Ambient Conditions:**

Operating: 15 to 30°C (59 to 86°F), <70% RH

Storage: -30 to 55°C (-22 to 131°F), <85% RH

**Main Well Temperature**

Operating Range: -42 to -36°C

Setting facility: 0.1°C divisions.

Stability  $\pm 0.05^\circ\text{C}$  for a 24 hour period as measured by an SPRT in the well of a cell inside the Cryostat set at -41°C.

## OPERATING INSTRUCTIONS

### INITIAL SETUP

1. Inspect the outside of the cabinet for evidence of shipping damage.
2. Remove the rear panel of the cabinet.
3. Remove the stopper (DO NOT DISCARD) from one of the pre-chill wells and insert a thermometer with a range including -40°C and 25°C.
4. Ensure that the front panel "POWER" switch is off.

 **CAUTION: HAZARDOUS VOLTAGE IS PRESENT INSIDE THE CABINET WHEN POWER IS CONNECTED.**

5. Connect the power cable to an outlet that can supply a continuous current of 3A and 15A (compressor starting current) for about 0.2 second.
6. Locate the sight glass at lower centre-left (viewing from the rear of the cabinet).
7. While observing the sight glass, have someone turn the front panel "POWER" switch on. The sight glass, initially empty, should immediately fill with liquid. This verifies the operation of compressor and liquid-line cut-off valve.
8. Adjust the "SETPOINT" on the controller to -38°C and observe the thermometer reading. The temperature should drop to about -38°C.

NOTE: the pre-chill well is not tightly coupled thermally to the main well and, consequently, will take a longer time to attain a temperature approximately equal to that selected.

9. Observe the "COOLING" indicator light on the front panel. As the temperature approaches the setpoint, the indicator should begin cycling on and off and the temperature should become stable. Cycling should commence about 30-45 minutes after switch-on. This verifies operation of the controller and bypass valve.
10. Disconnect the power supply and replace the rear panel of the cabinet. This completes initial check-out.

## GENERAL CRYOSTAT NOTES

The following notes apply to the cryostat, independently of cell operation (which will be covered in detail later):

1. Air-cooled refrigeration systems operate best when kept clean. Cleaning is accomplished by removing the lower front panel and cleaning the front panel screen and the condenser with an "industrial-strength" vacuum cleaner. This should be done whenever any dust build-up is observed.
2. Moisture is a problem in any low-temperature system exposed to the atmosphere. The wells should be kept closed as much as possible during use and should be kept open when at ambient temperature. Moisture may be removed from the wells by swabbing them with alcohol at room temperature, then drying them with dry compressed air or a paper towel.
3. DO NOT stopper the cryostat wells tightly while they are returning to ambient temperature, lest the stoppers due to expansion of trapped air, unexpectedly become projectiles.
4. The control system on the cryostat will cause an initial overshoot beyond setpoint by as much as 2.5 Kelvins because of a long time-constant. This is normal and will actually be helpful in operating the cell, which has an even longer time-constant.

## GENERAL CELL NOTES

1. While stainless steel cells are far more rugged than glass cells, they are still somewhat delicate, especially the thermometer guide tube.
2. Isotech Mercury Triple Point Cells are sealed with an internal pressure of less than 100 micrometers Hg, so that the effect of any argon (used in initial purging during manufacture) remaining in the cell will be negligible and the temperature at a given point in the thermometer well will be the true triple-point temperature plus the Mercury-column pressure head correction. That the pressure within the cell is low may be verified by holding the cell in a horizontal position and moving it gently back and forth along its axis. As the Mercury sloshes, it should produce sharp clicking sounds caused by the uninhibited collapse of bubbles in the absence of non-condensable gas.
3. The cell is supplied with a collar of closed-cell polyethylene foam around its guide tube. Do not discard this collar as it is the primary defence against moisture entry to the cryostat well when the cell is in use.
4. The thermometer well of the cell should be rinsed with alcohol and dried after each use to prevent build-up of moisture.

## OPERATING INSTRUCTION FOR TEMPERATURE STANDARD

The procedures presented in this section have produced results within  $\pm 1$  mK of the predicted temperature on melt and freeze plateaux respectively. For measurements of the best possible precision, the procedures used by NBS for the original development of the point can be adapted for use with the Isotech cryostat. These procedures are published in the NBS special publication 260-77, "Application of some Metal SRM's as Thermometric Fixed Points" by G. Furukawa, et al. (SRM = special reference material)

### MELTING PROCEDURE

1. Place the Mercury cell into the cryostat well, refer to drawing on page 30 for assembly. Ensure the closed-cell-foam collar and pre-chill well stoppers are in place.
2. Place a calibrated thermometer into the re-entrant tube of the Mercury cell and using a syringe with a thin bore tube attached fill the re-entrant tube up to the inner metal lip of the cell with pure (99.9 %) acetone or ethanol to act as the transfer medium.
3. Turn the cryostat on and adjust the "SETPOINT" temperature to  $-42.00$  °C.
4. Allow a minimum of 3.5 hours (preferably overnight) to allow the cell to freeze completely.
5. Observe the temperature of the calibrated monitor thermometer to ensure the cell is fully frozen.
6. The Mercury triple point is approximately  $-38.83$  °C, alter the set-point temperature to  $+2.00$  °C above this ( $-36.83$  °C) allowing for any controller offset.
7. Place the first thermometer to be calibrated into one of the pre-chill wells.
8. The cell will rapidly increase in temperature onto its melting plateau (the reference thermometer will confirm this with its measured temperature rising to  $-38.83$  °C).
9. The reference thermometer should then be removed from the cell and placed in a pre-chill well.
10. A copper or stainless steel rod, at room temperature should then be inserted into the re-entrant tube of the cell for approximately 2 minutes. This will create an inner melt around the re-entrant tube of the cell and ensure the flattest plateau.
11. The set-point temperature should then be altered to  $-38.33$  °C ( $0.5$  °C above the Mercury triple point) to prolong the plateau.
12. The reference thermometer can then be placed back into the cell, when the thermometer temperature has stabilised, the cell is ready for use.
13. Thermometers to be calibrated should be pre-chilled before being inserted into the cell (see note 7 above).
14. When a thermometer is inserted into the cell the level of the temperature transfer medium should be re-adjusted (see note 2).

