ISSUE 5

The Florentine Thermometer

4 databookfour

blackbody sources & thermocouple reference equipment

temperature calibration equipment & services

ISOTECH

The company is always willing to give technical advice and assistance where appropriate.

Equally because of the program 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.

It describes only some of our wide range of Blackbody and Thermocouple referencing products.

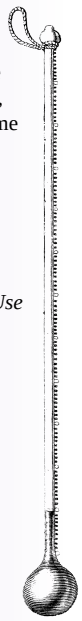
The Florentine Thermometer

The sealed liquid-in-glass thermometer was invented by none less than the Grand Duke of Tuscany, Ferdinand II, one of the great family of the Medici. Even after a very great allowance has been made for the desire of courtiers to flatter, the scientific ability of Ferdinand, and of his brother Leopold, shines brightly in the learned manuscripts of the period. Unfortunately, Ferdinand's grasp of politics was far inferior to his scientific acumen, and the prestige of Tuscany declined sadly during his reign.

The earliest date for the invention of the "Florentine" spirit-in-glass thermometer, that can be fully documented, is sometime in 1654.

For more information on the history of thermometers the reader is referred to:-

'A History of the Thermometer and Its Use in Meteorology' by W. E. Knowles Middleton (The Johns Hopkins Press, Baltimore, Maryland).



CONTENTS

Introduction: Blackbody Sources

A blackbody has been defined as either a source with zero reflectivity or a source emitting the maximum possible radiation (at all wave lengths) for its temperature.

Emissivity is the ratio of the radiation emitted by a surface to that emitted by a black body at the same temperature.

Isothermal Technology have worked in conjunction with our National Physical Laboratory and one of the world's leading producers of radiation pyrometers to produce a number of black body sources to the highest standards available to industry.

FIXED POINT	°C	APPARATUS	
		MEDIUM	HIGH
Gallium	29.76	✓	
Indium	156.60	✓	
Tin	231.93	✓	✓
Zinc	419.53	✓	✓
Aluminium	660.30		✓
Silver	961.78		✓
Gold	1064.18		✓
Copper	1084.62		✓

Sources with emissivity greater than 0.995:

1. Low temperature, range -10°C to +80°C; cavity 50mm diameter x 150mm deep to tip of 120° cone.

2. Medium temperature, range 50°C to 550°C; cavity 65mm diameter x 185mm deep to tip of 120° cone.

3. High temperature, range 150°C to 1200°C; cavity 20mm diameter x 65mm deep to absorbent face.

Each has a controller and an independent indicator which shows the temperature of the back face of the cavity. This can be calibrated and UKAS certified.

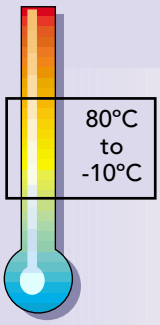
Another route to calibration is to use ITS-90 fixed point sources. Isothermal have patented a range of cells which fit into the low, medium or high temperature cavities as shown in the table.

NEW
The Blackbody sources now include a PC Interface and Cal NotePad software, full details at www.isotech.co.uk/industrial/software.html The temperature controllers have been upgraded featuring greater accuracy and improved resolution.

www.isotech.co.uk/bbody

Hyperion R

Model 982



The Hyperion R Calibration Bath comprises a blackbody cavity for calibration of radiation pyrometers. An important factor is that its operation range includes ambient temperature.

The temperature of the furnace is set on a controller, whilst an independent indicator, whose sensor fits into the cavity, indicates the actual radiance temperature. The sensor can be removed for external calibration or the complete system can be calibrated.

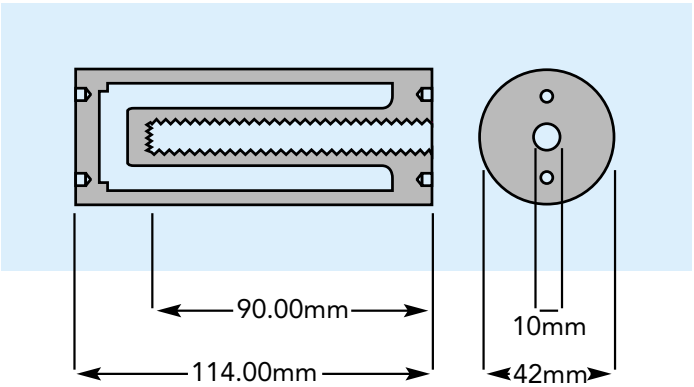
The temperature of the cavity can be set to within 0.1°C at any point from -10°C to +80°C.

This elegant, modern-styled range has been designed to work from a series of Peltier modules, which can be used either to heat or to cool a metal block. In conjunction with a specially programmed microprocessor-based controller it offers a unique concept in calibration sources.

With this bath, a temperature above, below or at ambient temperature can be set and will be maintained whether the source needs to be cooled or heated.

Traceability may be established with a UKAS certificate for the in-built indicator and supplied probe (935-14-13).

964-01-02 Gallium Fixed Point Cell



Model No.	982
Temperature range	-10°C to 80.0°C
Emissivity	Greater than 0.995
Stability	±0.1°C
Display Resolution	0.01°C
Cavity size	50mm diameter 150mm deep
Time to temperature	45 minutes -10°C 40 minutes 80°C
Power	200 Watts typical 100-130 or 208-240 VAC
Dimensions	Height 310mm Width 265mm Depth 200mm
Weight	10kg

Low Temperature Radiation Pyrometer Primary Source
50mm Cavity Diameter
0.995 Emissivity, Compact

Options

935-14-13	Probe
931-22-27	Carrying Case
812-01-06	Set of 4 orifice plates to restrict cavity aperture diameter to 40mm, 30mm, 20mm or 10mm.

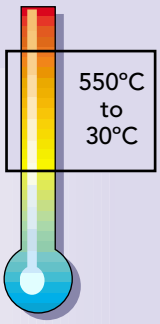
Now includes PC Interface and Windows software as standard

How to Order

Model 982 Hyperion R
Please state supply voltage required
Please state if UKAS calibration, or NPL calibration is required

Gemini R

Model 976



The Gemini R comprises a blackbody with which radiation pyrometers can be calibrated.

The temperature of the cavity can be set to ±0.1°C over the temperature range 30°C to 550°C.

The temperature of the furnace is set on a controller, whilst an independent indicator, whose sensor fits into the cavity, indicates the actual radiance temperature. The sensor can be removed for external calibration or the complete system can be calibrated.

The cavity temperature reaches 550°C approximately 45 minutes from switch on.

The variation seen on the controller's temperature indication over a 5 minute period was ±0.2°C. Similar variations were detected by a radiation thermometer looking into the cavity.

Using a portable radiation thermometer having a target diameter of 13mm, the 65mm target was surveyed. Maximum temperature differences of ±1°C were found for set temperatures in the range 100°C to 500°C.

Temperatures along the inner 100mm of the 160mm long cavity were measured at 400°C and 500°C, using a hand held fibre-optic radiation probe. Maximum temperature differences of ±4°C were found.

The temperature, as shown on the controller, agrees with the cavity temperature as measured by a radiation thermometer, where calibration is traceable to National Standards, to within ±2°C.

Traceability may be established with a UKAS certificate for the in-built indicator and supplied probe (935-14-72).

