

## A (Modest) Proposal to Establish a National Bureau of Microwave Standardization

By  
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Concerned Microwave Citizen

*(I know this story is highly presumptuous, but it has some considerable national importance, and I am writing it with my tongue tucked well in cheek.)*

*Here's the scenario: Tomorrow morning, as the 3,000-plus employees of the U.S. Commerce Department's Bureau of Standards drive to work at their sprawling campus in Gaithersburg, Md., or the imposing facility tucked up against the Rocky Mountains in Boulder, Colo., they find to their amazement that both facilities are gone. Since this is my scenario, I don't have to explain how or why it happened. Let's just consider it my version of zero-based budgeting.*

Well, you can imagine, in such an emergency, and after dismissing the employees for the day, the owners and operators immediately got together in a hastily called meeting to decide what to do. In attendance were: Dr. Ernest Ambler, director of NBS; the Honorable Malcolm Balderidge, secretary of commerce; the Honorable James Miller, director of the Office of Management and Budget; Representative Douglas Walgren, D-Pa., chairman of the House Subcommittee on Science, Research, and Technology (with oversight on NBS); and Senator Slade Gorton, R-Wa., chairman of the Senate Subcommittee on Science, Technology, and Space.

Prudently (as you or I might do on rebuilding a company facility), before dusting off the original drawings and calling for construction bids, they decided to call a national meeting of all interested parties to help them decide how to rebuild.

Meanwhile, back at their temporary offices, their phones were ringing off the hook. The word had gotten around and it seemed as if every acronym in the world was calling in to check on

the situation—IIEEE, NASA, DOD ISO ASQC, AMA, ANSI, ADA, ASTM, ASME, IEC, FAA, two NCSLS (National Conference of State Legislators and National Conference of Standards Labs), UL, API, OIML, APS, etc., etc., etc. And aerospace and industrial labs called, and the universities, and the trade associations, and all 50 state weights-and-measures labs.

Could it be that one small federal agency could have such a pivotal effect on thousands of organizations? Indeed it could. And it does! In a real sense, much of the industry and technology of our country depends on NBS—for quality, productivity, and technology underpinning.

We put communications satellites in orbit to enrich our lives and make business more productive. We navigate our airplanes with remarkable safety and reliability. And we now build our automobiles with robots and automated machine tools, with laser dimensional measurements feeding into sophisticated statistical quality control. Medical lab technicians calibrate their blood-characterizing instruments with precisely calibrated samples of NBS SRM liquids. Pollution-chasers measure levels of air-contaminants against precise mixtures of air pollutants from NBS. NBS is there, literally, in the middle of all of those economic and technical transactions.

Well, the real resources of the bureau—the wonderful amalgam of hundreds of Ph.D.'s, engineers, scientists, statisticians, material scientists, technicians, and machinists—are at home enjoying an unexpected but well-deserved respite. That human resource is absolutely unique. And it's not just the individuals, it is the combination of specialties and the interdisciplinary approach that has served the nation so well.

### A National Measurement System With NBS as the Lead Agency

We've got to begin rebuilding a Bureau of Standards. That's directed by the founding act of Congress, the "Organic Act of 1901." And in our Modern Technology Age, measurement science and the measurement standards underpinning our economy are an enormous giant. A mid-1960s study by Ray Sangster—who studied the size of the National Measurement System (NMS) (a concept developed in 1967 by Dr. R.D. Huntoon)—showed that perhaps 6 percent of a million-million-dollar GNP in those days was a mind-numbing \$60,000 million.<sup>1</sup>

*Yet, no one truly is in charge of this NMS.*

A November 1984 study by Pasqual Don Vito<sup>2</sup> more accurately defines the measurements part of the U.S. GNP as being 3.5 percent of a now \$4-million-million total. This yields a figure of \$161,000-million for the measurements sector, including labor and equipment. *And still, no one is in charge.* The economic effect of measurements is hard to realize. One example I always remember is this: If you make a 1-percent error measuring the moisture in grain, either the farmer or the grain buyer gains in a \$500-million mistake for (in effect) buying or selling water each year.

So, let's start with the Organic Act for some *basic* reasons for our new Bureau to exist.

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*John L. Minck has worked in measurements and instrumentation since 1952, and with Hewlett-Packard Co. since 1958. He is editor of the NCSL Newsletter, the publication of the National Conference of Standards Laboratories, an association with its focus on metrology and calibration.*

(a) The custody, maintenance, and development of the national standards of measurement, and the provision of means and methods for making measurements consistent with those standards, including the comparison of standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions with the standards adopted or recognized by the Government.

"(b) The determination of physical constants and properties of materials when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

"(c) The development of methods for testing materials, mechanisms, and structures, and the testing of materials, supplies, and equipment, including items purchased for use of Government departments and independent establishments.

