Certificate of Conformity

Isothermal Tower Aluminium Fixed Point Cell

MODEL: 493
SERIAL NUMBER:

ISSUED BY: **ISOTHERMAL TECHNOLOGY LIMITED.**

DATE OF ISSUE: 12th October 2009

Congratulations you are now the custodian of one of the best ITS-90 Fixed Point Cells ever produced.

The Cells we make are not just an ingot of pure metal.

We go to extreme lengths to ensure all elements that go into the fabrication of the cells are the best available world wide.

CUSTOMER:

CUSTOMER ORDER: **ITL REFERENCE:**

DESCRIPTION: Isotech Model 493 Isothermal Tower Aluminium Fixed Point Cell.

ASSIGNED ITS 90 TEMPERATURE: Freezing Point of Aluminium, 660.323 ˚C.

IDENTIFICATION:

CONSTRUCTION:

The fixed point cell within the Isothermal Tower comprises an ingot of 99.9999 (6N) pure metal in a very high purity graphite crucible, all sealed in metal.

PERFORMANCE:

There is a temperature variation with depth below the metal surface where the ITS 90 defined temperature applies.

The distance from the metal surface to the bottom of the re entrant well is 180 mm ± 5 mm.

The hydrostatic temperature variation of this cell is 0.0016 mK per mm.

The correction should be calculated using the distance between the metal surface and the mean sensing position of the thermometer in the re entrant well.

Approved By
Name:
Signature:

THE METAL

The metal we use in our fixed point cells is certified by the manufacturer to be 6N pure.

The manufacturer will typically analyse 20 elements from any one sample, however, their minimum detection levels to which they are operating may be relatively high, up to 5 ppm.

An assumption is made that if an impurity is less than the minimum detection level then it is classified as zero!

Clearly a manufacturer's analysis is of limited value.

The National Research Council of Canada (NRCC) has probably the best analysis facility publicly available.

At your request we can send a sample of the metal used in your cell to NRCC for analysis.

There the sample will be analysed for up to 60 elements in a system with minimum detection levels down in the parts per billion (ppb).

This analysis will give a higher confidence level to you, the user.

There is an additional cost for this service, consult Isotech for a sample NRCC certificate of analysis and an up to date cost.

Certificate of Analysis
For
Isothermal Tower Aluminium
Serial No:

Date: 8/9/2005

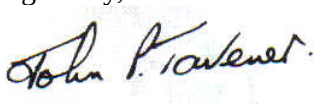
Material: Aluminium

Lot No.: M9904

Based on information supplied with the material Lot No. as above, the significant detected metallic impurities are those listed:-

Mg	=	0.16 ppm
Si	=	0.42 ppm
Fe	=	0.22 ppm
Cu	=	0.23 ppm

Signed by;



…….
John P. Tavener, Managing Director
& Head of Laboratories.

THE GRAPHITE CRUCIBLE

The graphite crucible that surrounds the metal in the fixed point cell must be the densest available with the smallest particle size, whilst also having the highest purity.

Our research identified graphite with average grain size of 7μm and a purified grade containing less than 5 ppm of impurities.

But this is only the first stage of the process.

The finished machined parts then go through a post machine purification process to further reduce the impurities.

Finally followed by a time versus temperature versus vacuum process prior to the metal being introduced.

The resulting graphite contains no measurable impurities.

Certificate of Isotropic Graphite Analysis For Cell Crucible. Serial No.

Date: January 2008

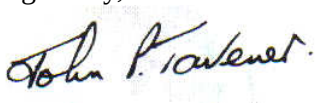
Material: Isotropic Graphite

Grade: SS

Based on information supplied with the material Grade as above, the significant detected metallic impurities are those listed:-

Fe	=	<1 ppm
Mg	=	<1 ppm
Si	=	<1 ppm
Ti	=	<1 ppm

Signed by;



…….
John P. Tavener, Managing Director
& Head of Laboratories.

THE GAS

Compared to say 1 Kg of 6N pure metal, only a few milligrams of Argon are used to surround the cell.