NEW!
Gemini R 700.
Also available is a model with a maximum operating temperature of 700ºC
- ask for details

Medium Temperature Radiation Pyrometer Primary Source
65mm Cavity Diameter, 0.995 Emissivity
Compact, Accepts Fixed Point Cells

Model No.	976
Temperature range	30°C to 550°C
Emissivity	Greater than 0.995
Stability	±0.1°C
Display Resolution	0.01°C to 99.99; 0.1°C from 100.0 to 550.0
Cavity size	65mm diameter 160mm deep
Time to temperature	45 minutes
Power	1000 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 310mm Width 265mm Depth 200mm
Weight	10kg

Options

431-03-00	Gallium Hockey Puck Cell
976-05-00A	Indium Hockey Puck Cell
976-05-00B	Tin Hockey Puck Cell
976-05-00C	Zinc Hockey Puck Cell
935-14-72	Probe
931-22-27	Carrying Case
976-01-05	Set of 5 orifice plates to restrict cavity aperture diameter to 50mm, 40mm, 30mm, 20mm or 10mm.

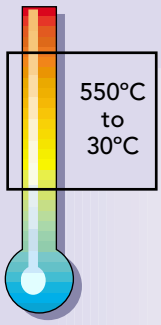
Now includes PC Interface and Windows software as standard

How to Order

Model 976 Gemini R
Please state supply voltage required
Please state if UKAS calibration, or NPL calibration is required

Medusa R

Model 999



The Medusa R comprises a blackbody with which radiation pyrometers can be calibrated.

The temperature of the cavity can be set to ±0.1°C over the temperature range 30°C to 550°C.

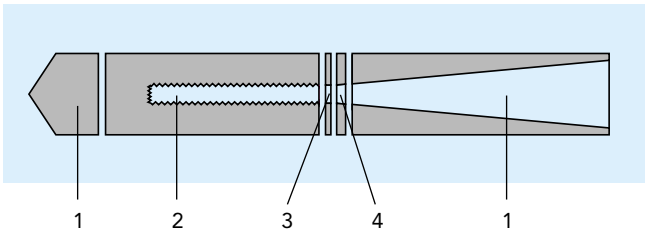
The controller reaches 550°C approximately 45 minutes from switch on. Also, the cavity temperature, as measured by a radiation thermometer took approximately 45 minutes to reach stability from switch on. The variation seen on the controller's temperature indication over a 5 minute period was ±0.2°C. Similar variations were detected by a radiation thermometer looking into the cavity.

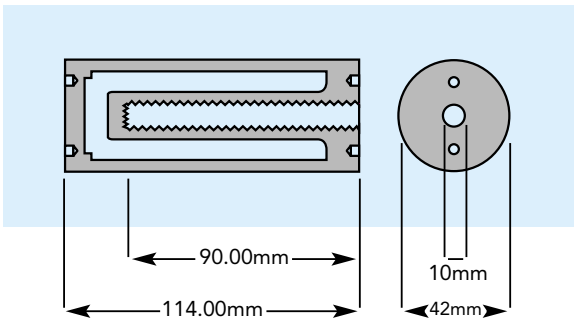
Using a portable radiation thermometer having a target diameter of 13mm, the 45mm target was surveyed. Maximum temperature differences of ±1°C were found for set temperatures in the range 100°C to 500°C. Temperatures along the inner 200mm of the 285 mm long cavity were measured at 400°C and 500°C, using a hand held fibre-optic radiation probe. Maximum temperature differences of ±4°C were found.

The temperature, as shown on the controller, agrees with the cavity temperature as measured by a radiation thermometer, where calibration is traceable to National Standards, to within ±2°C. Large Fixed Point Cells (see p10-11) can be fitted to the Medusa R giving small uncertainties suitable for National Standards.

Traceability may be established with a UKAS certificate for the in-built indicator and supplied probe (935-14-95).

1. Insulation
2. Fixed Point Cell
3. Graphite Disc
4. Inconel Disc





Model No.	999
Temperature range	30°C to 550°C
Emissivity	greater than 0.995
Stability	±0.05°C
Display resolution	0.01°C to 99.99; 0.1°C from 100.0 to 550.0
Cavity size	45mm diameter 285mm deep
Time to temperature	45 minutes
Power	1000 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 480mm Width 425mm Depth 260mm
Weight	17kg

Freeze and Melt Blackbody FIxed Point Cells
Can be used for Comparison Calibration
Accuracy to ±0.05 K

Options

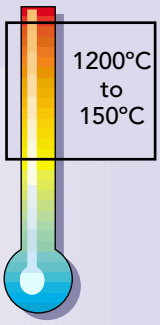
Fixed Point Cells		
998-06-00A	Indium	Large Blackbody Fixed Point Cell
998-06-00B	Tin	Large Blackbody Fixed Point Cell
998-06-00C	Zinc	Large Blackbody Fixed Point Cell
984-00-00		Gas Flow System
Now includes PC Interface and Windows software as standard		

How to Order

Model 999 Medusa R
Please state voltage required
Please state if UKAS calibration, or NPL calibration is required

Pegasus R

Model 970



The Pegasus R is a compact furnace for calibrating radiation pyrometers.

The temperature of the furnace is set on a controller, whilst an independent indicator, whose sensor fits into the cavity, indicates the actual radiance temperature. The sensor can be removed for external calibration or the complete system can be calibrated.

The cavity diameter is 20mm, the depth 65mm. Emissivity is 0.995.

The cavity is removable and a fixed point cell may be put in its place.

The cavity inside the fixed point cell is 10mm in diameter by 65mm deep to the tip of a 120° cone.

BLACKBODY TARGET RADIATION SOURCE FOR USE WITH PEGASUS R

For calibration radiation thermometers in the wavelength range 0.9 to 14 micrometres.

A blackbody radiation source 'based on a design study by England's National Physical Laboratory (NPL)' for Isothermal Technology Ltd is housed, with suitable insulation, in the Pegasus tube furnace.

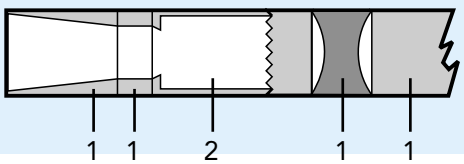
The aperture is 10mm in diameter.

A Pegasus blackbody source has been calibrated at NPL (National Physical Laboratory) with an uncertainty of ±2°C and the calibration was found to be reproducible after a period of about 2 months.

A scan across the aperture at 444°C showed that the source was uniform to better than 0.3°C.

Traceability may be established with a UKAS certificate for the in-built indicator and supplied probe (935-14-40).

Blackbody cavity (shown in section)



1. Insulation
2. Fixed Point Cell (see page four/11)

High Temperature Radiation Pyrometer Primary Source
NPL Designed Cavity, 0.995 Emissivity
Compact, Accepts Fixed Point Cells

Model No.	970
Temperature Range	150°C to 1200°C
Emissivity	0.995
Stability	±0.1°C
Display resolution	0.1°C to 999.9; 1°C from 1000 to 1200
Cavity size	20mm diameter 65mm deep
Time to temperature	20 minutes
Power	2.3kW typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 310mm Width 265mm Depth 200mm
Weight	7.2 kg

Options

970-06-00A	Indium Blackbody Cell
970-06-00B	Tin Blackbody Cell
970-06-00C	Zinc Blackbody Cell
970-06-00D	Aluminium Blackbody Cell
970-06-00E	Silver Blackbody Cell
935-14-40	Probe
931-22-27	Carrying Case
984-00-00	Gas Flow System

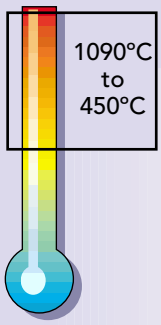
Now includes PC Interface and Windows software as standard

How to order

Model 970 Pegasus R
Please state supply voltage required
Please state if UKAS calibration, or NPL calibration is required

Oberon R

Model 426



Model 426 is for Aluminium, Silver, Gold or Copper. Heatpipes provide the ideal conditions for the creation and maintenance of slim ITS-90 cells.

