

SATURN/CYCLOPS 878 BLACKBODY SOURCE

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.

GUARANTEE

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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

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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 manual)
	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 degree 2.

The apparatus has two input connectors for temperature sensors, see Figure 1. These inputs are only suitable for either a thermocouple or resistance thermometer. No other sensor or signal may be connected.

Environmental Ratings

Operating Temperature 5-35°C

Relative Humidity 5-95%, non condensing

HEALTH AND SAFETY INSTRUCTIONS

1. Read this entire manual 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 temperatures.
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.

CAUTIONARY NOTE

ISOTECH PRODUCTS ARE INTENDED FOR USE BY TECHNICALLY TRAINED AND COMPETENT PERSONNEL FAMILIAR WITH GOOD MEASUREMENT PRACTICES.

IT IS EXPECTED THAT PERSONNEL USING THIS EQUIPMENT WILL BE COMPETENT WITH THE MANAGEMENT OF APPARATUS WHICH MAY BE POWERED OR UNDER EXTREMES OF TEMPERATURE, AND ARE ABLE TO APPRECIATE THE HAZARDS WHICH MAY BE ASSOCIATED WITH, AND THE PRECAUTIONS TO BE TAKEN WITH, SUCH EQUIPMENT.

INTRODUCTION

This patented furnace has been uniquely designed.

Introduced by Isothermal Technology in 1984, the full potential of the bath has yet to be realised.

The lower temperature limit is dictated by the controller and the furnace time constant so that by reducing the heater power (HL) to about 5 to 10% of full power good results can be obtained even at temperatures just above room temperature.

THEORY OF OPERATION

The windings that heat the Cyclops are specially profiled to give a uniform area of constant temperature in the central part of the oven or furnace.

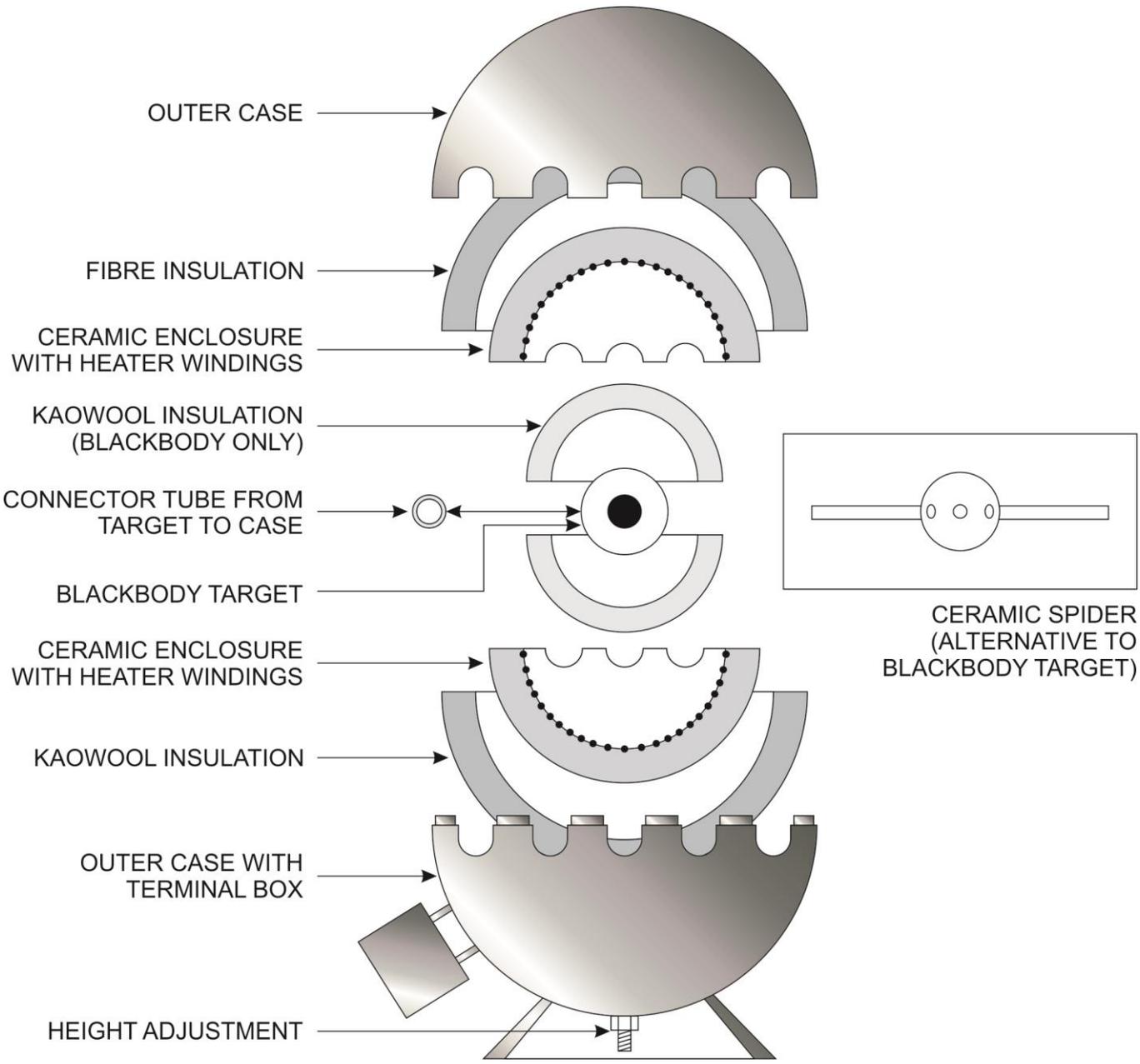
The theory behind the Isotech Spherical Black Body Source is that a solid conducting sphere suspended in the centre of a hollow outer, heated sphere will take up the temperature of the outer hollow heated sphere by convection and radiation to give a very stable temperature reference, without end, or edge effects.