15. A plateau duration of between 8 and 12 hours is achievable, dependant on loading and the set-point temperature.
16. To increase the plateau duration the setpoint can be altered from 0.5 °C above to 0.2 °C above the Mercury triple point temperature. (Note, it is important to regularly check the controller offset for accurate setting).

## **FREEZING PROCEDURE**

1. Place the Mercury cell into the cryostat well, refer to drawing on page 30 for assembly. Ensure the closed-cell-foam collar and pre-chill well stoppers are in place.
2. Place a calibrated thermometer into the re-entrant tube of the Mercury cell and using a syringe with a thin bore tube attached fill the re-entrant tube up to the inner metal lip of the cell with pure (99.9 %) acetone or ethanol to act as the transfer medium.
3. The Mercury triple point is approximately -38.83 °C, alter the set-point temperature to approximately -2.00 °C below this (-40.83 °C) allowing for any controller offset.
4. Place the first thermometer to be calibrated into one of the pre-chill wells.
5. Observe the temperature of the reference thermometer as its measured temperature will drop below the fixed point temperature and to continue to drop as the Mercury cell 'super-cools'.
6. The measured temperature will then rapidly increase toward the triple point temperature as the cell begins to freeze.
7. The reference thermometer should then be removed from the cell and placed in a pre-chill well.
8. A copper or stainless steel rod (pre-chilled in liquid nitrogen) should be inserted into the re-entrant tube of the cell for approximately 2 minutes. This will create an inner freeze around the re-entrant tube of the cell and ensure the flattest plateau.
9. The set-point temperature should then be altered to -39.33 °C (0.5 °C below the Mercury fixed point) to prolong the plateau.
10. The reference thermometer can then be placed back into the cell, when the thermometers temperature has stabilised the cell is ready for use.
11. Thermometers to be calibrated should be pre-chilled before being inserted into the cell (see note 4).
12. When a thermometer is inserted into the cell the level of the temperature transfer medium should be re-adjusted (see note 2).
13. A plateau duration of between 8 and 12 hours is achievable, dependant on loading and the set-point temperature.
14. To increase the plateau duration the setpoint can be altered from 0.5 °C below to 0.2 °C below the Mercury triple point temperature. (Note, it is important to regularly check the controller offset for accurate setting).

## THEORY OF OPERATION (Please refer to Figures 1 and 2)

### REFRIGERATION SYSTEM

The refrigeration system is a sealed system with capillary-tube expansion and hot-gas-bypass control. Although the principle is simple, the implementation is complicated by the use of several specialised techniques to achieve a control stability of  $\pm 0.05^{\circ}\text{C}$  as measured by an SPRT in the well of a Mercury Cell inside the Cryostat at  $-41^{\circ}\text{C}$ .

Hot-gas-bypass is a standard technique for controlling refrigeration. It works by providing a controlled flow of super-heated vapour from the outlet of the compressor to the evaporator and/or the compressor suction line. This method provides rapid response and an excellent control range because the full capacity of the refrigeration system is maintained, and, at the other end of the scale can produce strong active heating of the evaporator up to the condenser temperature.

In this system the hot gas is introduced through a special adaptor in the form of a "T" fitting which directs the end of the bypass capillary tube towards the compressor intake, about 2 inches downstream from the lower end of the evaporator coil. Bypass operation is controlled by a (normally-closed) solenoid valve and 1.2m (4ft) of 1.6mm (0.064 in.) I.D. capillary tubing to restrict gas flow when the valve is open. The valve cycle-time is controlled by the temperature controller electronics, and varies from about 5 to 30 seconds, depending on the load on the refrigeration system.

Expansion control is provided by 3m (10ft) of 0.7mm (0.028 in.) I.D. capillary tube. The original design incorporated control of mass flow of refrigerant through the capillary tube by operation of a small heater connected to its inlet end. The heater function was to vaporize a small portion of the refrigerant, thus reducing total mass flow and providing a lower temperature in the evaporator at the expense of cooling capacity. Heater-operation was initiated by the controller electronics whenever the by-pass valve was closed and the evaporator temperature was below  $-30^{\circ}\text{C}$ .

An improvement in compressor performance under standard conditions has made the heater largely redundant. A heat exchanger is provided between the downstream end of the capillary tube and the exit of the evaporator to improve efficiency and reduce temperature gradients in the evaporator.

The evaporator coil is wound to be a close fit around the main well, with refrigerant entering the top of the evaporator and any excess liquid draining into the suction line. The evaporator tube cross section is approximately 4mm (0.16 in.) x 10mm (0.4 in.), which provides sufficient space for the liquid and vapour to remain in equilibrium throughout the whole length of the evaporator, with minimum pressure difference. This makes the evaporator act as an externally-driven heat pipe, producing excellent temperature uniformity and providing for rapid return to room temperature by transferring heat from the compressor suction service valve.

The evaporator assembly, including all three well-tubes, most of the capillary tube, the hot-gas-bypass "T", the heat exchanger and the temperature sensors used by the control electronics, is a potted semi-hermetic copper shell surrounded by foam-in-place closed-cell urethane insulation all encased in an aluminium housing. This aim to exclude moisture results in the entire assembly being a single non-repairable component. Consequently, two pairs of temperature sensors are included at the time of manufacture.

Colour-codes of sensor leads are as follows:

RT1 (coil)	MAIN: White
RT2 (coil)	AUX: Yellow
RT1 (well)	MAIN: Black
RT2 (well)	AUX: Orange

## CONTROLLER

The controller installed on this equipment is an advanced three loop controller with a multi-channel sensor input.