Even so the Argon that we use is certified as 5N5 pure, ensuring that the effects of its impurities are un-measurable.

THE CELL GAS PRESSURE

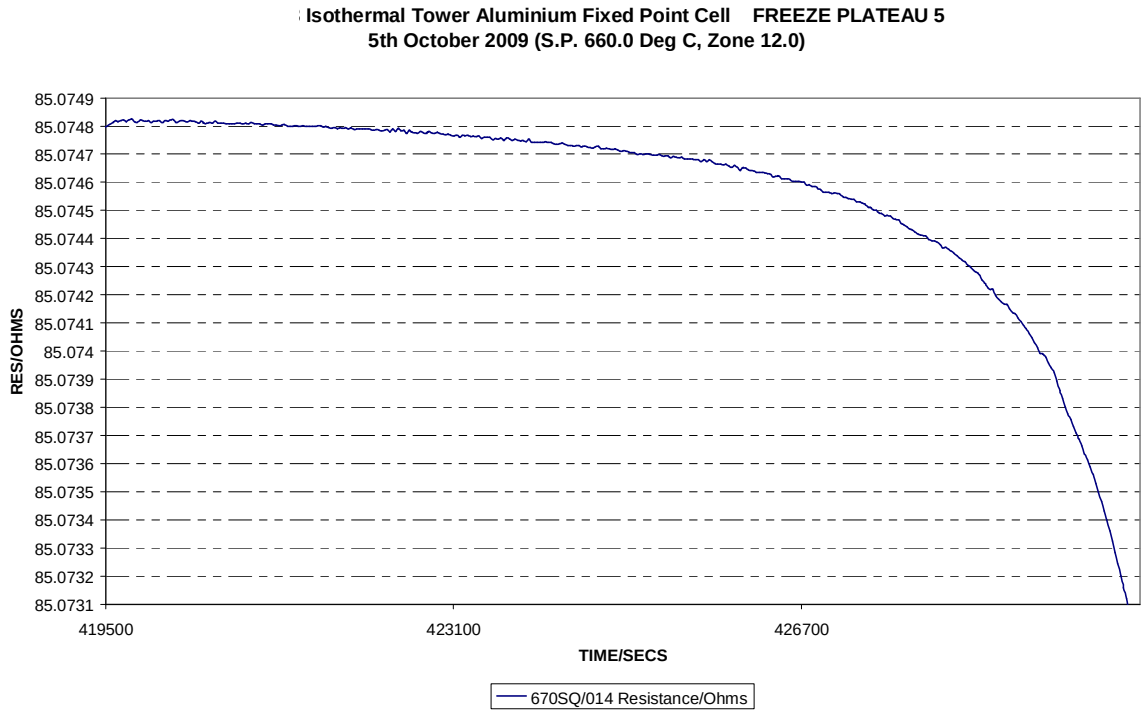
ITS-90 specifies that at the transition temperature where the cell melts and freezes the pressure inside the cell shall be within 1 % of one standard atmosphere. (101, 325 Pa or 1.013 bar) (excepting Triple Points). **

