random NEWS

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HART SCIENTIFIC

James C. Triplett,
Chairman, CEO

It's That Time of Year Again

It's almost time for a new catalog, and we've got more than 20 new products to put in it. It's been 8 years since we published our first catalog, and I still enjoy working with Randy and all of the other Hart employees to produce each catalog because I like to write about the products and deal with the creative challenges that catalog selling poses.

Selling temperature calibration equipment by catalog was not the common method of marketing when I first got into the business. It was a risky strategy for us to adopt, especially considering how small we were when we first tried it.

Up until that time, companies in the temperature calibration business sold equipment through manufacturers' reps or in-house traveling sales teams. Both of these methods of selling are very expensive, and one way or another the customer pays for it. Randy and I felt that neither of these selling methods gave customers the support and technical assistance they needed and wanted. We also thought it was better to spend more money on new product development and less on traveling.

There's a myth in this and several other industries that if a sales person pays a visit to a customer they're going to provide the customer with key decision-making information. In most cases this is totally false. We've found most sales people just don't make accurate, informed comparisons of equipment. They're biased, and they tend to mislead. They pressure customers. Catalogs don't pressure.

You're probably wondering if we're saying we're not biased. Stop wondering. Of course we are! And we're confident too. Our equipment is flat out the best in the business. Now, how can we possibly back this up?

see JIM on page 8

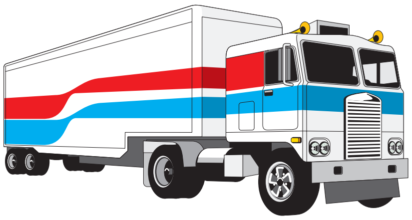
Want to Lose Your Lab Accreditation?—Just Buy the Wrong Bath

By Thomas J. Wiandt
Manager, Metrology Services
Hart Scientific, Inc.

In Europe, calibration labs must be accredited before claiming traceability to national standards. Accreditation is a growing trend around the world. Many factors impact the accreditation process including bath stability. During an audit, one lab had its uncertainty downgraded from ±0.01°C to ±0.1°C directly due to poor bath stability.

In the U.S.A. lab accreditation is not yet universally required, but it's becoming more popular as an independent and generally accepted validation of your labs accuracy or uncertainty levels. Picking the wrong bath can limit your lab's capability and cost you lost revenues.

Hey! We've Moved.



And it's about time! Our new address is:

Hart Scientific, Inc.
799 E. Utah Valley Drive
American Fork, UT 84003

Our new phone number is:
801-763-1600

Our new fax number is:
801-763-1010

Thermometers are generally calibrated using one of two methods: fixed point calibration or comparison calibration. Fixed point calibrations generally yield the highest accuracy and form the basis (along with a defining interpolation formula or well-known physical laws) for the International Temperature Scale of 1990 (ITS-90). These calibrations are carried out on the most accurate of thermometers, which in turn are used as standards in the comparison calibration of other thermometers.

A comparison calibration simply compares the reading of a standard that has already been calibrated with the reading from the sensor being calibrated. For accurate comparison of two sensors, both sensors must be kept in a temperature environment that is both uniform and stable. Nothing provides a more stable or uniform medium for heat transfer than a calibration bath.

Comparison Accuracy

Although there are variations, comparison calibrations have the same four basic components: the thermometer under test, the standard thermometer, the comparison medium, and the supporting instrumentation. The type and performance requirements of the medium and instrumentation are dictated by the accuracy class of the calibration needed.

Accuracy classes are established by the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP specifies technical criteria in their handbook that are specific to the discipline involved and the level of total uncertainty (accuracy class) desired. Following NVLAP methodology helps ensure quality calibrations. The accuracy classes are shown in Table 1.

Table 1 NVLAP Accuracy Class

Accuracy Class	Total Uncertainty
I	≤ ±0.005°C
II	> ±0.005°C to ≤ ±0.05°C
III	> ±0.05°C to ≤ ±0.20°C
IV	> ±0.20°C to ≤ ±1.0°C
V	> ±1.0°C to ≤ ±5.0°C

The NVLAP handbook specifies calibration techniques and instrumentation. The accuracy required of these instruments must be consistent with the desired total uncertainty. These requirements are straightforward and do not differ significantly from uncertainty analysis for any other discipline[2].