Other features of the controller are:

- Built in data logging
- Ethernet connection
- USB host for controller updates and data export
- Bright colour display
- Dynamic optimisation of the control PID parameters
- Eight point zone linearization for Main and Annealing furnace
- Built in Programmer, supports 100 programs, each of 25 segments

Before using the controller, please read this manual thoroughly to get the best performance from the equipment.

Certain features used in this controller require different levels of access. The Operator access requires no passcode to use. These functions include:

- Changing the setpoint
- Changing any values using the USER ACCESS PAGE

Other features will require the user to log in as “Supervisor” to carry out these functions. These include:

- Adjusting the PID settings
- Using the Programmer function
- Changing the linearity settings
- Extracting data from the recorder function

Configuration changes to the controller require you log in as “Engineer” to perform these functions. These include:

- Change language selection
- Change °C to °F or K
- Change equipment clock and time zone

## How to log in as the SUPERVISOR:



1. Press the Page button to display the Home menu
2. Scroll to LOG IN
3. Press the SCROLL button
4. Press up to scroll to SUPERVISOR in dialogue box
5. Press the SCROLL button to prompt for a passcode
6. Select code 15 from the soft keyboard
7. Press PAGE button to prompt to accept the changes
8. Select Yes and enter with SCROLL button to display the SUPERVISOR screen
9. When logged in as the SUPERVISOR the equipment will control in the normal way

## How to log in as the ENGINEER:

1. Press the Page button to display the Home menu
2. Scroll to LOG IN
3. Press the SCROLL button
4. Press up to scroll to ENGINEER in dialogue box
5. Press the SCROLL button to prompt for a passcode
6. Select code 17 from the soft keyboard
7. Press PAGE button to prompt to accept the changes
8. Select Yes and enter with SCROLL button to display the ENGINEER screen
9. When logged in as the ENGINEER, the equipment will **not** control the temperature of the heat source



## USING THE CONTROLLER:

### The Isotech splashscreen and controls

#### The USER INTERFACE start up screen and controls:

1. ISOTECH splashscreen
2. PAGE button
3. SCROLL button
4. DOWN button
5. UP button



#### The HOME page:

1. Well temperature
2. Well setpoint
3. Setpoint adjust box
4. Data Record indicator
5. PAGE button
6. SCROLL button
7. DOWN button
8. UP button



## The USER ACCESS page:

1. Proportional band
2. Integral band
3. Derivative time
4. Autotune feature
5. Units select (C, F, K)
6. Fixed offset
7. Network IP type
8. Setpoint ramp feature (°C/min)



## To change the Setpoint of the equipment:

1. From the ISOTECH homepage, press the SCROLL button once, this will highlight the SETPOINT ADJUST box.
2. Press the SCROLL button once more and this will allow adjustment of the setpoint via the UP/DOWN buttons.
3. Scroll to the desired set point as described above.
4. When the temperature is set, press the SCROLL button again to enter and save the setting.
5. The equipment will now raise or lower the furnace temperature as required.

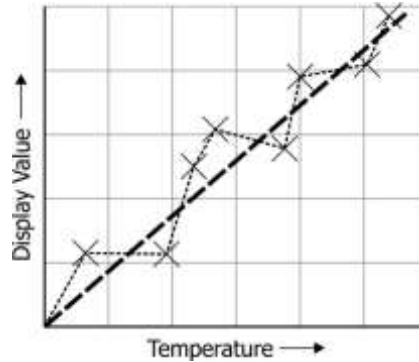
## How to globally change from °C to °F or Kelvin:

1. Log in as the Engineer
2. Scroll to INSTRUMENT
3. Scroll to DISPLAY
4. Scroll to UNITS
5. Select by pressing the Scroll button
6. Use up/down to select from °C, °F or Kelvin
7. Press the Page button to exit and save the selection

## PROCESS TO APPLY A USER LINEARIZATION TO THE EQUIPMENT

From time to time the control sensors inside the furnace will need to be adjusted as the sensor drifts with time. The controller has the capability to compensate for these errors using an eight point correction curve. This will need to be regularly checked for errors and can easily be corrected within the controller using the following procedure.

The image below illustrates a simplified graphical view of the process.



Isotech standard offset values are set at the following temperatures:

1. -42.0
2. -39.0
3. -36.0

Points 4, 5, 6, 7 and 8 are unused as standard.

Please follow the procedure below to linearise the controller display value:

1. Set the equipment up as it will be used with a fixed point cell using either a cell or a simulation of the cell using a thermally efficient metal block suitable for use over the temperature range (Aluminium would be ideal)
2. Place a reference thermometer inside the cell or simulation
3. Set the furnace to the lowest (coldest) useable temperature (recommendation would be to use the temperatures listed above)
4. Allow the system to thermally stabilise
5. Press the PAGE button to enter the SUPERVISOR menu
6. Scroll to the CHANNELS tab and enter with the SCROLL button
7. Select CHANNEL 1
8. Scroll to the ISOTECH tab and enter with the SCROLL button
9. Scroll to CAL STATUS and enter with the SCROLL button
10. Scroll to POINT 1 and note the value from the reference thermometer

***The controller is now ready to accept a value. Ensure the equipment is thermally stable, you will now need to use the temperature value displayed by the reference thermometer.***

11. Record the value on the reference thermometer and scroll to DISPLAY VALUE tab and press enter
12. This will bring up a soft keyboard, use this keyboard to enter the exact temperature displayed by the calibrated reference standard
13. Press the PAGE button to enter the value, the controller will ask you to confirm the settings. Select YES and enter the value
14. The controller will now accept the value and move to POINT 2 on the display
15. Exit back to the homepage and check the value on the relevant display window
16. When confirmed, move to the next temperature and repeat the process for point 2 and so on

**Important Note:** Ensure that Point 1 is always used as the lowest temperature and offsets are entered in *ascending* order. If the values are placed out of order then the controller will disregard them.

### **Enabling the AUTOTUNE feature:**

The equipment has the ability to AUTOTUNE the control parameters to hone the temperature stability at a specific block temperature. When enabled it will allow the controller to cycle the temperature of the block and calculate the best values for this temperature. After two cycles it will install the calculated values and use these for the control loop.