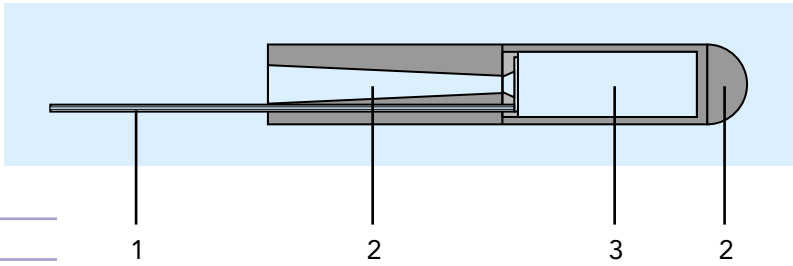
The furnace core is a specially-designed stress-free isothermal heat pipe, which provides a very low thermal gradient along the core working length. The furnace heater is of the non-inductive bird-cage design insulated by twin bore alumina tubes.

The heatpipe is designed so that the inner wall is not subject to thermal expansion stresses from the outer wall before the heat pipe reaches conduction temperature. The working fluid is permanently and safely sealed within the plasma-arc welded enclosure.

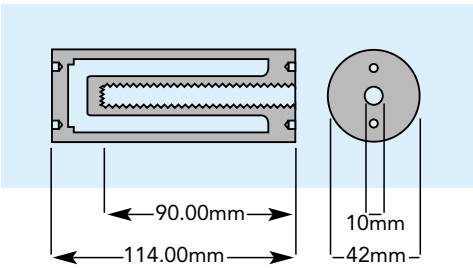
The range of the higher temperature furnace is suitable for Aluminium, Silver, Gold or Copper Blackbody Fixed Point Cells. Connections are provided for a water supply of 0.5 to 1 litre per minute. Water supply and waste connections are provided. Use without cooling is not recommended.

An advanced state of the art electronic control system controls the furnace temperature. The control may be self-calibrated using freeze-point cells as references. An over-temperature safety circuit is provided, using an on/off circuit driven by a second thermocouple.

1. Argon Filler Tube
2. Insulation
3. Fixed Point Cell



964-01-02



High Temperature Furnace for Aluminium, Silver, Gold or Copper Blackbody Fixed Point Cells

Model No.	426
Temperature Range	450°C to 1090°C
Emissivity	greater than 0.995
Stability	±0.05°C
Display resolution	0.1°C to 999.9; 1°C from 1000 to 1090
Cavity size	50mm diameter 300mm deep
Time to temperature	4 hours
Supply	110VAC, 3kW, 50/60Hz CTE (230VAC and 110VAC to 110VAC Isolating Transformers available)
Dimensions	Height 410mm Width 415mm Depth 280mm
Weight	30.5kgs

Options

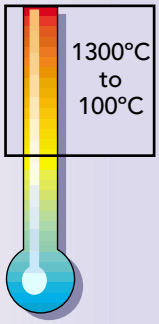
998-06-00D	Aluminium Large Blackbody Fixed Point Cell
998-06-00E	Silver Large Blackbody Fixed Point Cell
998-06-00F	Gold Large Blackbody Fixed Point Cell
998-06-00G	Copper Large Blackbody Fixed Point Cell
984-00-00	Gas Flow System
935-19-43	230v/110v Transformer
935-19-48	110v/110v Transformer

Now includes PC Interface and Windows software as standard

How to order

Model 426 Oberon R
Please state voltage required
Please state if UKAS calibration, or NPL calibration is required

Cyclops Model 878



The Cyclops is a hollow black sphere which fits inside our Saturn spherical furnace originally designed to calibrate thermocouples using an equalizing block.

The original equalizing block is removed and in its place the hollow black sphere is substituted enabling the furnace to be used for the calibration of radiation pyrometers.

The emissivity of the material is 0.98. The outer case viewing hole has an aperture of 17mm as standard. An aperture of 50mm is available to special order. Giving an apparent emissivity in relation to the wall greater than 0.999.

Effective emissivity of spherical cavities (values in relation of sheathed thermocouple near back wall)

D/d=3	**D/d=4**
1.007	1.004

Model No.	878
Temperature Range	100°C to 1300°C
Emissivity	Greater than 0.999
Stability	±0.1°C
Display resolution	0.1°C to 999.9; 1°C from 1000 to 1300
Time to temperature	1 hour to 700°C 3 hours to 1300°C
Power	3kW typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	diameter 425mm
Weight	25 kg

Options

878-02-08 Ceramic Spider to accept up to 8 thermocouples.

Now includes PC Interface and Windows software as standard

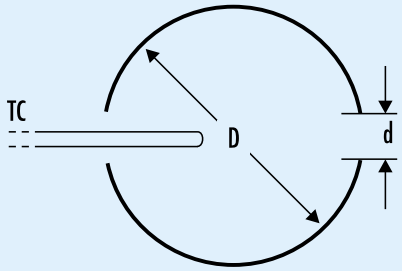
How to Order

Model 878 Cyclops

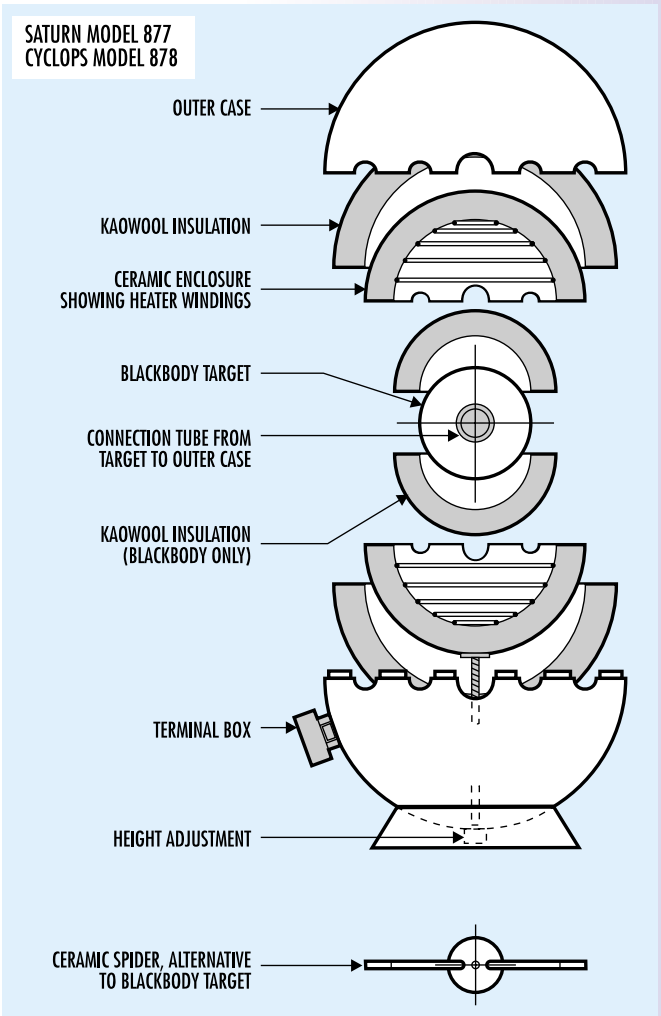
Please state supply voltage required

Please state target diameter (either 17mm standard or 50mm to special order

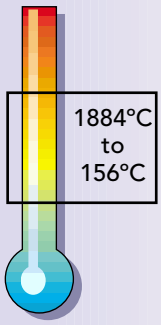
Spherical Blackbody Source
Wide Temperature Range
Can be Adapted for Thermocouple Calibration