SPHERICAL BLACK BODY SOURCE

FEATURES

1. It is spherical and its design ensures a central zone of constant temperature.
2. The temperature of the furnace is controlled from a microprocessor based controller which can incorporate remote facilities, enabling the furnace temperatures to be pre-programmed from a computer. Thus, totally automatic readings become possible and easily realisable.
3. Normally the windings will require replacing after 2 or 4 years of operating (dependant on work cycle) and so the furnace has been designed with ease of maintenance in mind. A spare set of windings is provided free with each furnace, as is a comprehensive manual.

Figure 1: Saturn/Cyclops Assembly Detail



PRINCIPLE OF OPERATION

The Spherical Black Body Source comprises of a number of concentric shells. (See Figure 1) The outer layer of the spun metal is for containment and support, inside this is a layer of ceramic fibre. Within the fibre is a ceramic spherical mantle containing the heater windings.

Lastly in the centre of the furnace is the Cyclops Black Body Source.

SPECIFICATIONS

Size:	425mm diameter sphere
Weight:	25 Kilos
Temperature Range:	100°C to 1300°C
Warm-up times*	1 hour to 700°C 3 hours to 1300°C
Power Supply:	3KW Typically Single Phase
Ambient Operating Temperature:	0 to 50°C <70% RH

* These times may increase as the windings age or if the supply voltage is low.

Each Unit Comprises Of:

1. Spherical Black Body Source
2. Cyclops
3. Controller
4. Spare set of windings
5. Thermocouple
6. Manual/Guarantee
7. Unpacking Instructions

PRECAUTIONS

Some precautions should be noted as follows:

1. Although the furnace has been insulated with the best available ceramic fibre material, some heat does escape, in fact it is essential for the correct operation of the furnace that it should.