*You are not required to log in to access this feature.*

To enable the AUTOTUNE feature:

1. Scroll to the USER ACCESS page
2. Press the Scroll button and then select the XXX AUTOTUNE feature using the down button
3. Press the Scroll button again to highlight the feature
4. Use the up/down button to select ON
5. Press the Scroll button again to enter the value.
6. The controller will now begin the tuning process

During the tuning process, AT can now be seen to the left of the clock on the ISOTECH homepage.

To disable the tuning feature during a tune, repeat the process above and select OFF. This will now disable the tune and install the previous values.

### **How to change the Date and Time or the Language of the equipment:**

The Date and time of the equipment can be changed to suit local time. This can also incorporate the any daylight saving time in the time zone of your country or region. The display language of some of the display screens can also be change to suit the local language.

The options for this are:

- English
- French
- German
- Italian
- Spanish

Note: Only the Supervisor and Engineer menus will read in the alternative language. The Isotech Home screen will still read in English when this feature is used.

### To change the DATE and TIME or LANGUAGE:

- To access these features you will need to log in as the Engineer.
- When logged in, scroll to the INSTRUMENT tab on the Engineer homepage
- Press the SCROLL button to enter
- Scroll to CLOCK and enter by pressing SCROLL button
- Alternatively scroll to LOCALE and enter by pressing SCROLL button
- Adjust as necessary and exit engineer mode

### The NETWORK INTERFACE:

Access to the NETWORK interface is available when logged in as the ENGINEER. This will allow adjustment to various network parameters, should they need to be adjusted.

This menu allows writeable access to:

- IP type (FIXED or DYNAMIC)
- IP address
- Subnet Mask
- Gateway

and Read only access to:

- MAC address
- Client identifier

### To access the NETWORK INTERFACE:

1. Log in as the ENGINEER
2. From the ENGINEER page scroll to NETWORK tab and enter with the SCROLL button
3. Scroll to INTERFACE and enter with the scroll button
4. Scroll to and adjust desired parameter using the pop out soft keyboard

### DATA LOGGING:

The equipment will always record data UNLESS the equipment is in ENGINEERING mode. This is indicated by the green **R** in the bottom left hand side of the ISOTECH homepage.

The data can either be extracted via the USB socket on the front panel or to a PC by means of the FTP protocol (Remote Archiving) using REVIEW software, see page 31 for details.

To back up the data via USB stick on the control panel use the following procedure:

1. Log in as the SUPERVISOR
2. Plug a suitable USB memory stick to the socket on the control panel (page 7, item 1)
3. Ensure the controller has accepted the memory stick by the icon in the lower right of the ISOTECH homepage
4. Press the page button to scroll to the SUPERVISOR menu
5. Scroll to DEMAND ARCHIVING
6. Scroll to ARCHIVE TO and enter, select USB from the options and enter
7. Scroll to ARCHIVE and select from:
  - a. Bring to date
  - b. All
  - c. Last month
  - d. Last week
  - e. Last day
  - f. Last hour
  - g. None
8. When the selection is entered by pressing the SCROLL button, the transfer will begin (this may take several minutes depending on the selection made)
9. When the transfer is complete, remove the USB stick and exit SUPERVISOR mode

The data will be stored in a folder called HISTORY.

### FTP SERVER ARCHIVING:

This allows the archiving of recorder files to a remote computer via the RJ45 type connector at the rear of the recorder, either directly or via a network.

In order to carry out a successful transfer:

1. Details of the remote host must be entered in the **Network Archive** area of configuration
2. The remote computer must be set up as an FTP server. Help from the user's IT department may be necessary in order to achieve this.
3. The remote computer must also be set up to respond to 'pings'. This is because the instrument pings the host whilst establishing connection, if it does not receive a response the archive attempt fails.
4. When accessing files using Microsoft® Internet Explorer, the address (URL) field can be in one of two formats:
5. ftp://<instrument IP address>. This allows a user to log in as the anonymous user (if the recorder has any account with the user name set to 'anonymous' with a blank password).
6. ftp://<user name>:<password>@<instrument IP address> to log in as a specific user.

For IE5 users, Microsoft® Internet Explorer displays, by default, history files only. To quit the history folder, either uncheck the Tools/Internet Options/Advanced/Browsing/'Enable folder view for FTP sites' option, or check the Tools/Internet Options/Advanced/Browsing/'Use Web based FTP' option.

## PROGRAMMER FUNCTION:

### PROGRAM page (no program running)

1. Current program selected
2. Mode (RUN, RESET, HOLD)
3. Current Well temperature
4. Well set temperature
5. Status



### Program page (program running)

1. Program status (running)
2. Segment type
3. Program progress
4. Segment time remaining
5. Program time remaining
6. Segment progress



The equipment has an on-board PROGRAMMER function built in. The PROGRAMMER runs in SEGMENTS and can store up to 100 programs, each containing 25 segments.

This feature is particularly useful for an automated calibration run, the test data can then be extracted and converted to a spreadsheet using the REVIEW software available.

The programs can either be created using the available software (page 31), or using the control interface on the equipment.

The software can be downloaded at [www.isotech.co.uk/downloads](http://www.isotech.co.uk/downloads). Once created, a program can be sent directly to the instrument via the network connection or saved to a USB memory stick and imported from there via the USB socket on the controller panel

Instructions and details of installation are supplied with the download.

Below is the procedure to install a program for Channel I

1. Log in as the Engineer
2. Scroll to PROGRAMMER and enter
3. Scroll to SET UP and enter
4. Scroll to CHANNELS and enable channel 2

To create, install and run a PROGRAM via the controller interface please follow the instructions below:  
See below for a more detailed description of each of the PROGRAM functions.

## PROGRAM DETAILS:

### Operation

This allows the user to select one of the following:

Load. Opens the program store and allows the user to select a program to be loaded.

Store. Allows the current program to be saved to the internal program drive. This is useful if you wish to snapshot the current program and store this under a different program name.