Instruments for Comparison

As an example, if you are doing a comparison calibration and the me dium is a liquid, the NVLAP guidelines specify that the liquid be stirred vigorously and that a comparison block be used in the bath to improve the uniformity. It also specifies that the temperature stability and uniformity of the fluid should be at least *10 times better* than the required uncertainty of the sensor being calibrated. Therefore, two decimal place accuracy for the calibration requires a liquid with three decimal place stability and uniformity. Most liquid calibrations are done in a bath. Very few baths have three decimal stability and uniformity.

The guidelines also recommend the use of an equilibration block. An equilibration block is a large mass of metal drilled to accept a specific probe size. It acts as a large, dense thermal conductor and improves the accuracy of a calibration. However, because the block is drilled for a specific sensor size, the flexibility of the bath is lost. Also, blocks are difficult and time-consuming to place and clean. A much better solution would be to select a bath that satisfies NVLAP uniformity and stability requirements without the use of a block, thus reserving the block for use in only the most demanding of applications.

Bath Performance

When selecting a bath, the two most important elements are mechanical design and electronic control. Mechanical design determines how the bath is heated, cooled, and stirred. Electronic control is the feedback mechanism that manages the heating, cooling and stirring processes.

Typical baths use a separate heater and cooler immersed in the bath or attached along one wall of the tank. This technique usually results in large temperature gradients and instabilities because the heat is only conducted along a narrow area. Better design calls for creating a massive "heat port" out of the entire tank thereby transmitting heat evenly throughout the bath fluid. This is the first step in producing huge improvements in performance.

Stability is the ability of a bath to maintain a constant temperature for long periods. Uniformity with frequent temperature swings would not produce highly accurate comparison calibrations, so the guidelines call for both high uniformity and stability.

The last element of good bath design is the stirring function. All baths have to stir the fluid to maintain uniformity of temperature, so stirring is important. The stirring function, however, is not independent. The type of fluid impacts stirring effectiveness. Of course, fluids are selected by their temperature range, but it's their viscosity that impacts stirring, and their viscosity changes with temperature. Viscosity is measured in centistokes, and a good bath should have proper stirring for fluids with up to 50 centistokes of viscosity.

Basically, you need to ask a lot of questions before buying a bath. It must have actual operating stability and uniformity 10 times greater than the uncertainty of the measurements you want to make.

Conclusions

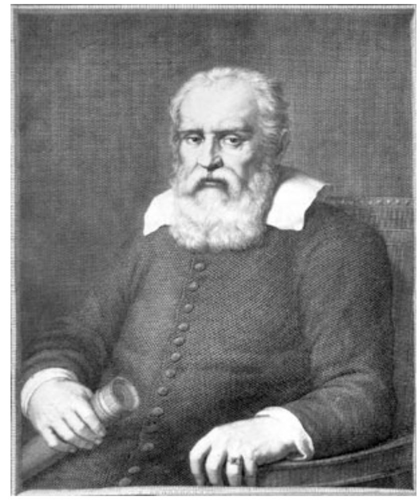
Before buying a bath, read the NVLAP guidelines and then find out how the bath you're considering actually performs over the temperature range at which you're going to use it, how easy it is to use, how easy it is to repair, and how much service the company you're buying it from is able and willing to provide.

It's really hard to fix a poorly designed bath. In most cases it will cost you far more to correct a mistake in buying than to buy the right equipment to begin with. And you might lose more than just your capital equipment investment. Remember, laboratory accreditation requires strict uncertainty analysis.

Notes.

1) Technical criteria can be found in NIST Handbook 150-2, NVLAP Calibration Laboratories Technical Guide.
2) Accepted methods are outlined in the ISO/TAG 4 document "Guide to the Expression of Uncertainty in Measurement." *End*

A man of deep thought and uncomfortable clothes.