This means that, at high temperatures the outside surface of the furnace becomes hot. If this is a safety problem then a protecting grill should be built round the furnace.
2. Over Temperature: All the materials used in the construction of the furnace have been rated to 1,400°C. However, at these temperatures the life expectancy of the heater windings for example are very short. We therefore recommend an upper temperature of 1300°C for the bath.
3. The furnace must be mounted on a suitable solid flat surface, horizontal to within $\pm 5^\circ$.

ON ARRIVAL

For your convenience this furnace has been pre-assembled with the Black Body, control sensor and access tubes already fitted and is ready for use.

In the event that the Black body needs to be removed or any maintenance carried out, there is an installation procedure below, please use this in conjunction with Figure 1 and 2.

On unpacking the Spherical Black Body Source, you will find 4 parts:

1. The controller.
2. The Furnace itself.
4. A spare set of windings and this instruction book

Re-assembly procedure:

- a) Stand the furnace on a flat surface and carefully unscrew the upper half of the outer Sphere.
- b) Lift off the upper half of the sphere and the ceramic fibre insulation.
- c) You will then see the inner sphere containing the heater windings.
- d) The Cyclops fits inside the inner sphere with a layer of fibre insulation around it, see Figure 1. It is recommended that two people continue with the procedure.
- e) Carefully lift the upper hemisphere taking care not to stress the two heater lead wires. When the top half ceramic is clear, position the insulation and the target to allow access for the target hole through the furnace aperture.
- f) Ensure the control thermocouple and ceramic tube are located as Figure 2. Should the height need adjusting use the adjustment screw on the base of the unit.
- g) Re-assemble the furnace.
- h) Unpack the controller and connect the cable marked "heater" to the cable from the lower half of the furnace.
- i) Connect a plug to the cable from the controller marked "supply". Note - the controller will normally require a 13 amp supply at 220/240V.
- j) Put the control thermocouple inside the winding shell as shown in diagram below.