Delete. Allows the selected program to be deleted.

Delete All. Deletes all programs.

Copy. Copies the selected program for 'pasting' either from the internal drive to the USB device, or vice-versa. This is useful if you wish to transfer a program to other instruments.

Copy All. As above, for 'Copy', but copies all the programs in the selected directory.

Note: If a 'Store', 'Copy' or 'Copy All' operation would result in there being a total of more than 100 program files in the internal drive, the operation fails and an error message is displayed.

### Status

Success. Previous operation was successful.

Failed. Previous operation failed.

Loading. The program is loading.

Copying. The program copy process is underway.

Deleting. The relevant program is being deleted.

### Program

The name of the program currently loaded.

### Holdback Style

Appears only if 'Holdback' is enabled. See 'Holdback', below.

### Program:

Holdback applies to all appropriate segments.

Per Segment: Holdback enabled on a segment by segment basis as described in 'Segment configuration below.

### Ch I Holdback

Appears only if 'Holdback Style' (above) is set to 'Program'.

Off: Holdback is disabled

Low: Holdback is entered when  $PV < (PSP - \text{Holdback Value})$

High: Holdback is entered when  $PV > (PSP + \text{Holdback Value})$

Band: Holdback is entered when  $PV < (PSP - \text{Holdback Value})$  or  $PV > (PSP + \text{Holdback Value})$

### Ch I Holdback value

The value to be used in triggering holdback.



**Ramp Style**

Ramp style applies to all ramp segments in the program. Ramp Style can be edited only when the program is in Reset mode. Setpoints, rates, times etc. are set in the individual segment configurations  
Rate. A Ramp Rate segment is specified by a target set-point and the rate at which to ascend/descend to that set-point.

**Time.**

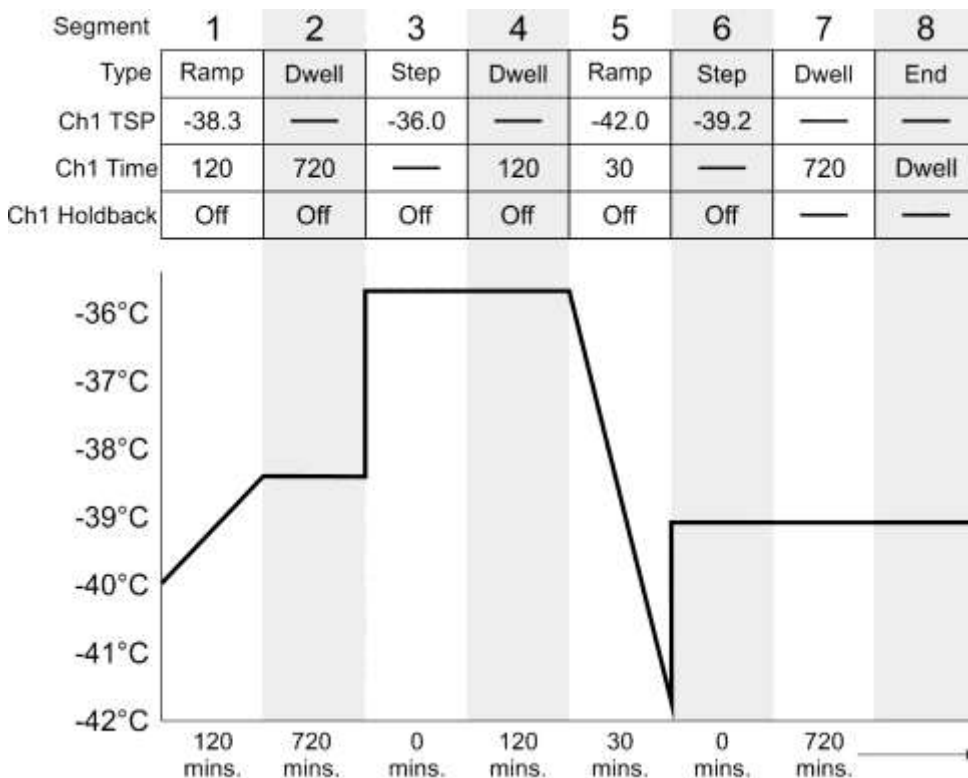
A Ramp Time segment is specified by a target set-point and a time in which to achieve that set-point.

**Ch I Ramp Units**

Select 'Per Second', 'Per Minute' or 'Per Hour' for ramp timing units. Ramp Units can be edited only when the program is in Reset mode.

## How to create a simple PROGRAM using the controller interface:

Below shows a basic PROGRAM that demonstrates the cryostat instrument ability to create a program.



This PROGRAM has 8 segments.

It shows the instrument starting with a setpoint of -40°C

- It is then set to RAMP to -38.3°C over a period of 120 minutes
- It is then set to DWELL at this temperature for a period of 720 minutes
- It is then set to STEP to -36°C
- It is then set to DWELL at this temperature for a period of 120 minutes
- It is then set to RAMP to -42°C over a period of 30 minutes
- It is then set to STEP TO -39.2°C
- It is then set to DWELL at this temperature for a period of 720 minutes
- It is then set to DWELL until manually changed

**To enable/RUN this PROGRAM:**

1. Log in as the SUPERVISOR and exit menu
2. Scroll to the PROGRAM page
3. Press the SCROLL button to highlight the RESET box
4. Press the UP button to highlight the PAGE icon in the top right hand side of the screen
5. Enter this with the SCROLL button
6. This will access the PROGRAM EDIT menu page
7. Scroll to OPERATION and select LOAD, enter with the SCROLL button
8. Scroll to MERCURY CYCLE and enter with the SCROLL button
9. The STATUS will display SUCCESS and the CURRENT PROGRAM will display MERCURY CYCLE
10. MERCURY CYCLE is now the default program
11. To RUN the program MERCURY CYCLE exit the PROGRAM EDIT page using the PAGE button until you see the PROGRAM homepage
12. Press SCROLL once to highlight the RESET box
13. Scroll to MERCURY CYCLE and press the SCROLL button to initiate the program

The page will now change to show the current program running.