EFFECTIVE EMISSIVITY OF CAVITY IN RELATION TO TEMPERATURE INDICATED BY THE THERMOCOUPLE (TC)



Cells for Blackbody Sources



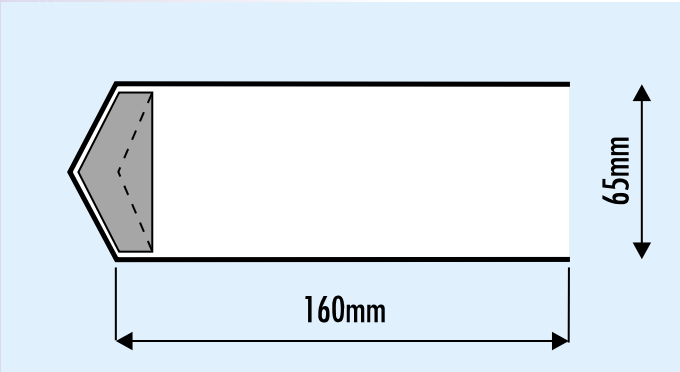
Primary Standard Cells - These cells are suitable for the Medusa R medium temperature cavity, and the Oberon R high temperature cavity. The cells contain 99.9999% purity metal giving a freeze or melt curve flat to ±0.01°C.

Available Temperatures:

998-06-00A	Indium	156.60°C
998-06-00B	Tin	231.93°C
998-06-00C	Zinc	419.53°C
998-06-00D	Aluminium	660.32°C
998-06-00E	Silver	961.78°C
998-06-00F	Gold	1064.18°C
998-06-00G	Copper	1084.620°C

Medium temperatures
fixed points for GEMINI R

See page 5 for apparatus and accessory details.



TEMPERATURES AVAILABLE ARE:

431-03-00	Gallium	29.76°C
976-05-00A	Indium	156.60°C
976-05-00B	Tin	231.93°C
976-05-00C	Zinc	419.53°C
Cavity diameter		65mm
Emissivity		.999±.001
Melt plateau		1 - 6 hours

Crucible material Graphite for Indium, Tin, Zinc, Teflon for Gallium

Metal purity is 99.999%

How to Order

65mm Hockey Puck Fixed Point Source

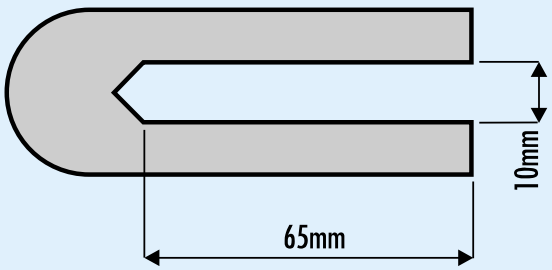
Please state type required

Fixed Point Black Body Sources
suitable for PEGASUS R

Page 7

Options

970-06-00A	Indium Blackbody Cell
970-06-00B	Tin Blackbody Cell
970-06-00C	Zinc Blackbody Cell
970-06-00D	Aluminium Blackbody Cell
970-06-00E	Silver Blackbody Cell



Cavity size	10mm Ø x 65mm
length to tip of 120°C cone	
Emissivity	0.995 ± 0.0002
Melt plateau	30 minutes to 1 hour
Crucible material	graphite

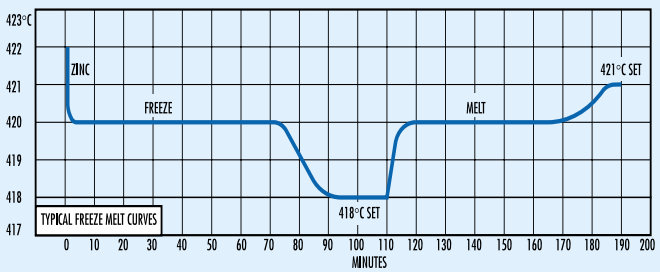
How to Order

High Temperature Blackbody Source

Please state type required.

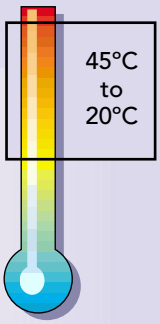
Hint:
Contact Isotech for Argon Flow Accessories.

Hint:
To maintain the purity of the aluminium and silver a small purge of an inert gas is required.



988

Blackbody Source



This new blackbody source has been introduced to meet the demand for a simple, cost effective but high accuracy calibrator for the calibration of thermal imagers and infrared thermometers used at temperatures around ambient.

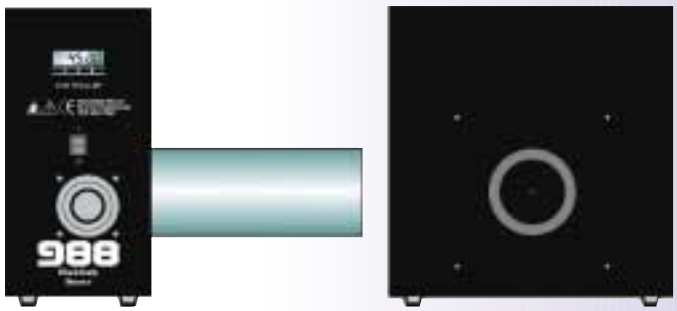
A 70mm diameter ridged plate is heated or cooled with an internal solid state thermoelectric heat pump. The temperature of the plate can be set from 20°C to 45°C to a resolution of 0.01°C.

Features

Combined stability / accuracy of ±0.2°C using contact thermometry.

The temperature controller has a resolution of 0.01°C.

Emissivity is better than 0.97 ± 0.02.

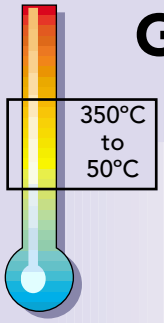


Model No.	988	
Temperature	20°C to 45°C	
Range	(70°F to 115°F)	
Resolution	±0.01°C	
Target Size	70mm diameter	
Emissivity	0.97 ± 0.02	
Combined	±0.2°C	
Accuracy / Stability	(±0.3°F)	
Power	70W	
Voltage	12 V.D.C.	
Dimensions	Height	230mm
	Width	225mm
	Depth	115mm
Weight	4kg	
Accessories	Switch Mode Power Supply	
	Supplied as Standard	
	100 - 240 V.A.C	
How to Order	988	

Evaluation at Land Infrared showed the advantages of fitting a stainless steel tube around the plate to give better uniformity and less sensitivity to draughts and ambient temperature effects.