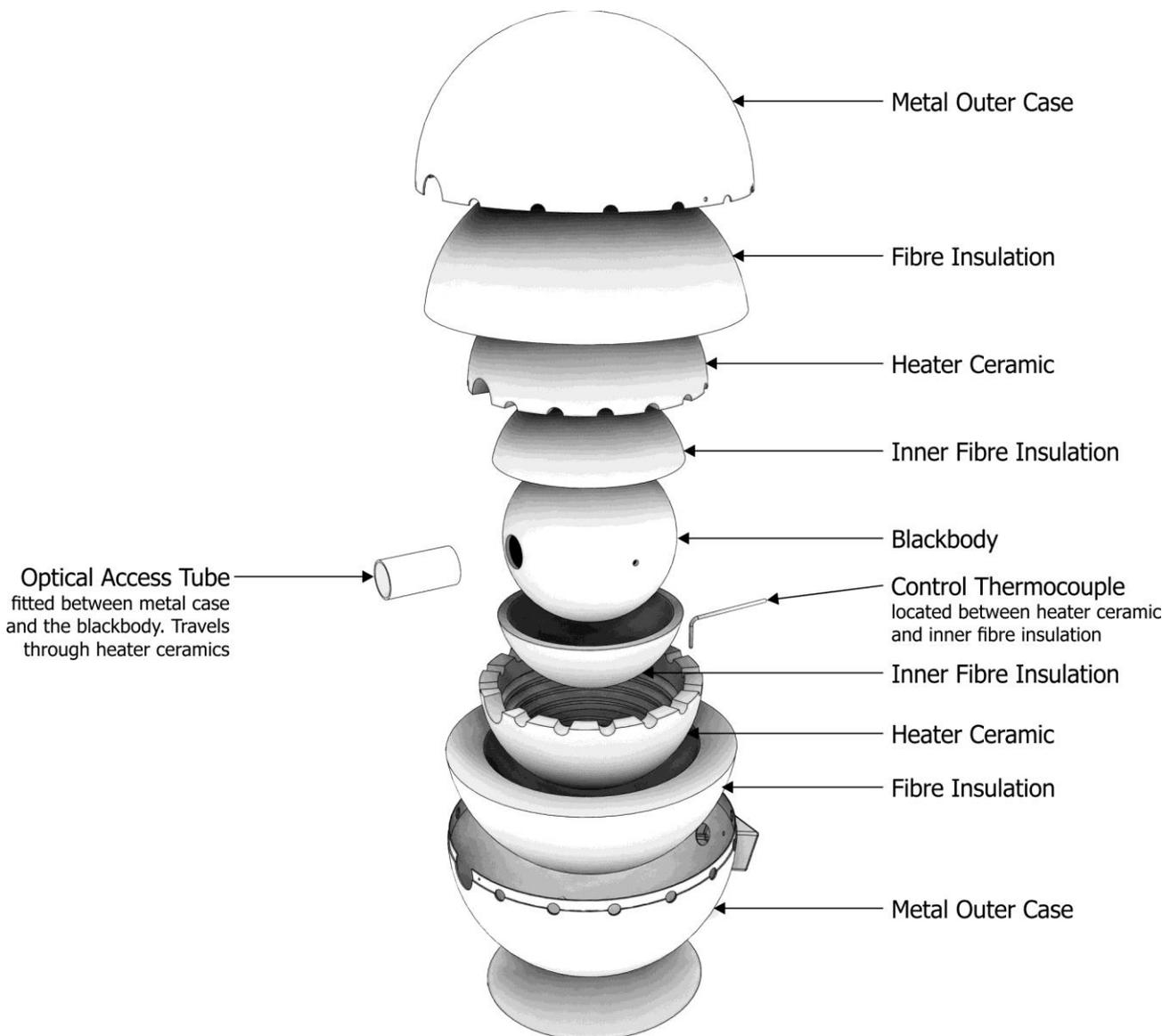
CAUTION

Before switching on, check that there is approximately 20Ω between the furnace heater windings and greater than 5 Megohms between windings and outer furnace case.

Assuming this is so you may now commission the furnace.

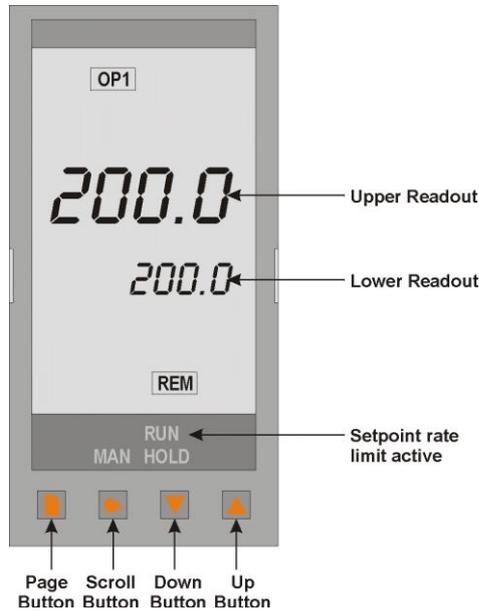
Please read the controller instruction manual carefully before proceeding.

Figure 2: Cyclops Assembly Diagram Exploded View



USING 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 bath is 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 bath to heat at a controlled rate it is easier to determine the temperature at which the thermostat changes state.

The bath 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 bath 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,

OPI	Heat Output
REM	This beacon indicates activity on the PC interface

Units

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

Diagnostic alarms

These indicate that a fault exists in either the controller or the sensor.