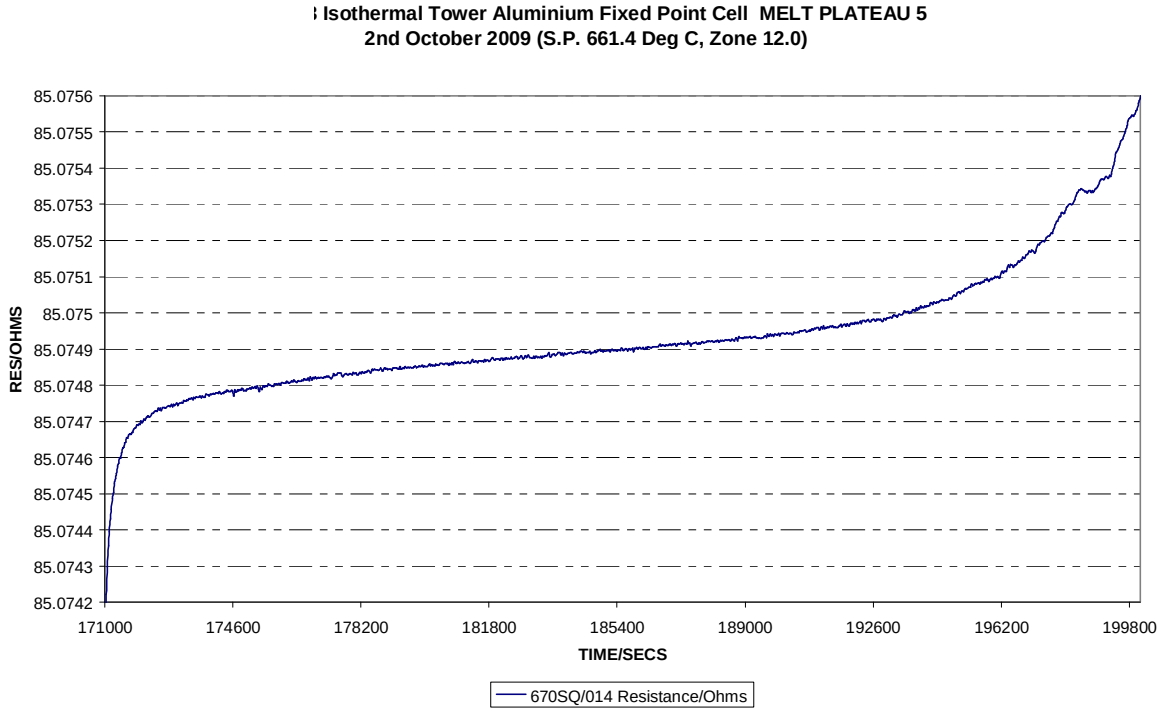
Each sealed cell produced by Isotech is set to one standard atmosphere +/- 5 mb, using a UKAS certified Druck vacuum gauge.

A cell whose pressure is not that of one standard atmosphere does not fully conform to ITS-90.

** Ref. Metrologia 27, 3-10 (1990).

Table 1 ‘’ Melting point, Freezing Point (temperature at a pressure of 101, 325 Pa, at which the solid and liquid phases are in equilibrium)’’.


Isothermal Tower Aluminium Fixed Point Cell FREEZE PLATEAU 5
5th October 2009 (S.P. 660.0 Deg C, Zone 12.0)
85.0749
85.0748
85.0747
85.0746
85.0745
85.0744
85.0743
85.0742
85.0741
85.074
85.0739
85.0738
85.0737
85.0736
85.0735
85.0734
85.0733
85.0732
85.0731
RES/OHMS
419500
423100
426700
TIME/SECS
670SQ/014 Resistance/Ohms


Isothermal Tower Aluminium Fixed Point Cell MELT PLATEAU 5
2nd October 2009 (S.P. 661.4 Deg C, Zone 12.0)
85.0756
85.0755
85.0754
85.0753
85.0752
85.0751
85.075
85.0749
85.0748
85.0747
85.0746
85.0745
85.0744
85.0743
85.0742
RES/OHMS
171000
174600
178200
181800
185400
189000
192600
196200
199800
TIME/SECS
670SQ/014 Resistance/Ohms

Certificate of Conformity

Isothermal Tower Tin Fixed Point Cell

MODEL: 491
SERIAL NUMBER:

ISSUED BY: **ISOTHERMAL TECHNOLOGY LIMITED.**

DATE OF ISSUE: 1st October 2009

Congratulations you are now the custodian of one of the best ITS-90 Fixed Point Cells ever produced.

The Cells we make are not just an ingot of pure metal.

We go to extreme lengths to ensure all elements that go into the fabrication of the cells are the best available world wide.

CUSTOMER:

CUSTOMER ORDER: **ITL REFERENCE:**

DESCRIPTION: Isotech Model 491 Isothermal Tower Tin Fixed Point Cell.

