

ITS-90 FIXED-POINT CELLS



ITS-90 Fixed-Point Cells

- Best cell uncertainties commercially available
- Every ITS-90 fixed point available from mercury to copper
- Plateaus last days (gallium for weeks and TPW for months)
- Manufactured and tested by Hart's primary standards scientists

Hart scientists have designed and tested ITS-90 fixed-point cells for many years. Not only do we manufacture all the major fixed points, our metrologists have written extensively on the theory and use of cells and have created new designs covering a range of applications no other company can match.

Our testing of fixed-point cells is also unmatched. The scope of our accreditation includes the testing of ITS-90 fixed-point cells. Each cell may be purchased with this intercomparison option, which includes comparing the equilibrium value of your cell against that of a Hart cell that has been intercompared with a cell at NIST.

Traditional Freeze-Point Cells

If you want true primary temperature standards capability, you want metal freeze-point cells that are very close to

the theoretical freezing temperature and provide plateaus that are both stable and long lasting.

Hart's metal freeze-point cells are the culmination of more than 20 years of primary standards experience. No other company has as much experience in the development of metal fixed-point cells as Hart. That's why you'll find Hart cells in many national metrology institutes around the world.

Each Hart cell is carefully constructed in our state-of-the-art lab, using high-density, high-purity graphite crucibles containing metal samples with purity of at least 99.9999% (six 9s). The crucible is enclosed within a sealed quartz glass envelope that is evacuated and back-filled with high-purity argon gas. A special sealing technique is used to seal the cell at the freezing point. We measure and record for you the exact pressure of

the argon gas to ensure the smallest corrections for pressure.

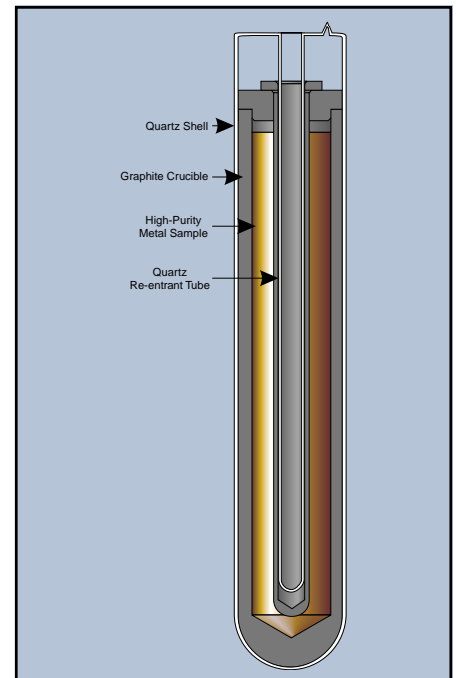
Every Hart cell undergoes thorough testing in our accredited lab where we realize melt-freeze curves and perform a detailed "slope analysis" to confirm cell purity. This data is supplied with every cell. If you want more data, we'll give you an optional intercomparison with our own reference cells that have been tested at NIST.

Gallium Cells

Gallium cells are a great reference for validation of instruments subject to drift, like SPRTs, and they're important for calibrating sensors used near room or body temperatures in environmental monitoring and in life sciences applications.

Hart makes two traditional-size gallium cells. The Model 5903 is sealed in a borosilicate glass envelope. Pure gallium (99.99999%) is enclosed in a plastic and glass shell. The borosilicate container is then filled with pure argon gas at one standard atmosphere at the melting-point temperature.

Gallium expands on freezing by 3.1%, requiring the cell to have flexible walls. Unlike some manufacturers' cells, which are made from PTFE enclosure



materials, our cells don't need pumping and refilling because they're not gas permeable. In fact, we guarantee our cells will maintain their uncertainty of 0.1 mK for at least five years. When maintained in a Hart Model 7012 or 7312 Bath, your melting plateaus will last as long as 14 days—that's *days*, not hours.