"(d) Cooperation with other governmental agencies and with

private organizations in the establishment of standard practices, incorporated in codes and specifications.

"(e) Advisory service to Government agencies on scientific and technical problems.

"(f) Invention and development of devices to serve special needs of the Government.

This authority is very broad; and under it, NBS (operating under a delegation of authority from the Secretary of Commerce) has initiated its major programs. In fact, the authority under the Organic Act is so broad that it could serve as the statutory basis for all of NBS's major activities.

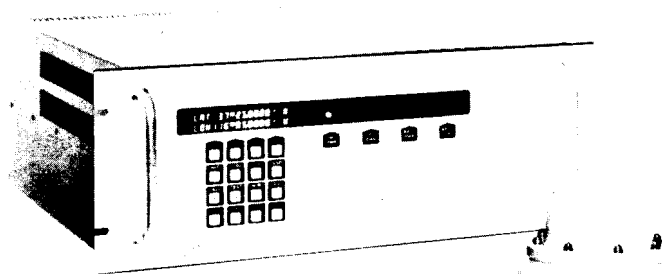
Significantly, the 15 to 20 mandatory requirements imposed on NBS came from Congress only in recent years. But NBS's position as the lead agency in measurement science needs clarification. Many of us in the measurement community feel that Con-

gress should amend or revise the Organic Act, to make clear that the NBS should assume a leadership role in the National Measurement System.

## Rebuilding an NBS Microwave Capability

In this "artificial" rebuilding of mine, I believe that research, development, and dissemination for measurements and measurement standards is the starting point. In particular, our country's radio-frequency and microwave industry believes that the serious lack of measurement services for its rapidly emerging requirements has already hampered our technology. The yeoman work of the NMCSL Committee on National Measurement Requirements and the IEEE/MTT Committee to Promote National Microwave Standards has clearly presented these deficiencies.

Only after the establishment of the standards and structure for dissemi-



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nation of the measurement services should the bureau build the many other programs that it does so well, for example:

1. standard reference material program—a powerful and innovative way of tying a measurement loop around chemical, analytical, and other tests;
2. standards-writing functions—where NBS works in conjunction with the large number of private-sector standards agencies;
3. pre-eminent meeting facilities and hosting—with hundreds of high-technology interchanges between NBS and industry and academia; and
4. publications—a national resource of knowledge.

### My Priorities, Your Priorities

As soon as we leave those programs on standards, the picture gets much more cloudy. Clearly, the standardization mandate requires a research function that is second to none; and NBS has had world-class research programs for years. However, the budget-bashing of recent years, along with new congressionally mandated programs, has caused deterioration of this national resource.

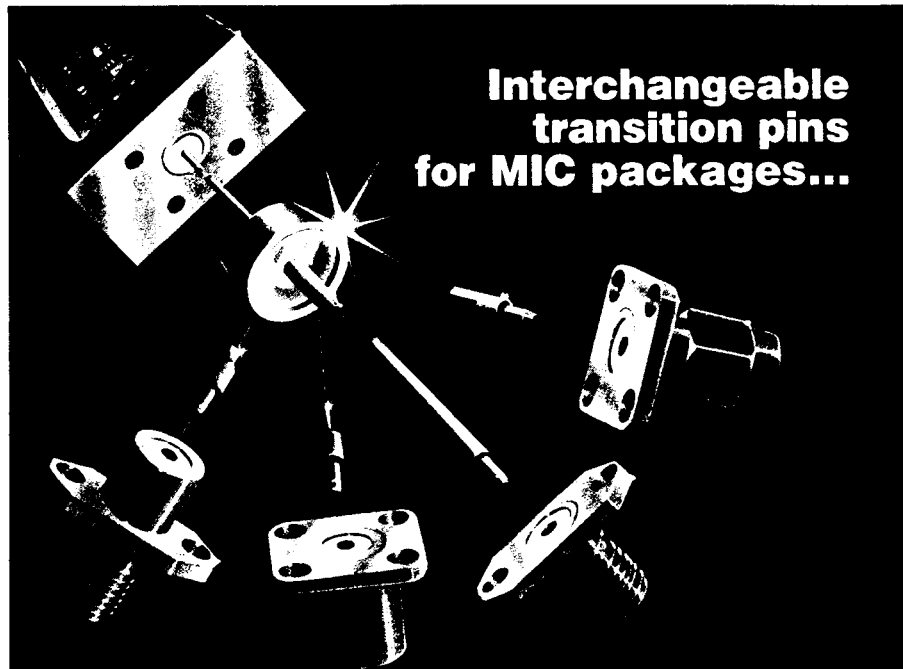
NBS's strength, unfortunately, also creates a problem. During the past 15 years, the NBS has been asked by Congress to serve as a "National Job Shop." It has ranged from proximity-fuse research in World War II to "burning baby blankets" during the 70s' consumer-safety era. The NBS programs on fire research, and building and construction standardization, are unquestionably tops in the world. The computer-science programs serve critical needs on standards and security.