ASSIGNED ITS 90 TEMPERATURE: Freezing Point of Tin, 231.928 ˚C.

IDENTIFICATION:

CONSTRUCTION:

The fixed point cell within the Isothermal Tower comprises an ingot of 99.9999 (6N) pure metal in a very high purity graphite crucible, all sealed in metal.

PERFORMANCE:

There is a temperature variation with depth below the metal surface where the ITS 90 defined temperature applies.

The distance from the metal surface to the bottom of the re entrant well is 180 mm ± 5 mm.

The hydrostatic temperature variation of this cell is 0.0022 mK per mm.

The correction should be calculated using the distance between the metal surface and the mean sensing position of the thermometer in the re entrant well.

Approved By
Name:
Signature:

THE METAL

The metal we use in our fixed point cells is certified by the manufacturer to be 6N pure.

The manufacturer will typically analyse 20 elements from any one sample, however, their minimum detection levels to which they are operating may be relatively high, up to 5 ppm.

An assumption is made that if an impurity is less than the minimum detection level then it is classified as zero!

Clearly a manufacturer's analysis is of limited value.

The National Research Council of Canada (NRCC) has probably the best analysis facility publicly available.

At your request we can send a sample of the metal used in your cell to NRCC for analysis.

There the sample will be analysed for up to 60 elements in a system with minimum detection levels down in the parts per billion (ppb).

This analysis will give a higher confidence level to you, the user.

There is an additional cost for this service, consult Isotech for a sample NRCC certificate of analysis and an up to date cost.

Certificate of Analysis
For
Isothermal Tower Tin
Serial No:

Date: 01/04/1998

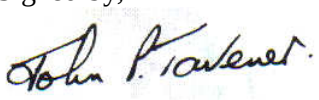
Material: Tin

Lot No.: M8967

Based on information supplied with the material Lot No. as above, the significant detected metallic impurities are those listed:-

B	=	0.1 ppm
Cs	=	0.2 ppm
Mg	=	0.1 ppm
Si	=	0.2 ppm

Signed by;



…….
John P. Tavener, Managing Director
& Head of Laboratories.

THE GRAPHITE CRUCIBLE

The graphite crucible that surrounds the metal in the fixed point cell must be the densest available with the smallest particle size, whilst also having the highest purity.

Our research identified graphite with average grain size of 7μm and a purified grade containing less than 5 ppm of impurities.

But this is only the first stage of the process.

The finished machined parts then go through a post machine purification process to further reduce the impurities.

Finally followed by a time versus temperature versus vacuum process prior to the metal being introduced.

The resulting graphite contains no measurable impurities.

Certificate of Isotropic Graphite Analysis For Cell Crucible. Serial No.

Date: January 2008

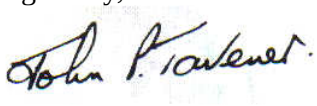
Material: Isotropic Graphite

Grade: SS

Based on information supplied with the material Grade as above, the significant detected metallic impurities are those listed:-

Fe	=	<1 ppm
Mg	=	<1 ppm
Si	=	<1 ppm
Ti	=	<1 ppm

Signed by;



…….
John P. Tavener, Managing Director
& Head of Laboratories.

THE GAS

Compared to say 1 Kg of 6N pure metal, only a few milligrams of Argon are used to surround the cell.

Even so the Argon that we use is certified as 5N5 pure, ensuring that the effects of its impurities are un-measurable.