Hart's new Model 5943 Stainless Steel Gallium Cell uses similar manufacturing techniques and provides the same low uncertainty as our glass-enclosed version, and its use is automated with our Model 9230 Gallium Cell Maintenance Apparatus. This device allows users to achieve a new melt plateau each week with an investment of just five minutes. Never has the maintenance of a world-class gallium cell been easier.

Water Cells

While simple ice baths are often used as a calibration point at 0°C, their limitations include gradients, purity problems, repeatability issues, and variances in construction and measurement techniques. Triple point of water cells not only solve these problems, they represent the most used temperature on the ITS-90, and they're inexpensive to own and use.

Hart makes three traditional size TPW cells (see page 20) that have been

Specifications

Fixed Point	Model Numbers	Assigned Value (°C)	Depth (cm)	Cell Uncertainty (mK, k=2)	Certification (mK, k=2)*
Mercury T.P.	5900	-38.8344	20	0.2	0.25
Water T.P.	5901, 5901A, 5901C	0.01	26	0.07	0.1
Gallium M.P.	5903, 5943	29.7646	15	0.08	0.1
Indium F.P.	5904, 5924	156.5985	19	0.7	0.7
Tin F.P.	5905, 5925	231.928	19	0.5	0.8
Zinc F.P.	5906, 5926	419.527	19	0.9	1.0
Aluminum F.P.	5907, 5927	660.323	19	1.3	1.8
Silver F.P.	5908, 5928	961.78	19	2.4	4.5
Gold F.P.	5910	1064.18	19	2.5	4.5
Copper F.P.	5909, 5929	1084.62	19	10.1	12.0

*Certifications at lower uncertainties are available for national laboratories.

repeatedly proven in national labs to surpass their published uncertainty specification of $\pm 0.0001^\circ\text{C}$. Ice mantles may be formed using dry ice, LN_2 , or immersion freezers (we'll teach you how—see pages 152 to 155) and can last for up to two months when maintained in our Model 7012 or 7312 Baths.

Open Cells

Made from the same materials and with the same manufacturing techniques as their sealed counterparts, Hart's new series of "open" fixed-point cells include

a valve for connecting to a precision pressure-handling system within your lab. Using such a system, the cell can be evacuated, charged and purged several times with a pure inert gas, then charged again to a regulated pressure level while measurements are made with the cell.

Because open cells allow users to measure the pressure within the cell, uncertainties due to pressure corrections may be minimized. Open cells can be used for demanding temperature-versus-pressure applications as well as precision SPRT calibrations.



Plateaus from Hart's new Model 5943 Stainless Steel Gallium Cell can easily be maintained for a week or more in the Model 9230 Gallium Maintenance System. The 9230 almost completely automates the melting and re-freezing processes.



In addition to our stainless steel-encased gallium cell, the Model 5903 Gallium Cell, enclosed in traditional quartz glass, offers plateaus that can last for weeks when maintained in a Hart metrology bath.