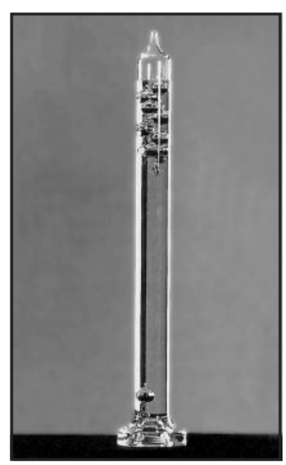
Galileo never read GQ magazine but he designed some interesting thermometers, and we're giving away some of them to customers randomly drawn from returned warranty cards. We congratulate the following thermometer winners to date.

Edward Gower of Wyeth-Ayerst Labs

Keith Lingle of Duke Power

Jim Bufano of Glaxo Wellcome

Paul Hargrove of Pierce County Utilities *End*



9102 Battery Pack

You have been asking for a battery pack to increase the portability of Hart's 9102 dry-well. Our new battery pack is rated at 17 AMP hrs, DC. This will give you approximately 5 hours of field use, depending on the ambient temperature and the range across which you are using your dry-well.

9102 battery pack and carrying case.

It's not practical to operate most dry-wells on battery power because the heating elements consume too much energy. The wider the dry-well's temperature range the more energy consumed. The battery would be so large and heavy the dry-well couldn't really be considered portable. However, because the 9102 covers a narrower range (–10 to 122°C) and because of its smaller block size, less energy is needed to heat and cool the unit resulting in a truly portable battery-operated dry-well.

To order, specify Battery Pack 9312. It comes complete in its own padded carrying case that fits the battery, the AC charger and your 9102 dry-well. The 9312 Battery Pack sells for $220 and can be added to your 9102 any time. Now you can calibrate sensors anywhere even without AC power. *End*

Myth: Water Triple Point Performance is All in the Click!

Well-made water triple point cells click when rotated end to end, an indisputable fact. This is caused by the "water-hammer" effect and is the result of a lack of remnant air inside the cell. But some people believe the louder the click the more accurate the cell.

Remnant air is the air left in the cell after the cell is sealed under a vacuum during the manufacturing process. With only remnant air inside the cell, the water slaps against the top of the cell as it turns downward because there's nothing to dampen the force of the water as it falls toward the glass. The clicking sound is reassurance that the cell is still sealed and was evacuated properly at the time of sealing. However, not all clicks are created equal.

Sound is influenced by many factors including remnant air, but also the shape of the surface the water slaps against. Flat-top cells click differently than round-top cells. The real question is whether or not this impacts the measurement performance of the cell? And the answer is, no!

We've tested both shapes of cells in our lab. The flat-top cells and round-top cells were within the allowable 0.1 mK every time we checked a pair of them. This means you should buy the cell of your choice based on other considerations such as the conditions under which you will be using it. Some customers like a handle as usually found on the flat-top cells and some customers prefer a round-top cell with no handle. It's a matter of personal choice.

