Volume 105, Number 6, November–December 2000
Journal of Research of the National Institute of Standards and Technology

News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 101, Room E215, Gaithersburg, MD 20899-2500; telephone: (301) 975-3577.

FIELD TESTING OF A FAULT DETECTION TOOL FOR AIR-HANDLING UNITS PERFORMED AT A LOCAL COLLEGE

Modern buildings are being designed with increasingly sophisticated energy management and control systems (EMCS) that have seemingly limitless capabilities for monitoring and controlling the conditions in buildings. Nonetheless, building heating, ventilating, and air-conditioning equipment routinely fails to satisfy performance expectations envisioned at design. Furthermore, such failures often go unnoticed for extended periods of time.

NIST researchers have developed a fault detection tool for air-handling units (AHUs), referred to as APAR (AHU Performance Assessment Rules), which has undergone 9 months of field testing at Montgomery College in Germantown, MD, and has successfully identified numerous operational problems. The heart of APAR is an expert rule set developed for common modes of operation and commonly available sensor information. The rules are currently implemented in code that runs in a batch mode, processing a week or more of data at one time. The rules could be embedded in an EMCS or operate as a stand-alone module that interfaces to the EMCS. This type of implementation would enable processing the data as they are produced. The aim of the tool is to detect faults that can produce significant energy waste, occupant discomfort, and equipment wear and are difficult to detect with single point alarming that is standard in today's EMCS.

The results of the field trials are encouraging. APAR successfully identified control performance problems that plagued most of the AHUs. Control problems observed were well known to the building operators and had resulted in the failure and replacement of numerous damper motors in recent months. APAR also successfully identified several occurrences of faults with the mixing box dampers. Detailed results are contained in a technical paper that will be presented as part of a symposium on fault detection and diagnosis at the winter meeting of the American Society of Heating, Refrigerating and Air Conditioning Engineers in January 2001.

CONTACT: John House, (301) 975-5874; john.house@nist.gov.

BACnet TESTING STANDARD BASED ON NIST RESEARCH APPROVED FOR PUBLIC REVIEW

For many years the building industry has struggled with the problem of integrating control devices made by different manufacturers in order to optimize operations, improve safety, and reduce maintenance costs. A key step toward overcoming these difficulties was the adoption of BACnet—A Data Communication Protocol for Building Automation and Control Networks—as an American national standard in 1995. BACnet was developed by NIST researchers and industry partners under the auspices of the American Society of Heating and Refrigerating Engineers (ASHRAE).

Building owners want the assurance of independent testing and certification of BACnet products. The need for testing and certification was recognized while BACnet was being developed. In 1993 NIST created the BACnet Interoperability Testing Consortium, a cooperative research and development agreement partnership with 22 companies, to address this issue. NIST researchers worked with consortium partners to develop test methods and testing tools while, at the same time, helping participating manufacturers to assure that their early products correctly implemented the BACnet

standard. The work of the consortium has resulted in a companion standard, ASHRAE 135.1P Method of Test for Conformance to BACnet, which recently has been approved for public review and comment.

The BACnet Manufacturers Association is launching a testing and certification program in the United States based on this draft standard. A similar effort is under way in Europe under the auspices of the BACnet Interest Group-Europe.

CONTACT: Steven Bushby, (301) 975-5873; steven.bushby@nist.gov.

NIST ASSISTS THE U.S. BUREAU OF RECLAMATION

NIST measurements of fish screens for the U.S. Bureau of Reclamation (USBR) Water Resources Research Laboratory were instrumental in a recent study of the hydraulic performance of self-cleaning, Coanda-effect screens. These screens are used on irrigation and small hydropower projects to separate debris and fish from diverted water. Coanda-effect screens employ unique tilted-wire geometry. The tilt angle is instrumental in determining the hydraulic performance of the screen. NIST measured the tilt angle with an optical projector to verify the USBR procedures for tilt-angle measurement. Results of the USBR study validated their theoretical model of the hydraulic performance of the screens. The model will be used to predict the capacity of Coanda-effect screens and hence to choose appropriate screen sizes to achieve desired flow conditions.