Greybody Source/QuickCal Blackbody

Models 975 and 550-02



When the high accuracy of the Gemini R is not necessary these two products offer cost effective solutions for the calibration and testing of infra red thermometers. The Quick Cal Blackbody is ideal for rapid and portable checking of infra red thermometers. The Greybody Model 975 gives fast accurate results with a larger sensing area.

A temperature sensor sits just under the target surface and controls the temperature of the source. A custom designed surface sensor is used to set the controller calibration and a traceable certificate is supplied with each source. Either model can be supplied for Fahrenheit operation, please specify at time of order.

Quick Cal Blackbody Model No.	550-02
Temperature Range	30°C to 350°C
Display Resolution	0.1°C
Time to temperature	9 minutes
Target Size	25 x 115mm Cavity with end cone
Stability	±0.2°C
Accuracy	±0.5
Emissivity	>0.99 Surface coating 0.98 - cavity gives overall emissivity of >0.99
Power	300 Watts 100-130 or 208-240 VAC
Dimensions	Height 65mm Width 152mm Depth 175mm
Weight	1.5kg

How to Order

Model 550-02 Blackbody Source

Please state voltage required

Optional Carry Case 931-22-51

Greybody Model No.	975
Temperature Range	50°C to 350°C
Display Resolution	0.1°C
Time to temperature	35 minutes
Target Size	Ridged Plate, 70mm Diameter
Stability	±0.5°C
Accuracy	±2
Emissivity	>0.95
Power	180 Watts 100-130 or 208-240 VAC
Dimensions	Height 115mm Width 230mm Depth 225mm
Weight	3.9kg

How to Order

Model 975 Greybody Source

Please state voltage required

Reference Junction Techniques

Three basic methods are used to take account of the reference junctions of the thermocouple circuits:

1. The junction is maintained at a fixed temperature of 0°C.
2. The junction is maintained at some other fixed temperature.
3. The temperature of the reference junction is allowed to vary and a compensating EMF is introduced into the circuit or accounted for by calculation.

A summarised list of the main features of each referencing technique is given below to help a potential user choose the most cost effective solution to their thermocouple referencing problems.

i) Automatic Ice Point

Can be bench or 19" Rack Mounted.

Will reference up to 100 Thermocouples.

Requires air circulation to remove the heat generated by the peltier modules.

Will work over the environmental temperature range +2 to +40°C or +65°C.

Power consumption approximately 100 watts.

Stabilisation time 10 to 50 minutes.

Will reference any, or a mixture of, thermocouples.

Maintains 0°C (the reference temperature normally adopted for Thermocouple Reference Tables).

Accuracy, between ±0.2 and 0.3°C fully loaded with 100 fine wire double junctions.

ii) Constant Temperature Ovens

Can be Bench Mounted, Rack Mounted or housed in a weatherproof wall mounted case to IP669.

Will reference up to 100 Thermocouples.

Requires some air circulation, but in a weatherproof box the conduction of heat through the box is normally sufficient provided the ambient temperature is 10 to 15°C below the reference temperature.

Will work in ambient temperatures up to 65°C.

Power consumption - 100 watts typically.

Stabilisation time - 10 minutes.

Will reference any, or a mixture of, thermocouples.

Maintains a constant temperature (often 150°F) which must be allowed for in the controllers, instruments etc. fed from the oven.

Accuracy between ±0.2 and 0.3°C fully loaded with 100 fine wire double junctions.

For low measuring junction temperatures negative outputs can be obtained.

iii) Isothermal System

Can be supplied for 1, 3, 6, 12, 25, 50 or 100 junctions.

Can be supplied for Rack, Bench, Weatherproof or Intrinsically safe applications.

No heat is generated in this passive system. The ambient temperatures in which this system will work is, therefore, wider (-20°C to +70°C).

Power consumption can be just a few milliwatts.

No warm-up time is required.

Will reference any mixture of thermocouples.

Data logging facilities are required to compensate for varying reference temperature.

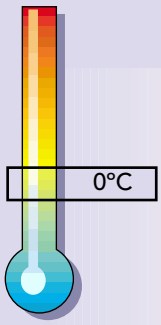
Accuracies of ±0.1°C are feasible at normal ambient temperature. Loading does not affect the accuracy.

Errors in the thermocouple wire can be allowed for.

www.isotech.co.uk/tcref

Zeref V

Model 700



The Zeref unit provides a stable and accurate 0°C reference temperature.

It is a self contained, all solid-state unit containing a sealed water/ice mixture automatically controlled to give zero degrees Centigrade.

The ice point reference unit consists of a copper cylinder closed at one end and fitted with a flexible metal bellows at the other.

The chamber is completely filled with pure water which is cooled by thermoelectric modules.

Ice forms internally at the walls and the resultant increase in volume expands the bellows until a predetermined amount of ice is formed.

The extended bellows operate electronics which disconnect the electrical supply to the cooling modules.

The closed end of the chamber is fitted with re-entrant tubes one end of each being closed.

The other end of the tube is left open, facilitating the insertion and removal of thermocouple junctions without interrupting operation of the reference unit.

The Zeref Ice Point Reference Unit Model 700 is designed to reference thermocouples at 0°C.

The Zeref can be supplied complete with selected thermocouple cold junctions connected to easily accessible terminals in an isothermal enclosure on top of the Zeref case. There are a wide range of options for thermocouple material screening, housing and terminals. Please telephone Isotech or your local distributor for details.

For harsher thermal environments refer to TRU page 17.

Model No.	700
Power	50 Watts typical 100-130 or 208-240 VAC 50/60Hz.
Dimensions	Height 304mm Width 196mm Depth 284mm
Weight	11.5kg

Accuracy: the accuracy of the Zeref is 0±0.01°C. Errors are introduced by loading the Zeref with Thermocouple wires or probes for calibration. The loading effect can typically vary from 0 to 0.1°C.

Stability: 0.01°C at constant ambient temperature.

Ambient Temperature Range: the ambient temperature should not be allowed to exceed 30°C until the yellow neon lamp occults. Thereafter, Zeref's may be operated continuously at ambient temperatures up to 35°C. Zerefs will only operate at an ambient temperature above 0°C. A free circulation of air to the heat sink fins is needed but fan assisted air circulation is unnecessary.

Stabilisation Time: Zerefs are ready for operation when the yellow neon lamp is seen to occult. This will happen in general 1 - 3 hours after switch on, when the correct amount of ice has formed. The time to form ice depends on the ambient temperature and load, so that a fully loaded Zeref in 30°C ambient may require up to 5 hours to stabilise at 0°C.

Alarm Facilities: a second and separate control circuit takes over and a green alarm light flashes.

Options

Type 131: contains 1 probe hole of 18mm diameter and 170mm depth and is suited for referencing thermocouples or calibrating temperature sensors such as thermocouples and thermistors.

Type 136: Contains 6 holes of 5mm diameter and 170mm depth and is mainly used for referencing thermocouples.

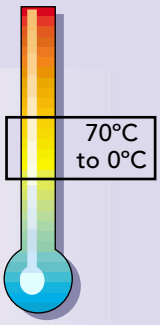
How to order

Model 700 Zeref
Please specify type
(e.g. 700/136)
Please specify voltage required

A full performance report is available on request.