THE CELL GAS PRESSURE

ITS-90 specifies that at the transition temperature where the cell melts and freezes the pressure inside the cell shall be within 1 % of one standard atmosphere. (101, 325 Pa or 1.013 bar) (excepting Triple Points). **

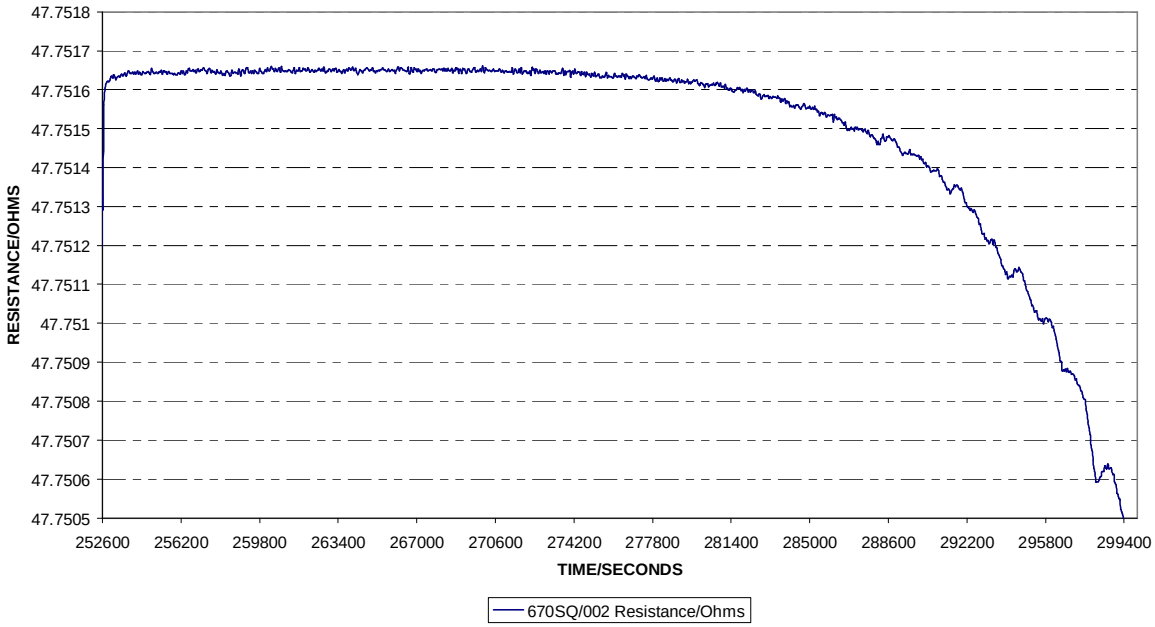
Each sealed cell produced by Isotech is set to one standard atmosphere +/- 5 mb, using a UKAS certified Druck vacuum gauge.

A cell whose pressure is not that of one standard atmosphere does not fully conform to ITS-90.

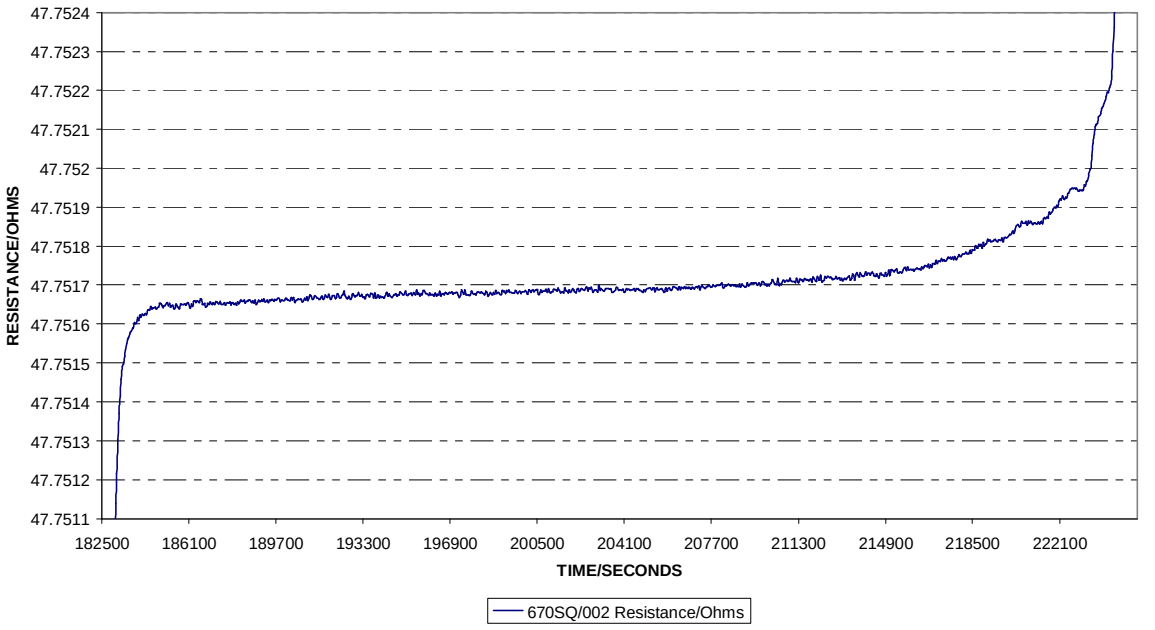
** Ref. Metrologia 27, 3-10 (1990).