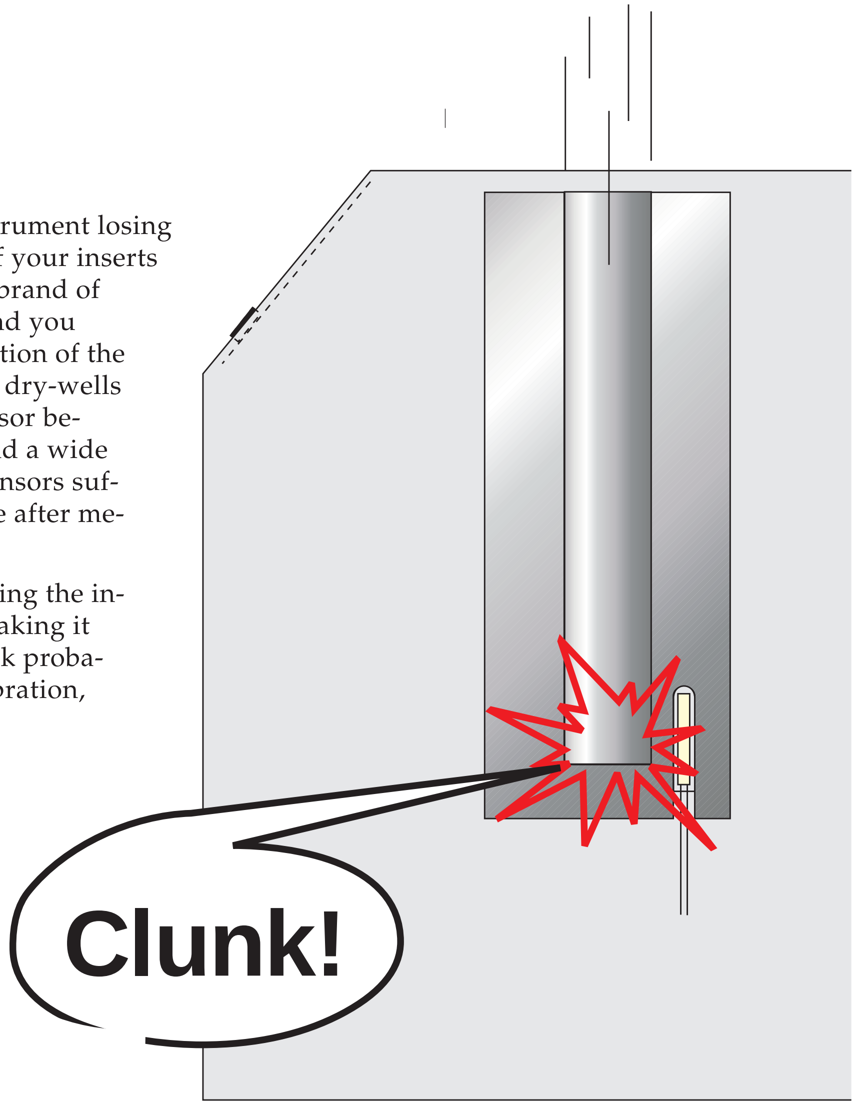
All water triple point cells should click, but the loudness of the click is not relevant in determining the quality of the cell. If the cell clicks, then the amount of remnant air is negligible. The remnant air in a Hart cell is usually lower than 0.133 Pa. This level of remnant air causes about 0.00001 mK of error. Even if the residual air were 10 times greater, the error would still be less than 0.0001 mK which has no significant impact on equilibrium temperature. *End*

Ouch!

Want to hear the sound of an instrument losing its calibration? Just drop one of your inserts into your dry-well. No matter which brand of dry-well you own, that clunking sound you hear might cause a shift in the calibration of the dry-well's temperature display. Most dry-wells use platinum RTDs as the control sensor because they have excellent accuracy and a wide temperature range. However, RTD sensors suffer small shifts in their base resistance after mechanical shocks.

Use the insert's lifting tool for putting the insert into the calibrator as well as for taking it out. Occasional light mechanical shock probably won't throw your unit out of calibration, but repeated clunking will.

If traceable accuracy is important, use a reference thermometer like Hart's 1502 Tweener to periodically check the accuracy of your dry-well. For critical applications, some customers use the thermometer as a comparison standard during each calibration performed in the dry-well. *End*



To the Point

News on fixed points and primary standards development.

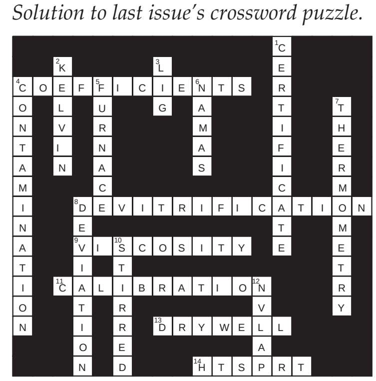
Gallium Melting Point

We've been doing some experiments with our Gallium Cell in one of our baths. With this combination we've been able to maintain a plateau for 13 days. Other gallium cells give you a plateau lasting only a few hours. With Hart's cell you can do far more work during each cycle of the melting point. A measurement at the gallium point tells you whether your SPRT is in compliance with ITS-90 requirements so its availability is second in importance to the triple point of water. If you would like a copy of our test data, or other information on our freeze point instruments call us at 1-800-438-4278.