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	<i>Electrically Erasable Memory Error:</i> The value of an operator or configuration parameter has been corrupted	Contact Isotech
S.br	<i>Sensor Break:</i> Input sensor is unreliable or the input signal is out of range.	Contact Isotech
HW.Er	<i>Hardware error :</i> Indication that a module is of the wrong type, missing or faulty	Contact Isotech
LLLL	<i>Out of Display range, low reading</i>	Contact Isotech
HHHH	<i>Out of Display range, high reading</i>	Contact Isotech
Err1	<i>Error 1: ROM self-test fail</i>	Consult Isotech
Err2	<i>Error 2: RAM self-test fail</i>	Consult Isotech
Err3	<i>Error 3: Watchdog fail</i>	Consult Isotech
Err4	Error 4: Keyboard failure 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	<i>Error 5: Input circuit failure</i>	Consult Isotech
Pwr.F	<i>Power failure.</i> The line voltage is too low	Check that the supply to the controller is within the rated limits

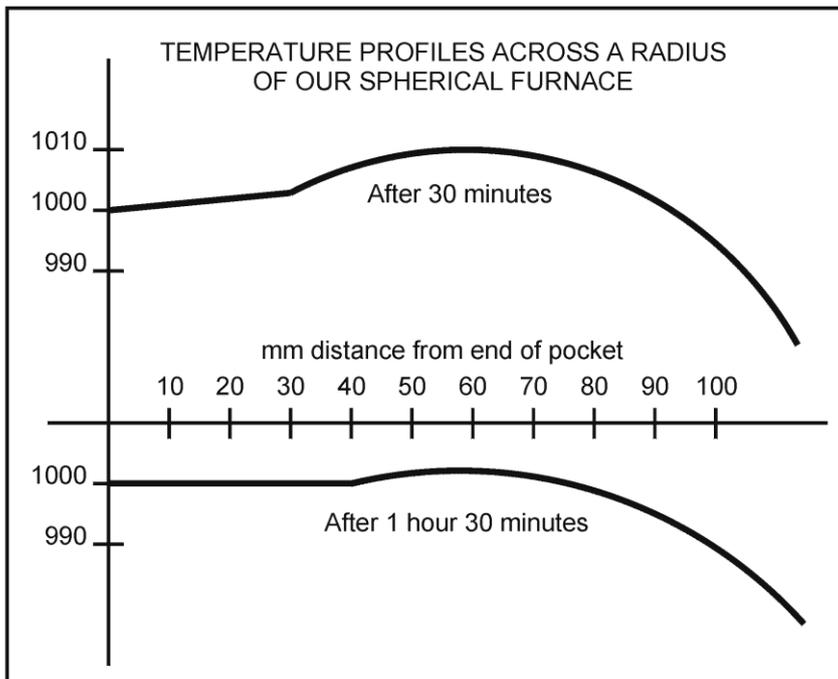
COMMISSIONING

During its trip to you, the package containing the furnace may have become damp; therefore, we recommend the following initial procedure:

1. Switch on the furnace/controller and set the temperature to 100°C. Allow the temperature to reach 100°C and stabilise there for 2 hours.
2. Increase the set temperature to 200°C. Allow 2 hours for stabilisation.
3. Increase the temperature in 100°C steps allowing 1 to 2 hours between each change until the furnace has reached 1,000°C.

Your Spherical Black Body Source is now ready for use!

SAMPLE RESULTS



USING THE PC INTERFACE

The bath includes an RS422 PC interface and a special converter cable that allows use with the a standard RS232 port. When using the bath with an RS232 port it is essential that this converter cable is used. Replacement cables are available from Isotech, part number ISO-232-432. A further lead is available as an option, Part Number ISO-422-422 lead which permits up to 5 instruments to be daisy chained together.

The benefit of this approach is that a number of calibration baths may be connected together in a "daisy chain" configuration - and then linked to a single RS232, see diagram.



Note: The RS 422 standard specifies a maximum lead length of 1200M (4000ft). A true RS422 port will be required to realise such lead lengths. The Isotech conversion leads are suitable for maximum combined lead lengths of 10M that is adequate for most applications.