CONTACT: Eric Stanfield, (301) 975-4882; eric.stanfield@nist.gov.

INTERNATIONAL INTERLABORATORY TESTING ADVANCES MASS DISTRIBUTION MEASUREMENT METHOD FOR SYNTHETIC POLYMERS

The quality of mass spectrometric measurements of mass distribution in synthetic polymers was assessed in a recent NIST report that described the results of an international interlaboratory comparison involving 21 laboratories. MALDI-MS, a form of mass spectrometry in which laser ablation is used to produce volatile charged molecules, is being explored as an absolute method for molecular mass distribution of synthetic polymers. Most current methods yield only moments of the mass distribution. For instance, gel permeation chromatography yields the mass distribution but requires calibration with hard-to-find standards of known mass. Published results of mass distribution by mass spectrometry yield conflicting findings; hence the interlaboratory comparison was undertaken to determine the current status of measurements on a single, well-characterized polymer and to identify measurement issues that require attention. The polymer, polystyrene, evaluated in the round robin was custom synthesized to NIST specifications with molecular characteristics such that it could be investigated not only by mass spectrometry but also by traditional spectroscopic methods and light scattering.

Participants of the interlaboratory comparison reported the mass spectrum of the polystyrene and moments of the distribution calculated from mass spectrometric data. NIST staff calculated the moments from the submitted data as well. In some cases, the moments calculated by NIST using the participants data differed significantly from moments reported by the participants. The distribution in values of moments calculated by NIST was very narrow, with a standard deviation of one polystyrene repeat unit, approximately. Furthermore, analysis of these data yielded moments of the mass distribution lower than those obtained from current methods but within the measurement uncertainty. Nonetheless, it was found that calibration of mass spectrometers was not performed correctly by several participants and that methods of data analysis differed widely with some participants reporting moments of the distribution that differed significantly from the mean. The findings of the report will be used to improve the quantification of the new mass spectrometric method for the determination of synthetic polymer mass distributions.

CONTACT: Charles Guttman, (301) 975-6729; charles.guttman@nist.gov or Stephanie Wetzel, (301) 975-6783; stephanie.wetzel@nist.gov.

QUASIELASTIC NEUTRON SCATTERING PROBES PROTEIN DYNAMICS

The function of a protein depends critically on its ability to adopt a specific structure. Remarkably a protein can fold efficiently to this native state from the unfolded states on physiological time scales. Understanding how this process occurs is one of the great challenges in biology. Proteins can also form collapsed, partially folded states. Such partially folded proteins resemble the intermediate states along the protein folding pathway and play important roles in understanding the mechanisms of protein folding.

To understand the changes in protein dynamics that occur in the final stages of folding, scientists at NIST have used quasielastic neutron scattering to probe the differences in the dynamics between the native state and the almost completely folded, molten globule state of the protein bovine a-lactalbumin. The results, show that the side-chain protons in the molten globules are

significantly more mobile than those in the native protein. Moreover, the length scale of the motion, information that is uniquely provided by neutron spectroscopic techniques, is substantially longer in the molten globule state compared to that in the more compact native state. (For further information, see Z. Bu, et al., J. Mol. Biol. **301**, 525 (2000).)
CONTACT: Dan Neumann, (301) 975-5252; dan.neumann@nist.gov or Charles Han, (301) 975-6772; charles.han@nist.gov.

INCREASED ACCURACY FOR PARTICLE TEMPERATURE MEASUREMENT

NIST scientists have obtained emissivity data that make possible more accurate measurements of the temperature of rapidly moving incandescent particles in thermal spray plumes. Thermal spray is used for many purposes, including deposition coatings for protection against heat, corrosion, and wear. However, it is difficult to obtain reproducible results or to determine the best instrument settings for processing new materials. One approach sought by industry is to use instrument control based on measured temperatures and velocities of particles in the spray plume.

