ITS-90 fixed-point cells

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- 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 reference Hart cell.

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 ultra-clean, state-of-the-art lab, using high-density, high-purity graphite crucibles containing metal samples with purity of at least 99.9999 % (six 9s) and, in many cases, 99.99999 % (seven 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 precise pressure of the argon gas to ensure the most accurate corrections for pressure.

Once manufactured, all Hart cells are tested and supplied with an assay of metal-sample purity. Every traditional size ITS-90 cell further undergoes more rigorous testing in our primary standards lab where we realize melt-freeze curves and perform a detailed "slope analysis" to confirm cell purity. If you want more data, we'll give you an optional intercomparison with our own reference cells.

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's 5943 Gallium Cell is sealed in a stainless steel envelope. High purity gallium (99.99999 %) is enclosed in a plastic and metal shell. The stainless steel container is then filled with pure argon gas at one standard atmosphere at the melting-point temperature.

Gallium expands by 3.1 % when it freezes 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. Realization and maintenance of the cell is automated with our 9230 Maintenance Apparatus (see page 33). This apparatus will provide melting plateaus up to eight days and a convenient control to automatically 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 14) that have been repeatedly proven in national labs to surpass their published uncertainty specification of ± 0.0001 °C. Ice mantles may be formed using dry ice, LN_2, or immersion freezers and can last for up to two months when maintained in our 7012 or 7312 baths.

Open metal cells

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

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Specifications

Model	Fixed Point	Style	Assigned Value (°C)	Outside Diameter	Inside Diameter	Total Outside Cell Height	Depth‡	Cell Uncertainty (mK, k=2)	Certification (mK, k=2)†
5900	Mercury	Stainless Steel	–38.8344	31.8 mm	8.0 mm	417.6 mm	208 mm	0.2	0.25
5904	Indium	Traditional Quartz Glass	156.5985	48 mm	8 mm	282 mm	195 mm	0.7	0.7
5905	Tin	Traditional Quartz Glass	231.928	48 mm	8 mm	282 mm	195 mm	0.5	0.8
5906	Zinc	Traditional Quartz Glass	419.527	48 mm	8 mm	282 mm	195 mm	0.9	1.0
5907	Aluminum	Traditional Quartz Glass	660.323	48 mm	8 mm	282 mm	195 mm	1.3	1.8
5908	Silver	Traditional Quartz Glass	961.78	48 mm	8 mm	282 mm	195 mm	2.4	4.5
5909	Copper	Traditional Quartz Glass	1084.62	48 mm	8 mm	282 mm	195 mm	10.1	12.0
5924	Indium	Open Quartz Glass	156.5985	50 mm	8 mm	596 mm	195 mm	0.7	0.7
5925	Tin	Open Quartz Glass	231.928	50 mm	8 mm	596 mm	195 mm	0.5	0.8
5926	Zinc	Open Quartz Glass	419.527	50 mm	8 mm	596 mm	195 mm	0.9	1.0
5927A-L	Aluminum	Open Quartz Glass (long)	660.323	50 mm	8 mm	696 mm	195 mm	1.3	1.8
5927A-S	Aluminum	Open Quartz Glass (short)	660.323	50 mm	8 mm	596 mm	195 mm	1.3	1.8
5928	Silver	Open Quartz Glass	961.78	50 mm	8 mm	696 mm	195 mm	2.4	4.5
5929	Copper	Open Quartz Glass	1084.62	50 mm	8 mm	696 mm	195 mm	10	12.0
5943	Gallium	Stainless Steel	29.7646	38.1 mm	8.2 mm	250 mm	168 mm	0.1	0.1

†Certifications at lower uncertainties are available for national laboratories.
‡Depth is measured from the bottom of the thermometer well to the top of the pure reference material.

gas, then charged again to a regulated pressure level while measurements are made with the cell.

Once assembled and tested, each Hart ITS-90 open cell further undergoes more rigorous testing in our lab, unlike cells from some manufacturers who provide their open cells as a kit of parts, without any test data.

Because open cells allow users to measure the pressure within the cell, uncertainties due to pressure corrections may be minimized. Use of open cells is now being suggested by the CCT, and open cells can be used for demanding temperature-versus-pressure applications, as well as precision SPRT calibrations.

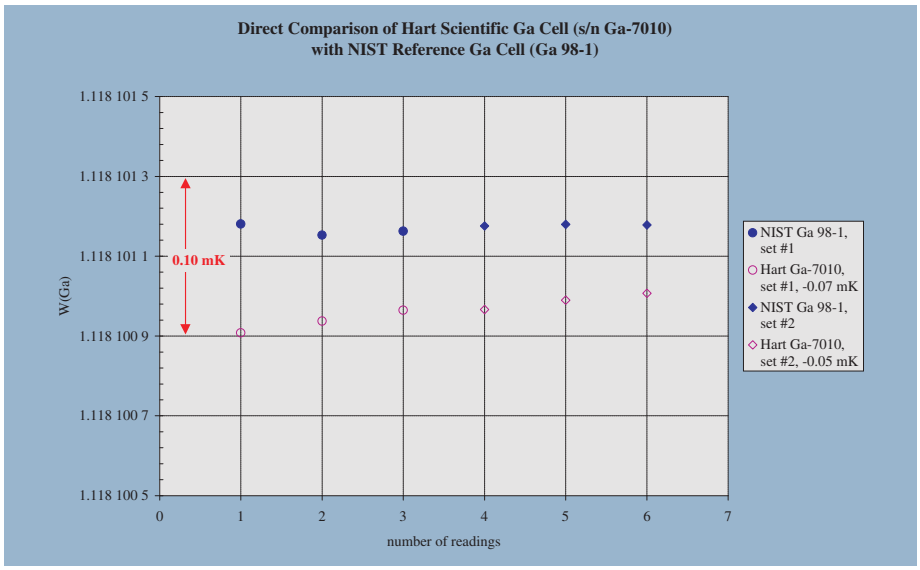
The height of these cells has been extended to allow easy access to the gas valve while the cells are in use. Pure quartz-wool insulation and four high-purity graphite discs prevent heat loss from the metal sample to the pressure regulation system while optimizing vertical temperature gradients within the cell. Each cell has an outside diameter of 50 mm (2 inches) and a height of 600 mm (23.5 inches)—(silver and copper cells are 700 mm [27.6 inches] tall).