**To edit an existing PROGRAM:**

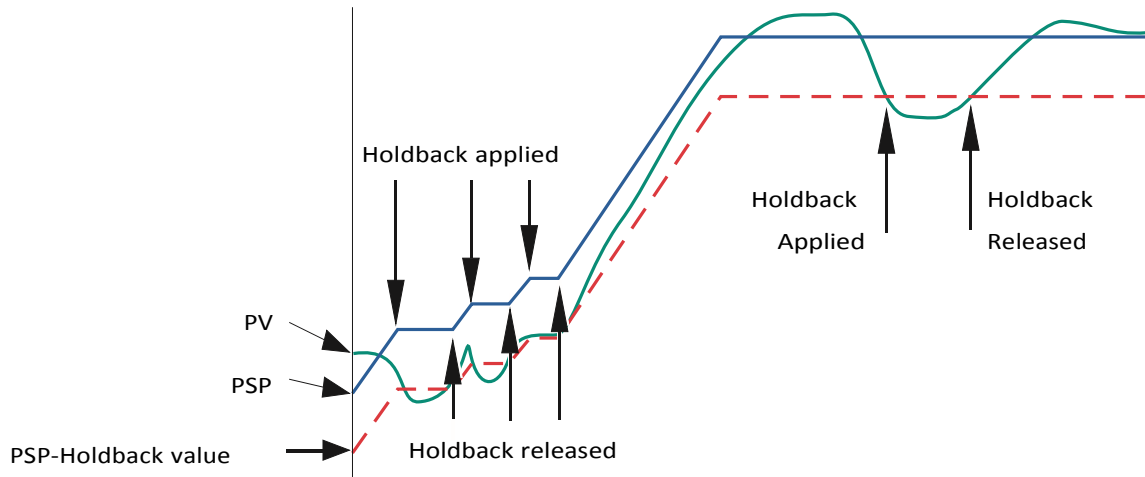
1. Follow the above procedure to point 10
2. Scroll down to SEGMENT NUMBER and select the SEGMENT you wish to edit using the SCROLL and UP/DOWN buttons
3. Edit the required parameter (RAMP, DWELL, TIME DURATION etc) using the scroll and UP/DOWN buttons and enter the value
4. When the editing is complete, it can either be left as the existing PROGRAM or saved under an alternative file name in the internal memory
5. To leave the alterations under the existing filename simply exit out of the menu and RUN the program as normal
6. To save as an alternative filename in the memory, SCROLL back up to OPERATION and enter using the SCROLL button
7. Scroll to STORE and enter
8. The soft keyboard will open allowing you to save the file as a filename of your choice
9. When the name is selected, press the PAGE button to save the changes
10. Both the original file and the modified file will now exist in the memory

**Using the HOLDBACK feature:**

The PROGRAMMER has a HOLDBACK feature available.

Holdback pauses the program (freezes the Programmer setpoint (PSP) and the time remaining parameters) if the difference between the Process value (PV) and the PSP exceeds a user-specified amount (Holdback value). The program remains paused until the PV returns to within the specified deviation.

In ramp or step segments, holdback indicates that the PV is lagging the SP by more than the specified amount and that the program is waiting for the process to catch up. In a dwell segment, holdback is used to guarantee that a work piece stays at set-point within a specified tolerance for the specified dwell duration.



This is particularly useful when running a calibration program as it will allow the heat source to eliminate any “lag” between the controller and the heat source itself.

Holdback can be configured to hold either the segment or the complete program.

The USER defined value is used to define the actual value applied to it.

This can either be:

**LOW**, where the heat source temperature is below the setpoint. The programmer will hold the value until the heat source has “caught-up” in temperature.

**HIGH**, where the heat source temperature is above the setpoint. The programmer will hold the value until the heat source has “caught-up” in temperature.

**BAND**, where the heat source is outside a band of temperature around the setpoint

### To enable this feature:

1. Go to EDIT AN EXISTING PROGRAM and enter the menu
2. Scroll to HOLDBACK STYLE and enter using the SCROLL button
3. Select desired parameter and enter using the SCROLL button
4. Scroll to CHI HOLDBACK and enter the desired parameter and enter with the SCROLL button
5. Scroll to CHI HOLDBACK VAL and select the desired temperature, enter using the SCROLL button