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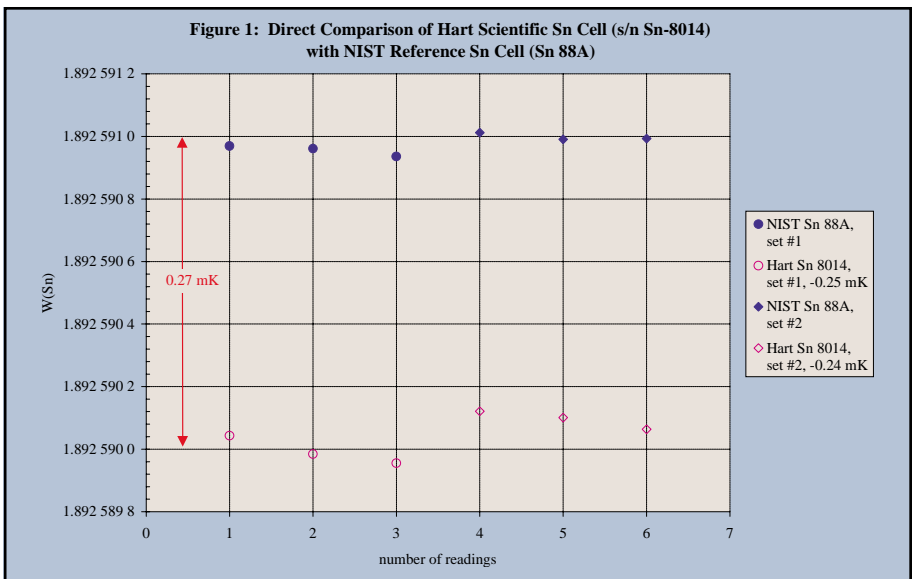
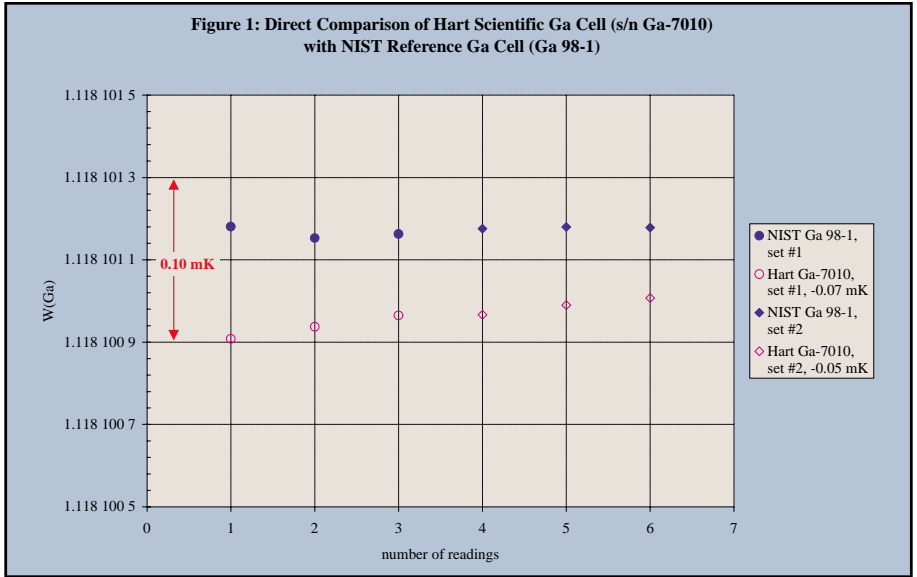
Primary Standards



Open cells allow users to minimize the uncertainty from pressure corrections by regulating cell pressures themselves.

The height of these cells has been extended to allow easy access to the gas valve while the cells are in use. Pure quartz-wool insulation and four high-purity graphite discs prevent heat loss from the metal sample to the pressure regulation system while optimizing vertical temperature gradients within the cell. Each cell has an outside diameter of 50 mm and a height of 600 mm (silver and copper cells are 700 mm tall).

When it comes to primary temperature standards, Hart supplies more equipment than all of our competitors put together. If your goal is to reduce uncertainty, start by buying from the company that supports its products better than any other metrology company in the world. Why trust your primary standards to any other company?



Ordering Information

5900	Mercury Triple Point Cell	5908	Silver Cell
5901	TPW, 12 mm well	5909	Copper Cell
5901A	TPW, 12 mm well, w/ handle	5910	Gold Cell
5901C	TPW, 13 mm well	5924	Indium Cell, open
5903	Gallium Cell, quartz	5925	Tin Cell, open
5943	Gallium Cell, SST	5926	Zinc Cell, open
5904	Indium Cell	5927	Aluminum cell, open
5905	Tin Cell	5928	Silver cell, open
5906	Zinc Cell	5929	Copper cell, open
5907	Aluminum Cell	1904	Accredited Cell Intercomparison