Table 1 ‘’ Melting point, Freezing Point (temperature at a pressure of 101, 325 Pa, at which the solid and liquid phases are in equilibrium)’’.

Isothermal Tower Tin Fixed Point Cell FREEZE PLATEAU 2
(S.P. 231.0 Deg C, Zone 4.0) 15th August 2009



Isothermal Tower Tin FixedPoint Cell MELT PLATEAU 2
(S.P. 231.6 Deg C, Zone 4.0) 14th August 2009



Certificate of Conformity

Isothermal Tower Zinc Fixed Point Cell

MODEL: 492
SERIAL NUMBER:

ISSUED BY: **ISOTHERMAL TECHNOLOGY LIMITED.**

DATE OF ISSUE: 20th October 2009

Congratulations you are now the custodian of one of the best ITS-90 Fixed Point Cells ever produced.

The Cells we make are not just an ingot of pure metal.

We go to extreme lengths to ensure all elements that go into the fabrication of the cells are the best available world wide.

CUSTOMER:

CUSTOMER ORDER: **ITL REFERENCE:**

DESCRIPTION: Isotech Model 492 Isothermal Tower Zinc Fixed Point Cell.

ASSIGNED ITS 90 TEMPERATURE: Freezing Point of Zinc, 419.527 ˚C.

IDENTIFICATION:

CONSTRUCTION:

The fixed point cell within the Isothermal Tower comprises an ingot of 99.9999 (6N) pure metal in a very high purity graphite crucible, all sealed in metal.

PERFORMANCE:

There is a temperature variation with depth below the metal surface where the ITS 90 defined temperature applies.

The distance from the metal surface to the bottom of the re entrant well is 180 mm ± 5 mm.

The hydrostatic temperature variation of this cell is 0.0027 mK per mm.

The correction should be calculated using the distance between the metal surface and the mean sensing position of the thermometer in the re entrant well.

Approved By
Name:
Signature:

THE METAL

The metal we use in our fixed point cells is certified by the manufacturer to be 6N pure.

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There the sample will be analysed for up to 60 elements in a system with minimum detection levels down in the parts per billion (ppb).

This analysis will give a higher confidence level to you, the user.

There is an additional cost for this service, consult Isotech for a sample NRCC certificate of analysis and an up to date cost.

Certificate of Analysis
For
Isothermal Tower Zinc
Serial No:

Date: 18/12/2006

Material: Zinc

Lot No.: M27615

Based on information supplied with the material Lot No. as above, the significant detected metallic impurities are those listed:-

No Impurities Detected

Signed by;

…….
John P. Tavener, Managing Director
& Head of Laboratories.

THE GRAPHITE CRUCIBLE

The graphite crucible that surrounds the metal in the fixed point cell must be the densest available with the smallest particle size, whilst also having the highest purity.

Our research identified graphite with average grain size of 7μm and a purified grade containing less than 5 ppm of impurities.

But this is only the first stage of the process.

The finished machined parts then go through a post machine purification process to further reduce the impurities.

Finally followed by a time versus temperature versus vacuum process prior to the metal being introduced.