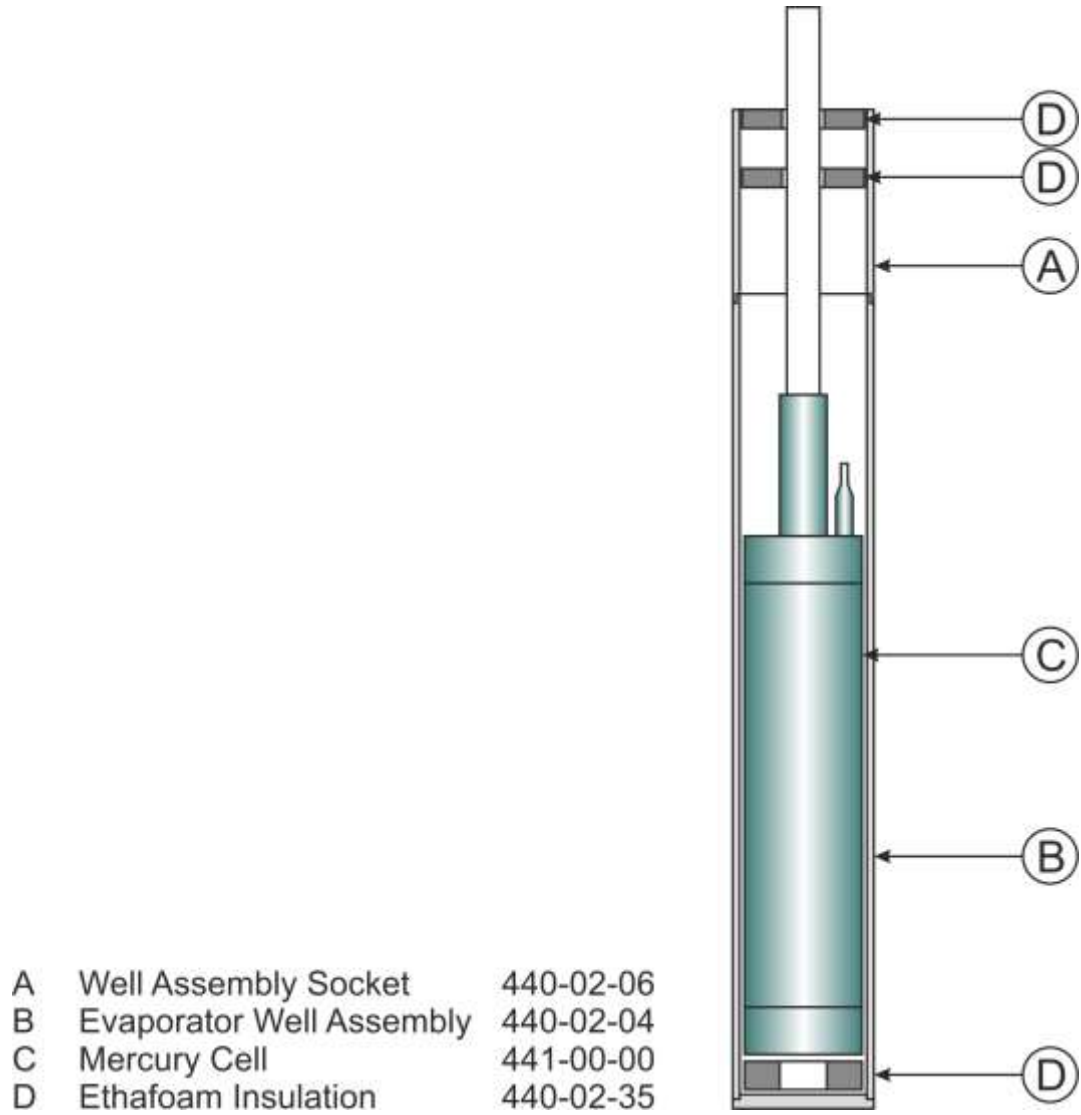
## TESTING WITH GAUGES

The following actions should be carried out by someone qualified in refrigeration servicing.

Connect pressure gauges to the service valves on the condensing unit and observe the pressures with the power off and then with the power on, if required.

Symptom	Probable Cause
High side low with power off	Leak in high side
High side high with power off	Leak in low side, allowing air-ingress
Low side equal to high side	Cutoff bypass valve leaking
Low side goes lower than 15" Hg vacuum with power on	Plugged capillary
Low side does not reach 5" Hg vacuum with power on	Bypass valve leaking

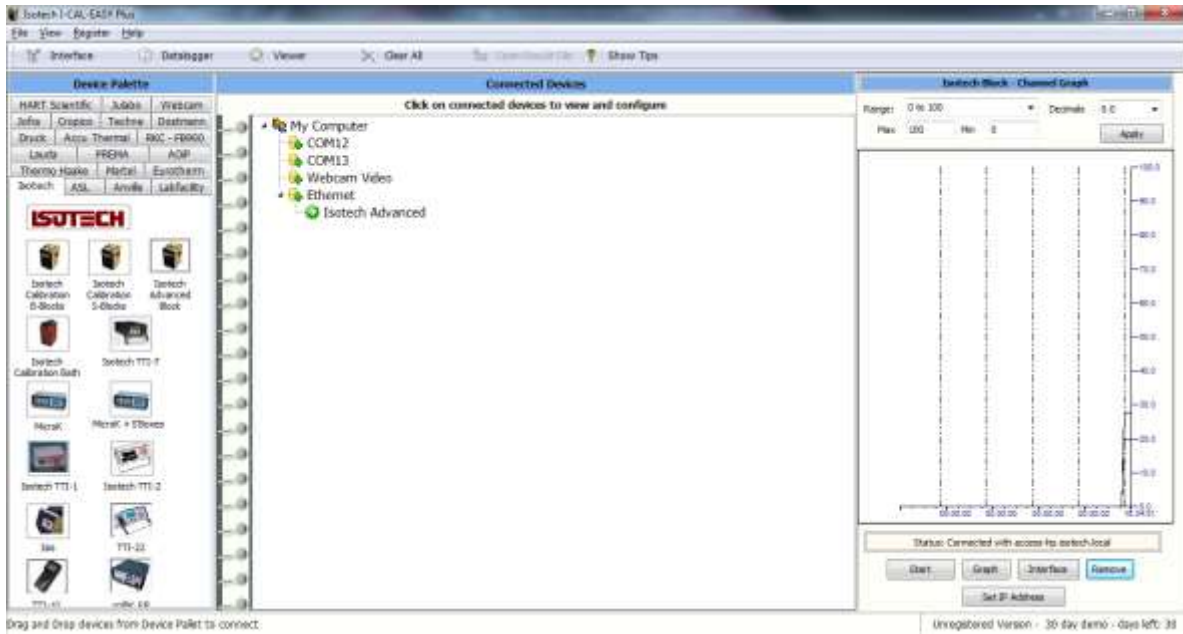
## Standard Sized Mercury Well General Arrangement