Thermocouple

Multi-junction probes



Isothermal Technology Limited manufacture a wide range of multi-junction thermocouple probes. Probes available contain up to 10 double junctions or 20 single junctions in a variety of thermocouple combinations.

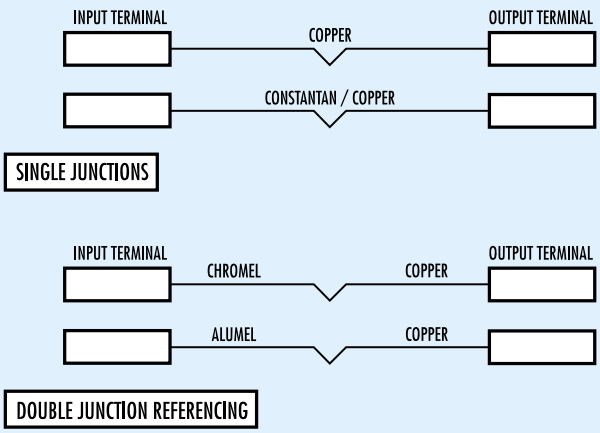
All wire material is to E320 Class 1 (highest grade available) and PTFE covered to Grade A.

Normal lead length is 1 metre, but other lengths are available. Probe diameter is less than 8mm.

Thermocouple probes or looms are available for Zeref's, and our other models of thermocouple compensation units. Two wire connections can be provided as below.

Thermocouple wires are clearly numbered and colour coded, according to B.S. 1843.

Output wires are colour coded Pink for +ve and White for -ve.



Looms for our Compensation Units
Saves On-site Wiring
Maintains Accuracy of Unit

STANDARD COMBINATIONS AVAILABLE

Code	Single Junction Probes
K	Nickel Chromium vs Nickel Aluminium
E	Nickel Chromium vs Copper Nickel (Constantan)
J	Iron vs Constantan
T	Copper vs Constantan
N	Nicrosil vs Nisil
U	Copper vs Cupronic
S	Platinum vs Platinum 10% Rhodium
R	Platinum vs Platinum 13% Rhodium

Code	Double Junction Combinations examples
K	Nickel Chromium vs Copper
K	Nickel Aluminum vs Copper
J	Iron vs Copper
J	Constantan vs Copper
U	Cupronic vs Copper
S/R	Platinum vs Copper
S	Platinum 10% Rhodium vs Copper
R	Platinum 13% Rhodium vs Copper

("U" is a substitute metal alloy combination for Pt/Pt Rh types in the range 0 to 50°C).

Other materials are available on request.

How to order

Model 880 Cold Junction Probes are normally specified for each order. Please discuss your exact requirements with us before ordering.

Thermocouple Selector

Model 740

For those customers wishing to be able to purchase a system complete with thermocouple cold junctions and selector switch, Isotech have designed the Model 740 Thermocouple Selector.

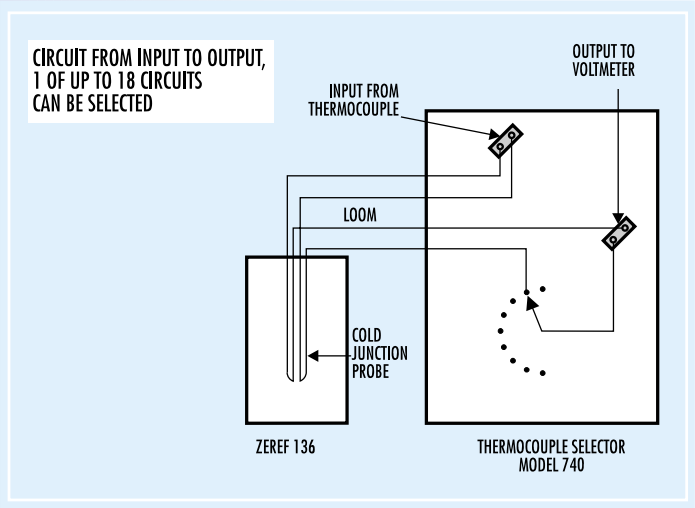
It is housed in an attractive case and stands next to the Zeref, Model 700 enabling 1 of up to 18 thermocouples to be selected.

The Model 740 Thermocouple Selector Switch acts in conjunction with the Zeref Ice Point Reference Unit to give a complete thermocouple referencing system.

Up to 18 thermocouples can be accommodated on the top of the Selector, by Klippon terminals, standard or miniature thermocouple sockets, or a combination of all three. The sockets or Klippon terminals are connected via looms to cold junction probes which fit into a Zeref Type 136, (see page 14).

Any type of thermocouple, or combination of thermocouples, can be referenced if specified at the time of ordering.

From the Zeref, the referenced outputs of the thermocouples return to the Thermocouple Selector and are presented via the highest quality thermocouple switch available to two output terminals which can then be connected to a microvolt measuring device.



Ideal for Laboratory
Simple to Use
Less than 1.5µV Switching Errors

Model No.	740
Dimensions	Height 325mm (including switch) Width 200mm Depth 350mm
Weight	4.5kg nett

Switch: less than 0.001 Ω resistance. Maximum 1.5 microvolts error on fast switching

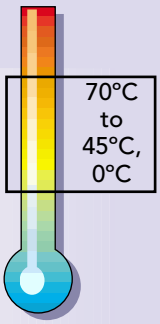
Looms: 815mm long, made of premium grade thermocouple wire

How to order

Model 740 Thermocouple Selector.
Please specify the number and types of thermocouples to be switched (up to 18) and connector type. i.e.. Miniature sockets, standard sockets, or klippon terminals.

TRU

Model 938



The TRU (Temperature Reference Unit) supplies a stable and accurate 0°C, or elevated reference temperature.

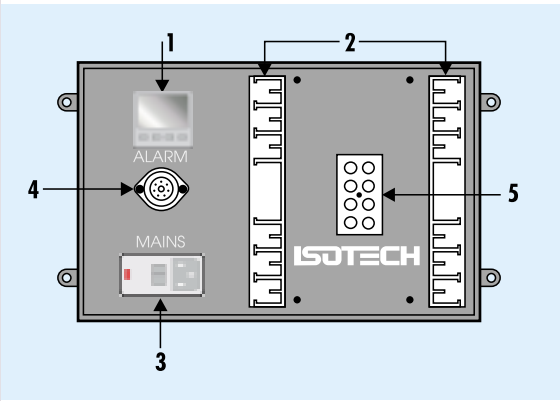
It is a self-contained all solid-state unit using Peltier technology which provides maintenance free operation.

The TRU features rapid temperature shift even from high ambient temperatures and is stable within 10 minutes from switch on.

An alarm will be activated should the reference temperature deviate by more than 0.2°C.