The only method currently available to measure the temperatures of such rapidly moving particles (hundreds of meters per second) is two-color pyrometry, which derives a temperature from measurement of the light emitted in two different bands of wavelengths. It is normally assumed, due to lack of any specific knowledge, that the emissivity of the material does not depend on wavelength, so the intensity of the light in the two wavelength bands can be calculated from a standard Planck function. NIST researchers use a special facility, which uses electrical resistance heating to heat wires and holds the wires at an elevated temperature during optical meas-urements. The researchers were able to make specific measurements of the wavelength dependence of emissivity of tungsten and molybdenum at temperatures up to those materials melting points. The measurements allowed NIST to derive a correction factor for the two-color pyrometry of these materials, which was several hundred degrees at the melting point of tungsten. Additional factors, such as oxidation, which can affect the accuracy of two-color pyrometry, will be the subject of future investigations.
CONTACT: Steven Mates, (301) 975-8114; steven.mates@nist.gov.

NEW TEXTURE MEASUREMENT SOFTWARE NOW AVAILABLE ON WEB

Many components and devices are fabricated from materials that have a preferred crystallographic orientation or texture. The properties and performance of these components and devices can be highly dependent upon the texture. For example, the remanent polarization in $PbZr_xTi_{1-x}O3$ films used in non-volatile memory devices is orientation-dependent so the ability to switch domains in the devices during a writing operation is strongly influenced by the texture of the film. To optimize the development of textured materials it is desirable to quantify the effects of texture on properties, which requires accurate measurement of the texture. The specialized equipment typically used for texture measurements is not routinely available in most laboratories. NIST has developed accurate techniques that use commonly available equipment for measuring fiber texture in thin film and bulk materials. The measurement protocol, as well as the TexturePlus software needed to correct and analyze the resulting data, are available on the web at www.ceramics.nist.gov/webbook/TexturePlus/texture.htm. To date, the techniques have been used to measure texture in thin films of $Ba_{1-x}Sr_xTiO_3$, $PbZr_xTi_{1-x}O_3$ and Cu as well as bulk samples of alumina and silicon nitride.
CONTACT: Mark Vaudin, (301) 975-5799; mark.vaudin@nist.gov.

PRECISION ION-BEAM CUTTING FOR SEM SAMPLES

In cooperation with the Research Institute for Technical Physics and Materials Science in Budapest, Hungary, the capabilities of a new, extremely low energy ion gun for precision ion-beam cutting or slope milling of scanning electron microscopy (SEM) samples is being investigated. This new system delivers milling rates five times that of any other units available and the ion-beam angle is controllable with less than one degree of accuracy. Using this system it is possible to cut resist sample lines at a 45° angle. This opens the potential for measurements in top down critical dimension (CD)-SEMs that reveal the cross-section without the necessity of braking the wafer samples.
CONTACT: Andras Vladar, (301) 975-2399; andras.vladar@nist.gov.

M^3 IMAGES CRYSTAL LATTICE

For the first time, the Molecular Measuring Machine (M^3) probe has successfully resolved the periodicity of a crystal lattice. The crystal that was imaged is an organic, electrically conductive crystal called (TEET) $[Ni(dmit)_2]_2$. It is triclinic, with lattice spacing for the basal plane of 1.02 nm and 0.75 nm and with a 1.67 nm step height as determined by x-ray crystallography. With the M^3, NIST researchers have been able to image the step and to resolve the 1.02 nm periodicity. The step height can be compared to the capacitance gage built into the *Z* motion axis of the scanning tunneling microscope probe; and the surface period can be compared to the interferometer-measured position data that were simultaneously acquired. This is an important step toward the longtime goal of validating the M^3 metrology system against a known crystal lattice.

CONTACT: John Kramar, (301) 975-3447; john.kramar@nist.gov.