CONNECTIONS

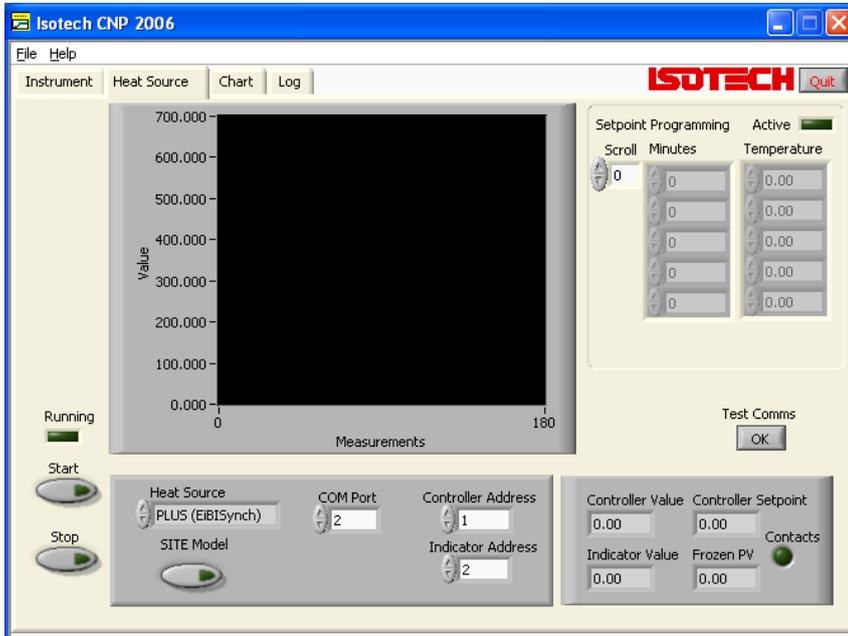
For RS232 use simply connect the Isotech cable, a 9 to 25 pin converter is included to suit PCs with a 25 pin serial converter.

RS422 Connections

Pin	Connection
4	Tx+ A
5	Tx- B
8	Rx+ A
9	Rx- B
1	Common

CAL NOTEPAD

Cal Notepad can be used to log and display values from the Dry Blocks and an optional temperature indicator such as the milliK or TTI-10. The software requires Windows 9X, XP, a minimum of 5Mb of free hard drive space and free serial ports for the instruments to be connected.



DEVELOPMENT

Cal NotePad was developed by Isothermal Technology using LabVIEW from National Instruments. The license details are shown on the download page and in the Cal Notepad manual.

HOW TO INSTALL CAL NOTEPAD

1. Download the ZIP from <http://www.isotech.co.uk/downloads> (7.6Mb)
2. Extract the files to a temporary folder
3. Run setup.exe



4. Follow the prompts which will install the application, a user manual with setup information and the necessary LabVIEW run time support files.
5. Should you ever need to uninstall the software then use the Add/Remove Programs option from the Control Panel.

PROTOCOL

The instruments use the "Modbus Protocol"

If required, e.g. for writing custom software the technical details are available from our Document Library at <http://www.isotech.co.uk>

GETTING THE BEST FROM YOUR SATURN

INTRODUCTION

Although every effort is made to get complete symmetry inside the Saturn. Variations in tube wall thickness, winding spacing, ceramic densities inevitably mean that there is a small consistent and reproducible profile round the inner equalizing sphere.

After assembly, the following test procedure will allow an evaluation of this profile. The profile will be consistent throughout the life of the furnace and enable calibration to be performed to an accuracy of $\frac{1}{4}^{\circ}\text{C}$.

1. Set temperatures to 100°C and allow 1 to $1\frac{1}{2}$ hours for stabilisation to occur.
2. Make two thermocouples type R or S, (or use two model I600's available from ISOTECH).
3. Place 1 in a designated pocket, place the second thermocouple in each of the other pockets in turn, taking readings in each pocket compared to the standard pocket.
4. Repeat survey at 200°C intervals.
5. Use the survey to provide a correction factor to the results subsequently obtained.