The resulting graphite contains no measurable impurities.

Certificate of Isotropic Graphite Analysis For Cell Crucible. Serial No.

Date: January 2008

Material: Isotropic Graphite

Grade: SS

Based on information supplied with the material Grade as above, the significant detected metallic impurities are those listed:-

Fe	=	<1 ppm
Mg	=	<1 ppm
Si	=	<1 ppm
Ti	=	<1 ppm

Signed by;

…….
John P. Tavener, Managing Director
& Head of Laboratories.

THE GAS

Compared to say 1 Kg of 6N pure metal, only a few milligrams of Argon are used to surround the cell.

Even so the Argon that we use is certified as 5N5 pure, ensuring that the effects of its impurities are un-measurable.

THE CELL GAS PRESSURE

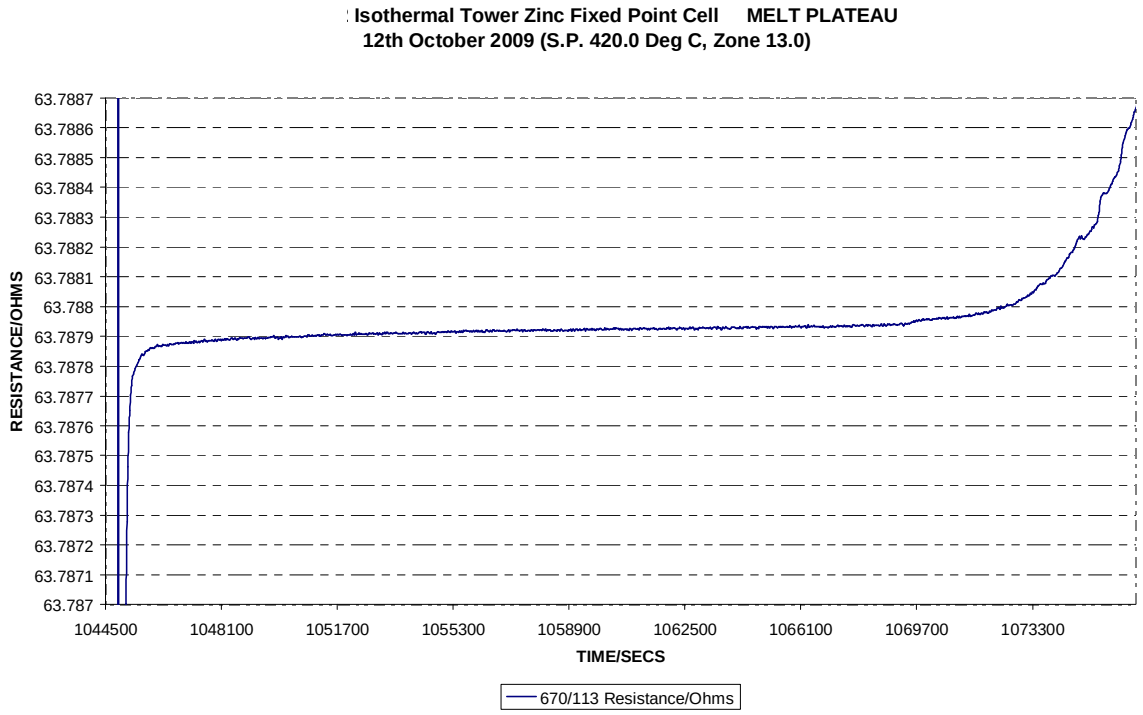
ITS-90 specifies that at the transition temperature where the cell melts and freezes the pressure inside the cell shall be within 1 % of one standard atmosphere. (101, 325 Pa or 1.013 bar) (excepting Triple Points). **