Metal-Sheathed SPRTs

Need a metal-sheathed SPRT? Hart now makes the Model 5680 25-ohm SPRT and the Model 5682 100-ohm SPRT with Inconel sheaths. They're great for use in dry-wells and salt baths because they don't need a protection sleeve. These new SPRTs meet ITS-90 requirements and feature stability better than 0.01°C per 100 hours at 480°C (typically 0.005°C). Another advantage is their excellent price—only $1,895 each. Call us for more

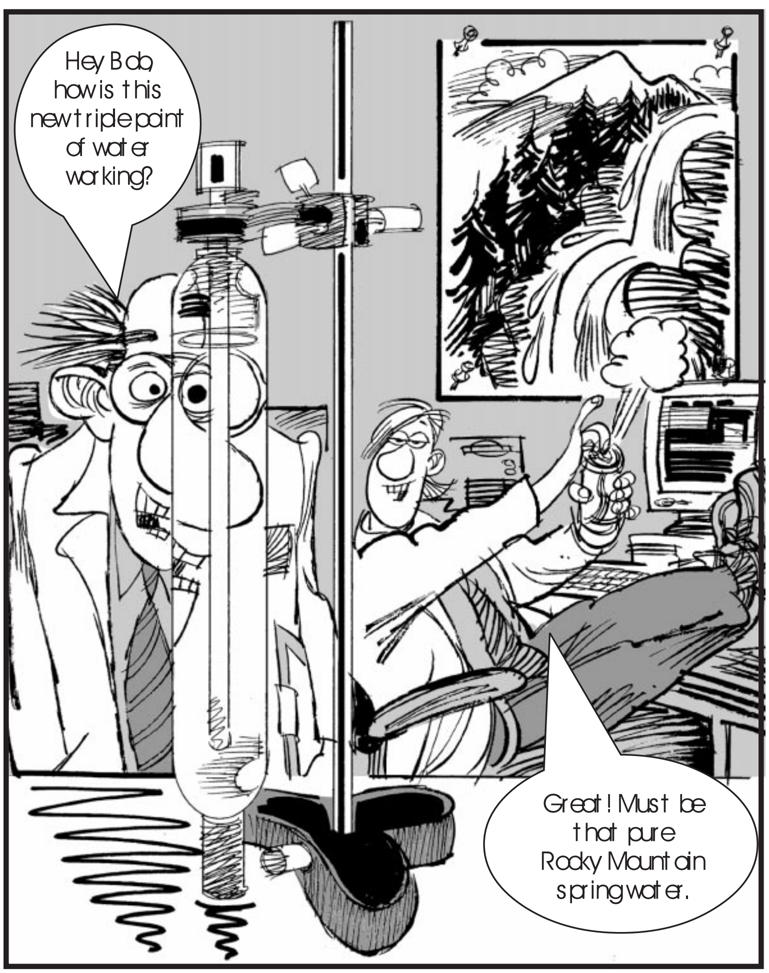
Solution to last issue's crossword puzzle.



Q and A

Does A Triple Point of Water Cell Need Periodic Recertification?

The triple point of water (TPW) is a defining fixed point for ITS-90. At exactly 0.01°C, or 273.16 K (by definition), pure water reaches a state of thermodynamic equilibrium in which it simultaneously exists as a solid, liquid and gas. Triple Point of Water Cells are designed to reach and stay at this thermodynamic state under laboratory conditions thus making calibrations possible and practical.



TPW Cells have excellent stability. With proper care a cell should not lose more than 0.1 mK over a five year period[(1)]. Most SPRTs don't have that kind of stability. An SPRT, in excellent condition, is generally stable to only about 1 mK over a period of one year. Furthermore, additional TPW research has detected a change of only 0.3 mK over a 12 year period making the triple point of water cell one of the most reliable instruments in the lab[(2)].

For a primary standard that costs less than $1000 this is unbelievable performance, and it's even more incredible when you consider there are no periodic recalibration costs.