## ISOTECH I-CAL EASY SOFTWARE

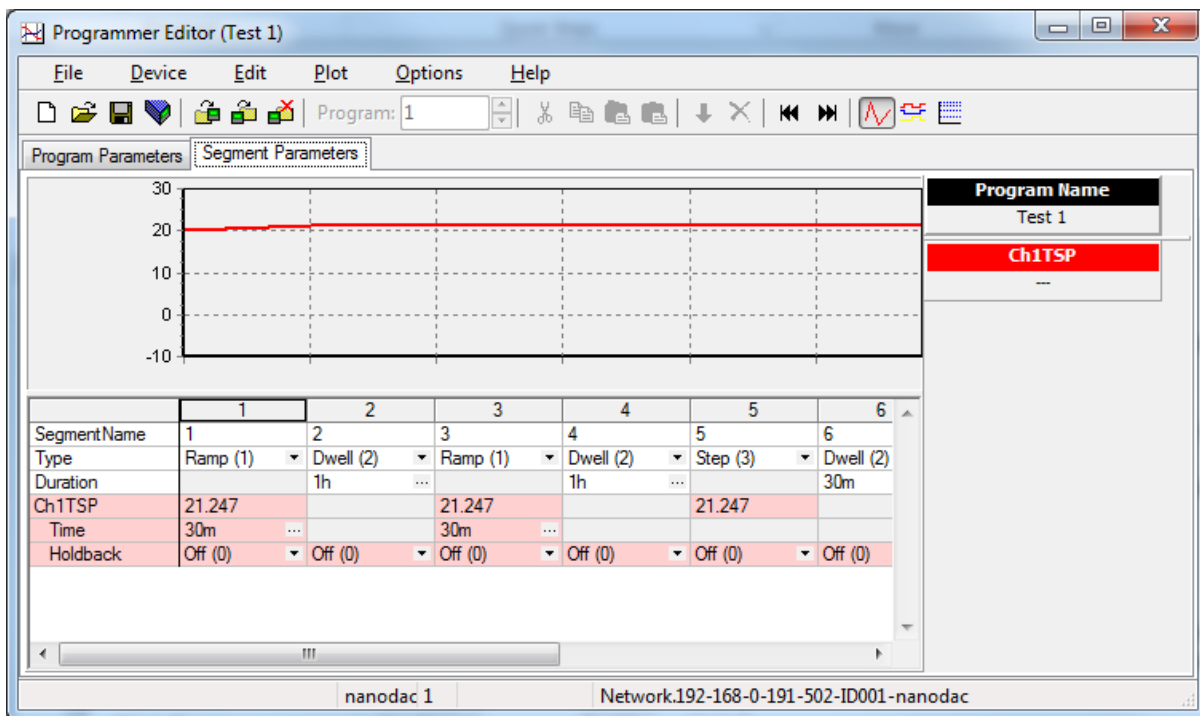
This application allows logging of data from the Mercury Apparatus. Additionally if a license is purchased it allows for fully automatic calibration including certificate printing and the calculation of coefficients.

Refer to the Isotech I-Cal EASY handbook and help system for more details.



## Program Editor

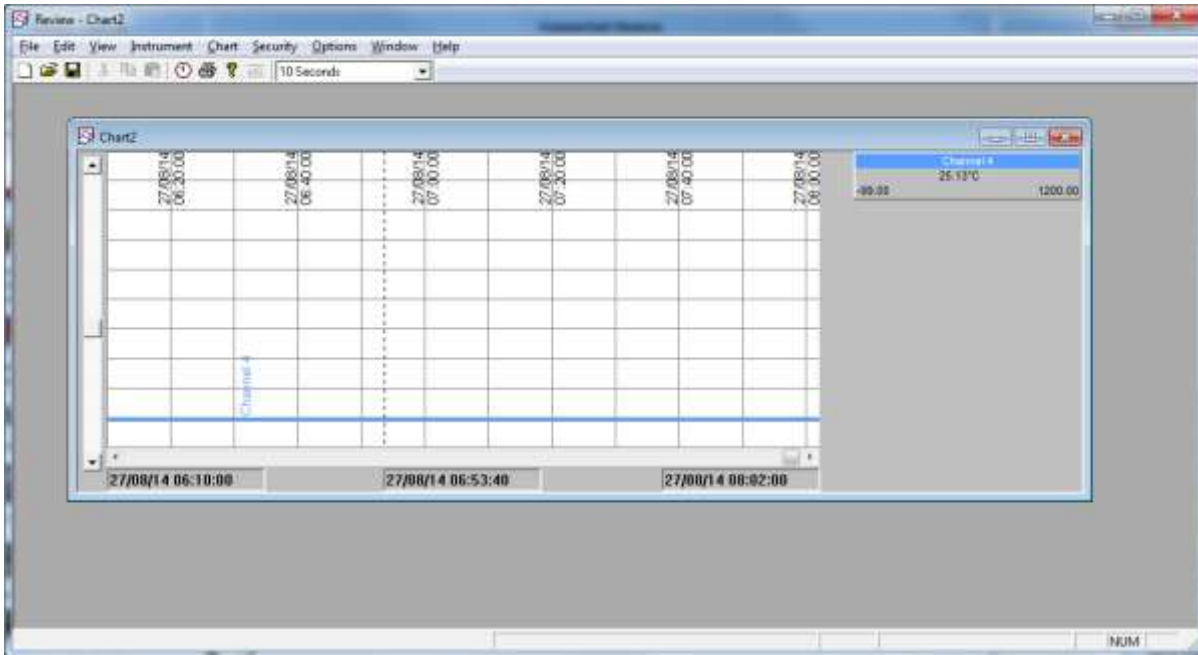
This allows set point programs to be created on a PC and uploaded to the Mercury Apparatus.



Installation instructions are included with the download

## Review

This is a proprietary software package which allows the user to extract 'archive' data from one or more Mercury Apparatus and to present this data on a host computer, as if on a chart, or as a spreadsheet.



As described in the Review help system, 'Review' allows the user to set up a regular transfer of data (using ftp) from connected instruments into a database on the pc, and then from this database to the chart or spreadsheet. The chart/spreadsheet can be configured to include one or more 'channels' from one or all connected instruments.

It is also possible to archive instrument history files to a memory stick and to use this to transfer the data to the pc.

**The user name and password are both 'history and they are not editable.**

These applications can be downloaded from the Isotech website <http://www.isotech.co.uk/downloads>

Connection to the unit is via the Ethernet interface, configure the IP address to suit your network and then select that IP address in the software. Consult your network manager for assistance if required.