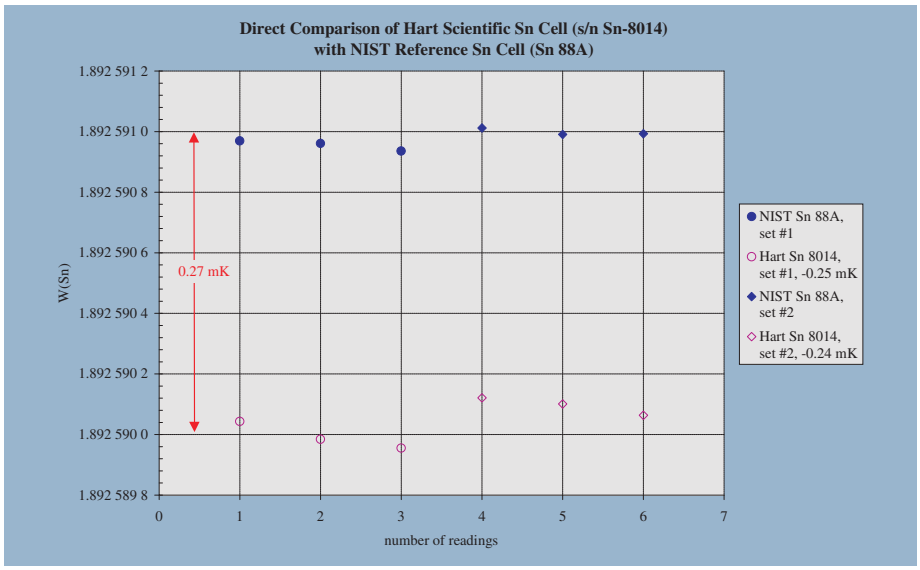
When it comes to primary temperature standards, Hart supplies more equipment than all of our competitors combined. If your goal is to reduce uncertainty, start by buying from the company that supports its products better than any other metrology company in the world. Why trust your primary standards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

Ordering Information

5900	Mercury Cell, Stainless Steel
5904	Indium Cell, Traditional Quartz Glass
5905	Tin Cell, Traditional Quartz Glass
5906	Zinc Cell, Traditional Quartz Glass
5907	Aluminum Cell, Traditional Quartz Glass
5908	Silver Cell, Traditional Quartz Glass
5909	Copper Cell, Traditional Quartz Glass
5924	Indium Cell, Open Quartz Glass
5925	Tin Cell, Open Quartz Glass
5926	Zinc Cell, Open Quartz Glass
5927A-L	Aluminum Cell, Open Quartz Glass, Long
5927A-S	Aluminum Cell, Open Quartz Glass, Short
5928	Silver Cell, Open Quartz Glass
5929	Copper Cell, Open Quartz Glass
5943	Gallium Cell, Metal Cased
2068-D	Stand, Fixed-Point Cell, Black Delron

ITS-90 fixed-point cells







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

What is the uncertainty of my cell?

Fixed-point cells are standards which embody reproducible physical phenomena. The uncertainty associated with these standards can be viewed in two ways.

The first way is based on the purity of the constituent components only. Unfortunately, most of the assays provided by manufacturers of pure metals are not of sufficient quality to make a determination of the purity of the supplied metal to the level of uncertainty required. To be used in realizing the ITS-90, it would typically be necessary to have a high quality traceable assay capable of verifying 99.9999% purity or better. Even with an assay, additional evidence of the purity is necessary. This evidence includes an analysis of the slope of the freezing and melting curves and a comparison against another cell which makes similar or better claims of purity. Finally, because the temperature of a fixed point cell is defined at one atmosphere, pressure traceability is required as well.

The second approach to fixed-point uncertainties is similar but shifts the emphasis away from the traceable assay and derives its traceability through inter-comparison with another traceable fixed-point cell. In this case, the assay and the slope analysis become the supporting evidence for the observed difference against the traceable cell. This second approach represents actual observed performance in a laboratory rather than unproved claims and weakly justified hopes. This approach is particularly important with sealed cells because there is no way to verify the pressure within a sealed cell after it has been sealed.

Hart's published specs are guaranteed and can be verified through an optional accredited certification in our primary temperature lab. Are the values assigned to your fixed-point cells traceable?