TECHNIQUE DEVELOPED FOR CHARACTERIZATION OF PHOTOSENSITIVE GLASS

Ultraviolet light can induce a permanent change in the refractive index of a glass material. While this UV photosensitivity has a detrimental effect on photolithography optics, it is very useful in fabricating integrated optic and fiber Bragg grating devices. Fiber Bragg gratings are wavelength-selective reflectors that can be written into the core of optical fiber. They are very useful as wavelength filters and dispersion compensators in the new wavelength division multiplexed optical fiber communication systems and also make excellent strain sensors that can be networked to obtain distributed strain measurements of large structures, such as bridges and ships. Despite the development of numerous techniques to control the phenomenon, a fundamental understanding of UV photosensitivity remains incomplete.

To facilitate a study of the formation mechanisms, NIST scientists developed a technique for measuring UV-induced index change using a Michelson interferometer. The technique was applied to compositions of germanium-doped glass that had been exposed to periodic spatial patterns of ultraviolet light. The resulting index pattern in the samples was passed through one arm of an interferometer, which produced a fluctuation in amplitude response due to the optical path difference. The measured fluctuations were interpreted as index changes based on the phase relationship of the interfering beams at the measurement wavelength. Index changes as small as $(2 \pm 0.5) \times 10^{-5}$ have been measured, with the potential for much higher sensitivities. With this measurement technique, the effect of glass composition, fabrication processes, and irradiation conditions on photosensitivity can be studied quantitatively.

CONTACT: Sarah L. Gilbert, (303) 497-3120; sgilbert@boulder.nist.gov.

emiT EXPERIMENT IMPROVES LIMIT ON TIME-REVERSAL VIOLATION

A collaboration between NIST researchers and researchers from six other institutions performed an experiment that improved the limit on the time reversal violating coefficient "*D*" in neutron beta-decay. The Standard Model of particle physics permits only a very small prediction for a time-reversal violating effect, and the existence of an effect above that level would be an indication of new physics. One very sensitive probe of this symmetry in the weak interaction is the measurement of the so-called *D* correlation coefficient in the decay of polarized neutrons. The technique employed by the emiT collaboration to search for time violation involves detecting the distribution of decay products from a beam of cold neutrons at the NIST Center for Neutron Research using an octagonal array of scintillation and semiconductor detectors. The signature of a time-violating effect would be a change in the measured distribution of the decay products as one changes the spin state of the neutron. In a paper to be published in *Physical Review C,* the collaboration details the results of the experiment, which now provides the worlds most stringent limit on time reversal in neutron decay and further constrains possible extensions to the standard model.

CONTACT: Jeffrey Nico, (301) 975-4663; jeffrey.nico@nist.gov.

OPTICAL THERMOMETRY MEASUREMENTS FOR IMPROVED "LASER RAZOR" TECHNIQUES

Lasers have been used in cosmetic procedures for several years, with applications from dermatological resurfacing to hair removal procedures, with varying degrees of patient comfort. In an effort to improve cosmetic procedures, researchers from NIST recently collaborated with a private company to obtain time-dependent infrared thermal images of laser-irradiated hair and follicles. In earlier experiments it was found that for certain laser fluences and pulse durations, live extracted hair follicles can absorb 800 nm light and become dormant—sometimes remaining in a non-growth state for up to several weeks.

The collaboration with NIST researchers was established to determine the transient temperature changes associated with laser-hair heating and to monitor heat dissipation processes of hair shafts and live follicle samples of varying colors and textures. Initial experiments were conducted on hair shafts of different color (e.g., black, brown, red, blond, and gray) and hence varying melanin content. When exposed to fixed duration and intensity diode laser pulses, an infrared camera directly monitored the hair transient temperature rise and its accompanying heat dissipation. Samples with higher melanin concentrations, such as black and brown hair, absorbed radiation more readily than lighter colored hairs and showed a higher temperature increase. The collective findings are now being analyzed and a publication with Gillette will result.