References

1. National Conference of Standards Laboratories, Recommended Intrinsic/Derived Standards Practice, ***Triple Point of Water Cell*** (RISP-2, May 1995)

2. G. T. Furukawa, W. R. Bigge, ***Reproducibility of some Triple Point of Water Cells***, Temperature, Its Measurement and Control in Science and Industry, vol. 5, American Institute of Physics, New York, Part 1, 291-297, 1982

End

ITS-90 SPRT Problem

The following data set shows the values obtained for an SPRT at the ITS-90 fixed points. Can you: (1) Determine which ITS-90 subrange(s) should be selected to obtain the widest possible temperature range, (2) Solve for the ITS-90 coefficients at 1 mA and zero power using the appropriate values from the table below, (3) Determine the change in R_{TPW} of the SPRT during the calibration process, and (4) Determine the R_{TPW} of the SPRT. The values shown are not corrected for hydrostatic head. We've solved the problem for you, but you better check us. The correct answers are hidden on the page somewhere. Can you find them? The first five people to send by mail or fax us with a copy of the correct answers to this problem will receive a Sony Walkman.

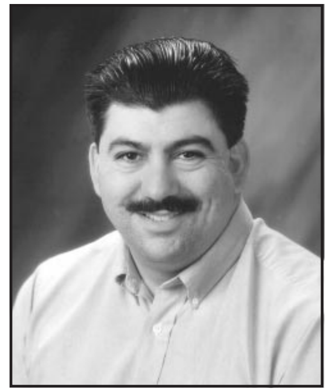
Good Luck.

Fixed Point	1 mA	2 mA	Immersion Depth (cm)
TPW	25.544 138	25.544 169	26.5
Al	86.222 998	86.223 168	18.0
TPW	25.544 137	25.544 165	26.5
Zn	65.612 093	65.612 161	18.0
TPW	25.544 118	25.544 150	26.5
Sn	48.344 981	48.345 058	18.0
TPW	25.544 123	25.544 152	26.5
In	41.117 640	41.117 809	19.0
TPW	25.544 133	25.544 170	26.5
Hg	21.563 768	21.563 798	15.0
TPW	25.544 131	25.544 163	26.5
Ar	5.518 084	5.518 131	10.9
TPW	25.544 128	25.544 157	26.5

The figures for this problem were submitted by a national standards laboratory. If you'd like to contribute a problem for the next Random News, contact Ed Lind at Hart. *End*

New Faces

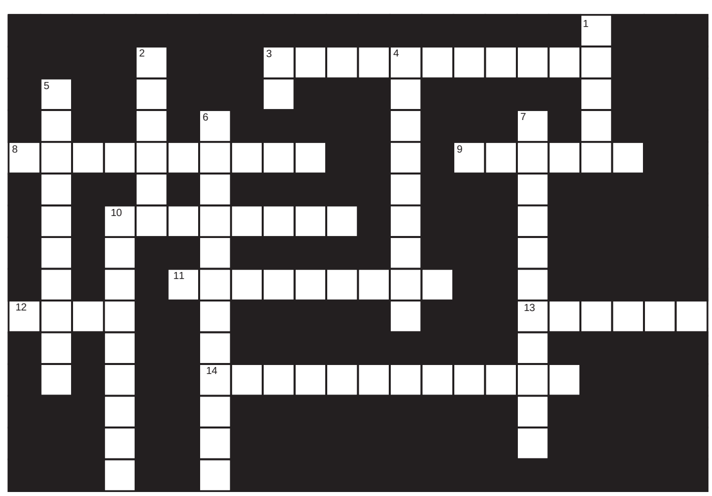
Have you read the article in this newsletter written by Tom Wiandt? He's the new Manager of Metrology Services. He has over 15 years of metrology experience to help you with your lab needs, and he'll do what it takes to give you the best service in the industry. You'll really enjoy talking to him on the phone and at conferences. Bring your toughest questions and let's find out just how good this guy is.



Tom Wiandt,
Manager of Metrology Services

	0 mA	1 mA
R(273.16 K), Ω	25.54414	25.54414
ΔTPW, mK	0.2	0.2
a4	–1.9326671E-04	–1.9011306E-04
b4	7.2622956E-06	8.5286014E-06
a7	–2.3555873E-04	–2.3821977E-04
b7	3.4636156E-05	3.7619741E-05
c7	–1.4557642E-05	–1.5431326E-05

Crossword Puzzle



Across
3. Multichannel switching device for thermometers
8. Lag effect on a body when the force acting on it is changed
9. A brilliant, crystalline mineral, mainly silicon dioxide
10. The curved upper surface of a liquid in a container
11. Device used to approximate sensor output in order to test calibration
12. Systematic error inherent in a method of measurement
13 Body of ice surrounding the insertion well of a water triple point cell
14. Auditable path of verification for a calibrated instrument