PANEL LAYOUT & FUNCTIONS

1 Controller
2 Cooling Ducts and Heat-Sink Fins
3 Switched Mains Cable Socket & Fuse-Holder
4 Alarm-Cable Socket
5 Metal Block with Pockets for Thermocouple Junctions



Thermocouple Referencing to ISO9000 at 0°C, in ambients of up to 65°C or elevated reference temperature, References 100 Thermocouples
Direct Replacement for other Units

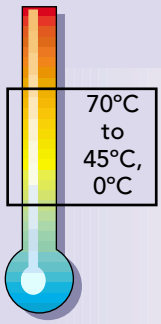
Hint:
The TRU can be supplied in a 19" rack mounted enclosure. For the mechanical details see the TRUrac page 19. Up to 2 TRUs can be fitted in to the 19" rack providing a maximum capacity of 100 double junction thermocouples, the unit is called the TRUrac

Model No.	938
Accuracy °C	±0.03°C, Errors introduced by thermocouple loading can be removed by adjusting controller offset
Stability	±0.05°C
Ambient Range °C	2°C to 65°C
Stabilising time	10 minutes from 44°C
Alarm facilities	Non-latching relay rated 5 Amps 240V
Standard Capacity	6 x 6.2mm holes plus 4.2 for calibrated standard PRT or 8 x 8.2mm holes plus 4.2 for calibrated standard PRT
Power	100 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 228mm Width 248mm Depth 143mm
Weight	5.5kg (12.1lb)

How to order
TRU Model 938
Normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.

TRU 100

Model 937



The TRU 100 (Temperature Reference Unit) supplies a stable and accurate 0°C or elevated Reference Temperatures between 45°C and 70°C.

It is a self-contained all solid state unit using peltier technology which provides maintenance free operation. The TRU 100 features rapid cool down from high ambient temperatures and is stable within 10 minutes from switch on.

An alarm will be activated should the reference temperatures deviate by more than 0.2°C. Thermocouple Reference Junctions are located in a reference block and connected to their marked input and output terminals in an isothermal enclosure. The uniform temperature throughout the enclosure ensures that no thermoelectric EMFs are generated at the terminals.

One advantage of the TRU100 is that the user need not be concerned with the supply and installation of reference junctions since it is only necessary to connect the thermocouple compensation cables to the input terminals and the measuring instrument to the output terminals of the TRU100.

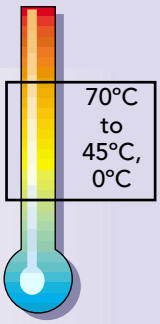
Thermocouple Referencing to ISO9000 at 0°C in Ambients up to 65°C or elevated reference temperatures between 45°C and 70°C
References up to 100 Thermocouples
Pre-wired Thermocouples, Compact Design

Model No.	937
Accuracy °C	±0.03°C, Errors introduced by thermocouple loading can be removed by adjusting controller offset
Stability	±0.05°C at 20°C ±10°C
Ambient Range °C	2°C to 65°C
Stabilising time	10 minutes from 44°C
Thermocouple Capacity	Up to 100 Double Junction Channels (Refer to table on page 15 for Thermocouple required)
Input/Output Connections	Klippon Terminals, type 1.5 AKZ
Monitor (optional)	4 wire Connected PT100, 1/3 Din Standard ±0.1°C Accuracy
Alarm facilities	Non-latching relay rated 5 Amps 240V
Power	100 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions	Height 285mm Width 253mm Depth 312mm

How to order
TRU100 Model 937
Normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.

TRUrac

Model 847



The Trurac is a 0°C or elevated temperature thermocouple reference system mounted in a 19" chassis.

It has been developed for situations where ambient temperature can be up to 65°C. (Also see TRU page 17).

The reference temperature is normally set to 0°C or between 45°C and 70°C. For other temperatures please contact Isothermal Technology Limited.

An alarm will be activated should the reference temperatures deviate by more then 0.2°C.

The capacity of the unit is up to 100 thermocouple channels, the probe wires being terminated at the rear of the unit in Klippon terminals. The customer simply connects their thermocouple wires and copper output wires to these terminals.

All the thermocouple cold junctions are inserted into a metal oven block which is accurately temperature controlled.

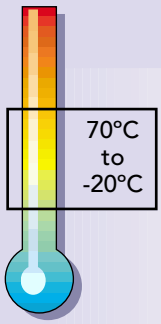
Rack mounted Temperature Thermocouple Referencing System
Large Capacity - up to 100 thermocouples,
Approved for Power Station Use
Reference temperatures set to 0°C or between 45°C and 70°C

Model No.	847
Accuracy	±0.03°C about set point
Long Term Stability per 1000 Hours	±0.02°C
Temperature Gradient between Junctions	±0.1°C
Stabilisation Time	10 minutes
Ambient Temperature Range	-10°C to within 10°C of reference temperature. 70°C maximum
Alarm facilities	Non-latching relay rated 5 Amps 240V
Power	100 Watts typical 100-130 or 208-240 VAC 50/60Hz
Dimensions 50 to 100 Channels	Height 400mm Width 483mm Depth 312mm

How to Order
Should be specified uniquely on each order.
Please discuss your exact requirements with us before ordering.

Isobox

Model 842



The function of this reference unit differs from other cased systems in that the temperature of the metal block in which the thermocouple and copper leads are inserted, actually varies with ambient temperature. A separate output signal is produced which is proportional to the difference between the environmental temperature and the actual reference temperature. The output signal can be fed directly into a computer/data logger to give accurate compensation over a large ambient range.

A thermal reservoir, heavily insulated, contains the reference junction probes. The reservoir temperature slowly follows the ambient temperature; an electrical compensation device is thermally integrated with the reservoir and thus senses the reservoir temperature. The device produces an output proportional to the difference between the reservoir temperature and the reference temperature (usually 0°C).

This is the signal the computer/data logger uses to compensate for the temperature of the reference probes junctions.

Units are housed in robust weatherproof enclosures to IP669 incorporating bottom gland plate. Fixing lugs for wall mounting are provided. Easy access to terminal rails and block assembly is via a lockable hinged front door.

Model No.	842
Referencing Temp	Effectively 0°C
Accuracy	±0.1°C per 10° ambient span
Long Term Stability per 1000 Hours	±0.05°C
Temperature Gradient between Junctions	±0.1°C
Stabilisation Time	10 minutes
Ambient Temperature	-20°C to +70°C
Thermocouple	0 to 100 channels
Capacity	Double junction referencing
Power	10 Watts typical 100-130 or 208-240 VAC 50/60Hz Low level D.C. Consumption 6VA typical
Dimensions	Height 600mm Width 600mm Depth 300mm
Weight	40kg

N.B. Numerous special versions are available and can be supplied either in their existing form or modified to customers' requirements.

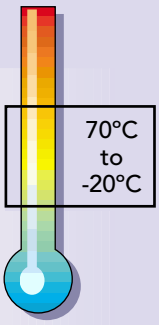
How to order

Model 842 Isoboxes are normally uniquely specified for each order. Please discuss your exact requirements with us before ordering.
For the Thermocouple variations, please see table on page 15.

Waterproof Cased Ambient Temperature Thermocouple Referencing System
Large Capacity up to 100 Thermocouples, Wide Ambient Range
Approved for Power Station Use

Isorac

Model 844



The function of this reference unit differs from other rack mounted systems in that the temperature of the metal block in which the thermocouple and copper leads are inserted actually varies with ambient temperature. A separate output signal is produced which is proportional to the difference between the environmental temperature and the actual reference temperature. The output signal can be fed directly into a computer/data logger to give accurate compensation over a large ambient range.

A thermal reservoir, heavily insulated, contains the reference junction probes.

The reservoir temperature slowly follows the ambient temperature; an electrical compensation device is thermally integrated with the reservoir and thus senses the reservoir temperature. The device produces an output proportional to the difference between the reservoir temperature and the reference temperature (usually 0°C).

This is the signal the computer/data logger uses to compensate for the temperature of the reference probes junctions.