CONTACT: Larry K. Iwaki, (301) 975-8525; lawrence.iwaki@nist.gov or Todd A. Heimer, (301) 975-4159; todd.heimer@nist.gov or Edwin J. Heilweil, (301) 975-2370; edwin.heilweil@nist.gov.

COMPUTATIONAL CHEMISTRY MODELS OF HYDROCARBON CHAINS TESTED

Computational chemistry is increasingly being used to model complex molecular systems to aid the development of new pharmaceuticals, chemicals, and materials. The ability of computational chemistry to contribute to these design efforts is dependent on the availability of experimental data to validate the modeling. Hydrocarbon rich systems, such as organic polymers, self-assembled monolayers, and the lipid bilayers critical to cellular membranes, are, in principal, ideal systems for the application of computational chemistry models since the numbers of electrons are small and the force fields are simple.

As part of an effort to provide validation data for the modeling of hydrocarbon rich systems, researchers at NIST have undertaken a systematic study of the microwave rotational spectra of substituted alkanes, such as 1-pentene, 1-hexene, 1-octene, and 1-dodecene. The spectra reveal a plethora of conformational isomers, differing solely by rotation about the C-C single bonds. Comparisons of the experimental data show significant discrepancies with computational chemistry models. The origin of these differences is being examined but most likely originates with the relatively poor quality of molecular-mechanics force fields. The researchers note that the ability to precisely control the conformational relaxation in the cold molecular beam may provide a tool to investigate the complex conformational reorientation required by a protein to fold.

CONTACT: Gerald T. Fraser, (301) 975-3797; gerald.fraser@nist.gov.

JOINT UNIVERSITY OF MARYLAND-NIST PROJECT PROVIDES DETAILS ON EFFICIENCY OF LASER PLASMA EUV SOURCE

Extreme ultraviolet (EUV) lithography is a promising candidate as the next-generation patterning tool for microelectronics. A large effort to develop this tool has been under way for several years by a team at Sandia and Lawrence Livermore National Laboratories. Finding a suitable source of EUV radiation for the tool has been one of the major challenges; the source must be compact, bright, and free of contaminating debris. The team has chosen a laser plasma source in which a 10 ns laser irradiates a target of tiny, micron-sized droplets of liquid xenon. The source is compact and the xenon plasma is practically debris-free, but greater brightness is desired for higher throughput.

Researchers at the University of Maryland and NIST have shown that EUV emission from laser-irradiated micrometer-sized droplets of krypton is a strong function of pulse duration. Using a very specialized laser that allows varying the pulse duration from 100 fs to 10 ns while keeping the pulse energy constant at 50 mJ showed that the EUV emission of krypton is greatest at 300 ps and is approximately five times brighter than the emission created by 10 ns pulses. Similar measurements soon will be undertaken for xenon that is being supplied by the Livermore-Sandia team.

CONTACT: Tom Lucatorto, (301) 975-3734; thomas.lucatorto@nist.gov.

MEASURING THE PERFORMANCE OF INTELLIGENT SYSTEMS

In August 2000, NIST hosted a workshop aimed at defining the critical technical directions and challenges in measuring the performance of intelligent systems. Although the terms “intelligent systems” and “intelligent control” are used frequently, there is no consensus on their definition and scope. This lack of formalism hinders progress in domains that anticipate benefits from these advanced control technologies. Examples of benefits include those cited by the Integrated Technologies Roadmapping Initiative and the Association for Manufacturing Technologies roadmaps. They list intelligent control as a key enabling technology to achieve increases in productivity and quality through capabilities such as machine tool self-diagnostics, tool wear and breakage monitoring, and thermal compensation. Without measures of performance, it is difficult to evaluate progress and make comparisons between different approaches to solving the same problem. Industry and government programs are asking NIST to organize efforts in defining metrics and methods for measurements to help them make decisions.