But do all these crucial programs belong at NBS? Or could they belong just as well at some of the other 73 U.S. national research laboratories? How about the projects for increasing U.S. productivity: robotics, semiconductor technologies, the cold-neutron reactor project? How about programs dealing with medical and pharmaceutical technology? It would seem to some of us that at least some of these might belong at NIH or elsewhere.

But the opposing argument is intriguing, too. The very interaction of all of these disciplines in one organization creates serendipity. Pursuing basic knowledge with multidisciplinary

people results in highly practical fallout. For example, NBS Boulder scientists zeroing in on a more accurate figure for the speed of light realized that one limitation of their measurement was due to the antenna-aperture effects of the light-wave launch antenna. In learning how to describe mathematically the near-field effect,

and thereby supply corrections, the microwave near-field antenna range was born. This remarkable computerized facility probes the complex wave across an antenna and predicts with amazing accuracy the far-field pattern. More than 20 ranges have already been installed in ten aerospace companies.



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In another example, industry reported continuing problems getting consistent data on the mundane "lead-pull" test for semiconductor bonding. In trying to understand the problems better, an interdisciplinary team of metallurgy and materials-science people were able to make several fundamental improvements to the metals-interface and the bonding-process parameters. This resulted in a 3:1 improvement in the bond strength itself, a benefit industry now receives—with all of us getting better ICs.

So now come the resource allocations. I guess most of the readers of MSN & CT would have to agree that RF/microwave/millimeter standards are crucial. With all the various constituencies and factions looking for their share of the NBS budget, it's a tough judgment call for the director and the congressional oversight committees. But I think they are the ones who should hear our call. There are probably 100 to 200 different constituencies and factions looking for their share of NBS activity. And within NBS itself, the science faction may put too much emphasis on pure research and ignore the delivery of standards services.

What hurts most is the attitude of the OMB and Congress that the NBS \$125-million budget is somewhere near adequate to do the job of the "lead agency" of the National Measurement System. DOD probably spills \$125 million on most programs. (Nothing personal.) If anyone asks me for my vote on appropriations, I'd start by *doubling* the present figure of \$125 million. I feel our money is well-spent at NBS. While I'm not privy to national priorities at the OMB level, I bet it would take me only about 10 minutes to find the extra money.

How much is a Boeing 747 full of people worth? It is \$125 million plus 400 people. It seems ludicrous to me that microwave standards supporting a global positioning system that can place you anywhere on earth within  $\pm 30$  feet and would have kept Korean Air Lines Flight 007 in its air lane and aloft, are being compromised by meager budgets.

Does anyone else want to join us in getting our national microwave priorities communicated? ■

## Disclaimer

*This somewhat irreverent external view of NBS obviously comes from a measurement background, from which I have observed the national scene. The views expressed are strictly my own responsibility and are specifically not to be connected with my employer, Hewlett-Packard, or the*

*National Conference of Standards Laboratories.*

## References

1. Sangster, *Structure & Functions of the National Measurement System*, NBSIR 75-949, 1977.
2. Don Vito, *Estimates of the Cost of Measurement in the U.S. Economy*, NBS Planning Report #21, 1984.

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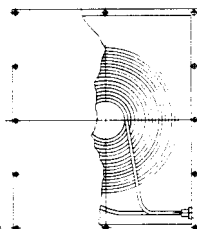
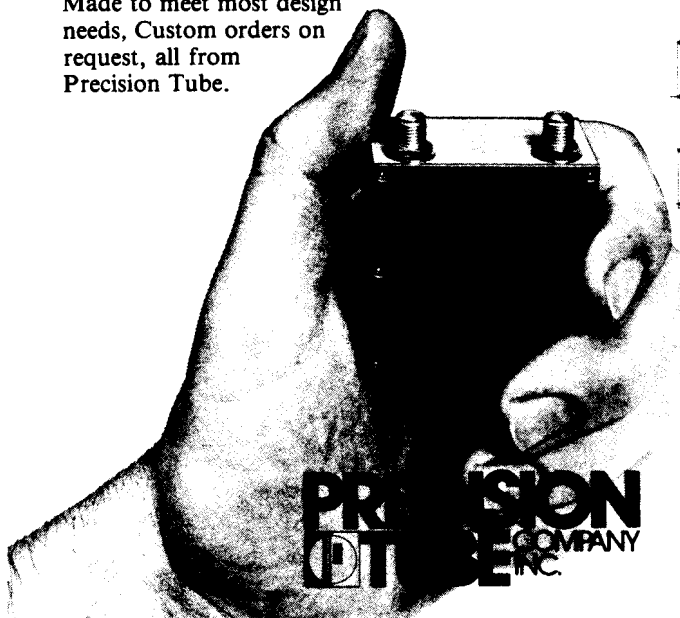
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