Down
1. Amount of variation in a measurement instrument over time
2. Point at which a liquid becomes a solid
3. Abbreviation for millikelvin
4. Depth to achieve correct reading for a temperature probe
5. Science of low temperature phenomena
6. Evidence by calibration that specified requirements have been met
7. Instrument that measures and indicates *heat*
10. A quantity subject to measurement

Calendar of Events

NCSL
Monterey, CA Aug. 25–29

IMEKO
Torino, Italy Sept. 10–12

ISA
Chicago, IL Oct. 7–10

Sensors
Philadelphia, PA Oct. 22-24

Hart Seminar
Am. Fork, UT Nov. 4-6

BIAS
Milano, Italy Nov. 26–29

Mesucora
Paris, France Dec. 2–6

JIM *continued from page 1*

Well, it's really very simple. If any piece of equipment doesn't perform the way we say it will, we'll give your money back. To put it another way, our instruments do the job just like the catalog says they will. They beat everybody else, period. If they don't, we'll take them back, and just to show you exactly how sure we are of what we're saying, we'll give you an extra $100 if we have to refund your money. ONE HUNDRED BUCKS!

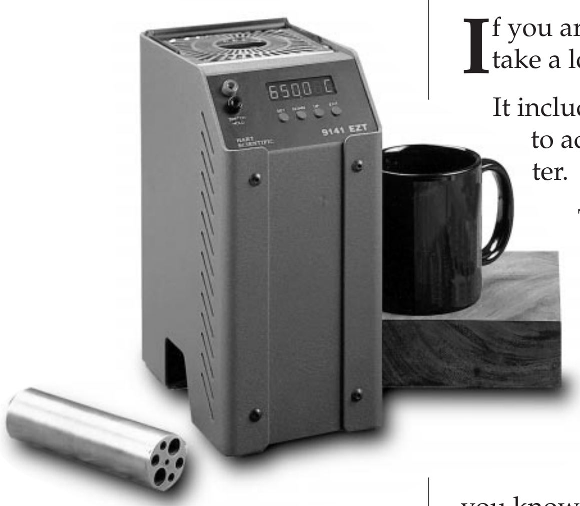
Every year we try to come up with a new program for the catalog that the competition won't or can't match, and this year it's the "Let's put our money where our mouth is" program. As newsletter readers you're finding out about it before the catalog comes out.

Try a little test. Next time a sales person calls on you, ask them how much they'll pay you if you buy their equipment and it doesn't work the way they said it would. I love these little tests because no one can deliver like Hart. It's why we're in the business, and it's our number one goal.

Just writing this stuff really makes me excited about the catalog. I think I'm going to have to add something extra to the "Let's put our money where our mouth is" program. Wait until you hear what else we're going to do for you when we announce the rest of the program in our new catalog.

End

Another New Product! The 9141 Dry-well



If you are calibrating sensors in the field up to 650°C, you'll want to take a look at Hart's new 9141 portable block calibrator.

It includes your choice of three standard, removable, multi-hole inserts to accommodate most probes from 1/16-inch to 1/2-inch in diameter.

The 9141 reaches 650°C (1200°F) in about 12 minutes and cools down to 100°C (212°F) in only 25 minutes without external cooling. Stabilization times are excellent for field work efficiency.

The 9141 fits in a slim, 4-inch wide case with a flip-up handle. The unit weighs in at less than 10 pounds.

The 9141 controller automates calibration of thermal switches. It freezes the display at the actuation temperature so you know exactly when the thermal switch tripped. The 9141 also has a ramp speed adjustment feature for ramping up or down to any temperature set-point. This equilibrates your switch before it trips.

Using your PC and the 9930 software package included with the 9141, you can store the switch points and print a certification report for each switch.

The 9930 software lets you adjust set-points, plot temperature readings to an electronic stripchart recorder, log data to a text file, and much more.

Call us today (1-800-GET-HART) about any temperature application or calibration problem. We'll be glad to help. *End*

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