Alternatively, a Pt100, a 4-20mA signal or other temperature sensor can be provided.

Model No.	844
Reference Temperature	Effectively 0°C
Accuracy	±0.1°C per 15°C ambient span
Long Term Stability per 1000 Hours	±0.05°C
Temperature Gradient between Junctions	±0.1°C
Stabilisation Time	10 mins
Ambient Temperature Range	-20°C to +70°C
Thermocouple Capacity	0 to 100 channels double junction referencing
Power	10 Watts typical 100-130 or 208-240 VAC 50/60Hz Low level D.C. Consumption 6VA typical
Dimensions Up to 50 channels	Height 255mm Width 483mm Depth 312mm Weight 17.2kg (38lb)
50 to 100 channels	Height 309mm Width 483mm Depth 312mm Weight 20.4kg (45lb)

Numerous special versions are available and can be supplied either in their existing form or modified to customers requirements.

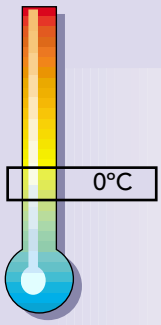
Rack Mounted Ambient Temperature Referencing System
19" Rack Mounting, Large capacity up to 100 Thermocouples
Approved for Power Station Use

How to order

Model 844 Isoracs are normally uniquely specified for each order.
Please discuss your exact requirements with us before ordering.
For the Thermocouple variations, please see table on page 15.

Trio

Model 885



The Isotech Trio is a low-cost, accurate, portable unit designed to compensate three thermocouples for the variations in EMF caused by the cold junction not being at the standard reference temperature of 0°C.

Tables are available for each thermocouple combination which give the voltage versus temperature variation. The Trio senses the ambient temperature and generates an electrical voltage to cancel out the variation, thus providing equivalent of a 0°C cold junction reference bath.

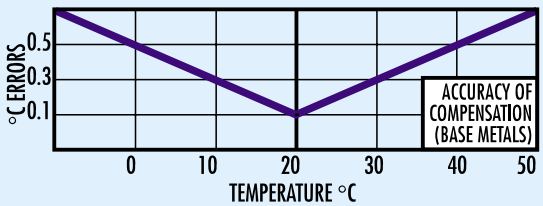
The Isotech Trio contains three electronic networks, incorporating a temperature-sensitive element which is thermally integrated with the thermocouple cold junction for maximum precision.

The unit is mains operated.

The Trio is manufactured to the highest standards and after assembly each unit is calibrated to ensure conformance to the relevant thermocouple table.

A wide range of thermocouple types are available. As standard, seven thermocouple combinations are offered to customer requirements. The internal structure of the Trio allows either one, two or three thermocouple types to be compensated.

N.B. The Trio has a common power supply and in some circumstances with grounded thermocouples earth loops can form causing apparent errors in compensation.



Model No.	885
Reference Temp	0°C (others by arrangement)
Operating Temp	0 to 55°C
Output Impedance	Less than 200 ohms
Power	10 Watts typical 100-130 or 208-240 VAC 50/60Hz
Accuracy	See Graph
Error due to Supply Variations	Negligible
Compensation for type	K, T, J, E, U, N U Wire used for R & S types unless otherwise specified
Stability	Typically 0.02% p.a.
Dimensions	Height 38mm Width 80mm Depth 150mm
Weight	349g

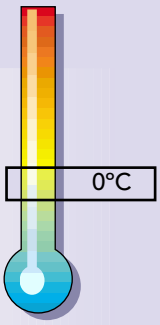
How to order

Trio Model 885: specify 3 thermocouple types and supply voltage
e.g.. Trio K.K.E. 220V 50Hz.

3 Channel Thermocouple Referencing System
3 Channels of Compensation
Accurate, Convenient

Frosty

Model 887



The Frosty is an accurate and low-cost device in which compensates a single thermocouple for the output EMF variations caused by the fluctuations in reference junction temperature.

Thermocouple tables give the voltage versus temperature variation with the cold junction at 0°C. This unit senses the temperature difference between ambient and 0°C and generates an electrical voltage to cancel out the resultant error, thus providing the equivalent of a 0°C reference bath.

The cased, battery-powered unit is portable and self-contained: modules can also be supplied for building into other equipment.

The unit is powered by a small Alkaline battery. A unique feature is an inbuilt miniature voltage stabiliser to eliminate the voltage variations which are one of the commonest causes of error in electronic thermocouple compensators, (the output of a dry cell varies with age, the amount of current which has been drawn from it and ambient temperature). This stabiliser, coupled with the thermal integration of the temperature sensitive element, makes the unit an outstandingly accurate device.

The unit is manufactured to the highest standards and after assembly each unit is calibrated to ensure conformance with the relevant thermocouple table.

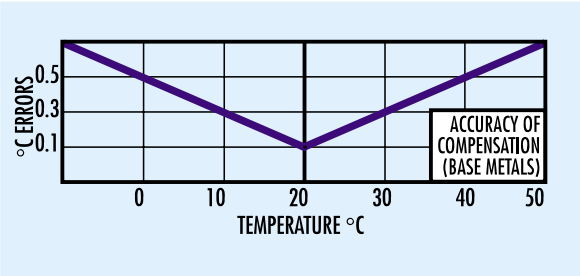
A wide range of thermocouple types are available.

Recalibration procedure when required.

1. Place thermocouple probe in stirred ice bath, connect to the input and switch on.

2. Connect an accurate measuring instrument to the unit and adjust the potentiometer for zero output.

British Aerospace approved versions of the unit's module are available.



Single Channel Thermocouple Automatic Compensator
Single Channel Automatic Reference Junction
Accurate, Light and Portable

Model No.	887
Referencing Temp	0°C (others by arrangement)
Operating Temp	0 to 40°C
Accuracy	±0.1°C at 20°C plus ±0.02°C per degree above or below 20°C (see graph)
Output Impedance	Less than 200 ohms
Battery	AAA 1.5V
Supply Current	Less than 0.5mA
Variations	Periodic checking of the battery and replacing when its voltage is 1.36 Volts or less, will ensure negligible error
Compensation	K, T, J, E, U, N
Used for type	U Wire used for R & S types unless otherwise specified
Stability	Typically 0.2% p.a.
Dimensions	Height 25mm Width 50mm Depth 100mm
Weight	107g

How to order
Frosty Model 887 (small plugs)
Specify thermocouple type e.g. Frosty K

databookone
Realising ITS-90




Includes:

- Fixed Point Cells
- Primary Apparatus
- Thermometers
- Instruments & Software

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Secondary Laboratory Equipment




Includes:

- Slim Cells
- Secondary Apparatus
- Thermometers
- Instruments & Software

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Industrial Laboratory Equipment




Includes:

- Metal Block Baths
- Furnaces
- Thermometers
- Instruments & Software

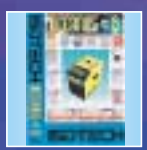
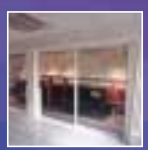
databookfour
Blackbody & Thermocouple Referencing




Includes:

- Blackbody Cells
- Blackbody Cavities
- Blackbody Furnaces
- Thermocouple Referencing

databookfive
Calibration Services & Information

Includes:

- U.K.A.S. Calibration
- Journal of Thermometry
- Video Courses
- Training Courses

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