Over 90 participants from industry, academia, and government shared their multidisciplinary perspectives on how to measure intelligence of machine systems. The workshop proceedings will provide a foundational reference document for continuing work. Further focused workshops are being planned.
CONTACT: Elena Messina, (301) 975-3510; elena.messina@nist.gov.

RAWCON2000 LEADS INTERDISCIPLINARY APPROACH TO WIRELESS

The 2000 IEEE Radio and Wireless Conference (RAWCON2000), co-sponsored by NIST for the fifth time, again brought a large multinational crowd to Denver, CO in September 2000.

RAWCON continued to forge new ground in the interdisciplinary areas of wireless communications. Several hundred people enjoyed a technical program of 65 oral and poster papers, all accompanied by a technical exhibition. Workshops covered ultrawideband communications and wireless networking, and panel sessions explored the wireless Internet and the role of universities in wireless. In conjunction with the conference, the IEEE 802.16 Working Group on Broadband Wireless Access Standards held a week-long meeting of about 140 people to further its standardization efforts. The influential trade magazine *EE Times* once again featured a cover story on RAWCON.
CONTACT: Roger Marks, (303) 497-3037; marks@boulder.nist.gov.

WORKSHOP CONCLUDES THAT REFERENCE DATA AND REFERENCE MATERIALS ARE NEEDED FOR BIOMATERIALS

Needs for reference data and biomaterials were identified at a NIST organized workshop held in July 2000. The 65 registrants from industry, National Institutes of Health, Food and Drug Administration, and academia joined with NIST staff in six concurrent breakout sessions that considered reference data needs in orthopaedic, cardiovascular, ophthalmologic, tissue-engineered, dental, and general biomaterials. Although the workshop was organized with the focus on reference data for biomaterials, an over-arching conclusion from participants was the complementary role of reference data and reference biomaterials in facilitating deployment of new health-care delivery devices and for the development of national and international standards. Owing to the rapid pace of innovation, the timely availability of reference data and reference biomaterials was deemed more critical to progress than completeness in most situations. In general, data on properties of interest included mechanical properties, surface and bulk physical and chemical properties, as well as biological and clinical responses to materials.

In addition to reference data, reference biomaterials for polymers, monomers, alloys, composites and ceramics were identified. The participants agreed that follow-up meetings should be held with the various constituencies for the purpose of exploring the formation of alliances to help meet the needs recognized in the workshop.
CONTACT: John Tesk, (301) 975-6799; john.tesk@nist.gov.

ELECTRIC FORCE MICROSCOPY WITH A SINGLE CARBON NANOTUBE PROBE TIP

A NIST scientist and collaborators in Japan and Taiwan have realized significant improvements in the performance and sensitivity of electric force microscopy for nanoelectronic device characterization. These improvements were accomplished by attaching a single carbon nanotube onto a standard metal-coated silicon microfabricated tip and cantilever. Improvements include a large increase in spatial resolution even at large tip-substrate separation; increase in the signal-to-noise ratio by more than an order of magnitude; substantial decrease in non-local contributions to the total capacitance; elimination of signal variation from changes in materials contrast and geometry due to wear of the probe tip; and the reduction or elimination of artifacts arising from long-range sampling of substrate topography. Resolution issues are being examined by electric force imaging of sub-10-nm gold nanoparticles on silicon. Material and geometrical contributions to the electrical signals that may originate with either the probe tip or substrate are being investigated by imaging one-dimensional and two-dimensional gratings prepared using KOH-etched scanned probe oxide masks patterned on oriented Si(110) and Si(100) substrates. Finally, voltage-contrast imaging of active silicon-on-insulator devices was demonstrated.
CONTACT: John Dagata, (301) 975-3597; john.dagata@nist.gov.

STEP PART 28 WORKSHOP HELD AT NIST

Technical experts from the United States and Europe met at NIST in August 2000 to review the latest draft of Standard for the Exchange of Product model data (STEP) Part 28, the XML (Extensible Markup Language) Representation of EXPRESS Schemas and Data. The NIST meeting included input from a Brown University expert in SGML/XML and editor of the W3C's XML Linking specification. Part 28 will

combine the semantically rich, international standard data models from STEP with the widespread infrastructure of XML and the web. Part 28 was expected to be balloted in TC184/SC4 in fall 2000 as an ISO Technical Specification.
CONTACT: Josh Lubell, (301) 975-3563; joshua.lubell@nist.gov.