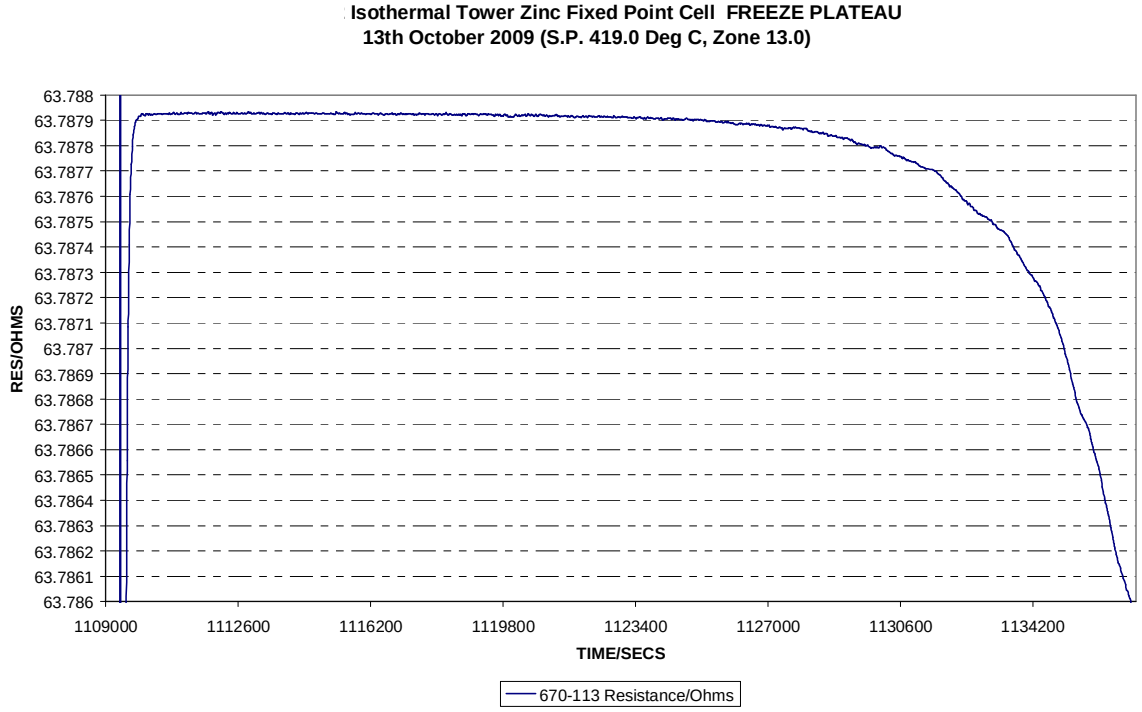
Each sealed cell produced by Isotech is set to one standard atmosphere +/- 5 mb, using a UKAS certified Druck vacuum gauge.

A cell whose pressure is not that of one standard atmosphere does not fully conform to ITS-90.

** Ref. Metrologia 27, 3-10 (1990).

Table 1 ‘’ Melting point, Freezing Point (temperature at a pressure of 101, 325 Pa, at which the solid and liquid phases are in equilibrium)’’.


Isothermal Tower Zinc Fixed Point Cell MELT PLATEAU
12th October 2009 (S.P. 420.0 Deg C, Zone 13.0)
RESISTANCE/OHMS
63.7887
63.7886
63.7885
63.7884
63.7883
63.7882
63.7881
63.788
63.7879
63.7878
63.7877
63.7876
63.7875
63.7874
63.7873
63.7872
63.7871
63.787
1044500
1048100
1051700
1055300
1058900
1062500
1066100
1069700
1073300
TIME/SECS
670/113 Resistance/Ohms


Isothermal Tower Zinc Fixed Point Cell FREEZE PLATEAU
13th October 2009 (S.P. 419.0 Deg C, Zone 13.0)
RES/OHMS
63.788
63.7879
63.7878
63.7877
63.7876
63.7875
63.7874
63.7873
63.7872
63.7871
63.787
63.7869
63.7868
63.7867
63.7866
63.7865
63.7864
63.7863
63.7862
63.7861
63.786
1109000
1112600
1116200
1119800
1123400
1127000
1130600
1134200
TIME/SECS
670-113 Resistance/Ohms