NIST HELPING THE ELECTRONICS INDUSTRY SPEAK A COMMON LANGUAGE

At industry's request, NIST hosted an implementers workshop on e-dictionaries for the electronics industry in September 2000. As the electronics industry moves to electronic commerce of components and larger subsystems (e.g., printed circuit assemblies) via the Internet, there is a critical need for common, online terminology to describe electronic components (i.e., a dictionary) that can be integrated with Business-to-Business (B2B) applications. This is necessary for users of electronic components to intelligently and efficiently compare similar components from competing manufacturers, reducing the cost and design time for printed circuit assemblies. According to the IPC (Association Connecting Electronics Industries), approximately 70 % of a printed circuit assembly cost is the components on the board.

During the workshop, NIST researchers demonstrated converting two dictionaries into the Electronic Component Technical Dictionary (ECTD) standard format. NIST has been working with the Silicon Integration Initiative (Si2), and the RosettaNet consortia to develop the ECTD standard. ECTD is an XML-based open standard that allows representing a technical dictionary in a computer-sensible form. There are many dictionaries used by the electronics industry for specialized domains which contain overlaps with other dictionaries. Representing dictionaries in a common format is the first step toward minimizing the overlap between dictionaries and establishing a mechanism for managing an inter-national network of e-dictionaries.
CONTACT: Kevin Brady, (301) 975-3644; kevin.brady@nist.gov.

NEW NIST MONOGRAPH OF SPECTRAL DATA FOR HIGHLY IONIZED ATOMS

Comprehensive tables of the spectra of numerous highly ionized heavy atoms have been published as a new monograph associated with the *Journal of Physical and Chemical Reference Data.* The monograph will be a valuable resource for fusion energy researchers and for those developing the new generation of space x-ray observatories, e.g., Chandra, XMM-Newton and Astro E, since it contains the largest collection of data available on soft x-ray transitions.

The volume contains critically evaluated spectroscopic reference data for about 16 000 transitions, from the soft x ray to the visible regions, for most ions of the elements of the Fe-group, from Ti though Ni, as well as for Cu, Kr, and Mo. The tables are arranged in order of decreasing wavelengths, and they include so-called forbidden lines, which are very important for plasma diagnostic applications.
CONTACT: Wolfgang L. Wiese, (301) 975-3201; wolfgang.wiese@nist.gov.

NIST CO-SPONSORS THIRD ANNUAL ELECTRONIC BOOK CONFERENCE

In September 2000, NIST and the National Information Standards Organization co-sponsored the Electronic Book 2000 Conference in Washington, DC. Attended by more than 850 representatives of all segments of the emerging e-book industry, the comprehensive conference and trade show included an overview of new e-book technologies and a forum for e-book authors. This years conference theme was Electronic Book 2000: Changing the Fundamentals of Reading.

Presentations focused on the impact e-books are having on everyone from publishers to librarians. Topics included e-book applications, international e-book activities, e-book and government, the digital divide and accessibility, standards and interoperability, digital rights management, and business models. ITL also exhibited the latest version of its Braille reader, which transforms the text of e-books into Braille for the blind and visually impaired.

NIST held the worlds first e-book conference in 1998. More information about the conference is available at www.nist.gov/ebook2000.html.
CONTACT: Victor McCrary, (301) 975-4321; victor.mcrary@nist.gov.

NIST HOSTS BIOMETRIC CONFERENCE

In September 2000, NIST hosted the Biometric Consortium 2000 Conference (BC2000). With an attendance of more than 600 people, the conference brought together executives of private industry and government officials as well as users and developers of personal authentication systems and IT users. Conference highlights included the release of Version 1.0 Beta of the BioAPI Reference Implementation developed by the BioAPI Consortium and the announcement of NISTs BioAPI Interoperability Test Bed, developed in support of the BioAPI industrial effort. These developments represent important milestones for the biometrics industry and users of biometric technologies.

The conference included informative presentations ranging from applications of biometric technologies and the business case for biometrics to government programs and initiatives, research on future technologies, metrol-ogy, biometric assurance, and emerging standards. Exhibitors represented private industry, industry consortiums, and government agencies.

BC2000 was part of NIST's Biometrics Week. Meetings co-located with the conference included the kick-off meeting of a new NIST initiative (NIST's Biometrics Interoperability, Performance, and Assurance Working Group, which will operate under the umbrella of the Biometric Consortium), a BioAPI Consortium meeting, and meetings of the International Biometric Industry Association.

CONTACT: Fernando Podio, (301) 975-2947; fernando.podio@nist.gov.

NIST HOSTS MICROMAGNETIC SOFTWARE WORKSHOP

In August 2000, more than a dozen users of micromagnetic software developed at NIST gathered at the computing facilities of NIST's Center for Computational and Theoretical Materials Science for a 1 day workshop. NIST researchers led the workshop for users of their micromagnetic software, the Object-Oriented MicroMagnetic Framework (OOMMF). Topics included advanced techniques for specifying micromagnetic problems, using OOMMF to investigate dynamic effects in micromagnetics, and the use of a batch system to control large numbers of micromagnetic simulations.

Workshop participants from McGill University, the University of New Orleans, and Washington University gave presentations on how they have used OOMMF to support their micromagnetic research work. Each presenter also contributed ideas about how OOMMF could be improved to suit their needs more effectively. The workshop concluded with the first public demonstration of the OOMMF eXtensible Solver (OXS). OXS is the first OOMMF component capable of full three-dimensional micromagnetic calculations. OXS has been designed to allow researchers in micromagnetics to extend OOMMF with their own models of micromagnetic effects.

More detailed information about OOMMF and the workshop may be found at the OOMMF web page, http://math.nist.gov/oommf/.

CONTACT: Michael Donahue, (301) 975-5424; michael.donahue@nist.gov or Donald Porter, (301) 975-3835; donald.porter@nist.gov.

NIST HELPS MANUFACTURERS PREPARE FOR CONVERSION TO LEAD-FREE SOLDER

U.S. electronics companies are facing the challenge of using an alternative to lead-tin solder in manufacturing. Japan and the European Union have issued a ban on lead in electronic equipment, which is scheduled to take effect in the next few years. Applying its expertise in materials processing, NIST is actively working with industry and university groups to develop a standard alloy that will serve as the alternative to lead-tin and ensure lead-free products by 2001.

A critical part of assembly, the solder serves as an interconnect, bonding components electrically and mechanically to the circuit board. The National Electronics Manufacturing Initiative (NEMI), a consortium of electronics equipment manufacturers, government agencies and universities, has chosen the tin/silver/copper alloy as the standard alternative to lead-tin. Data that led to the standard were provided by the NEMI Alloy Group, co-chaired by NIST. The group now is conducting manufacturing and reliability trials for lead-free circuit board assemblies.

NIST had been involved in earlier research on lead-free solder conducted by the National Center for Manufacturing Sciences. Various solders were classified by their behavioral properties, such as melting point and mechanical reliability under stressful conditions of heating and cooling on a circuit board. NIST led the development of the final project report.

Continuing its work with NEMI, NIST is developing a national lead-free electronics database, which will be available to the public. The database will contain information on the properties of the tin/silver/copper alloy and on other types of solder materials.

For more information about NIST's lead-free solder activities, contact Carol Handwerker, chief of the Metallurgy Division and co-chair of NEMI's Alloy Group, (301) 975-6158, carol.handwerker@nist.gov.

Media Contact: Pamela A. Houghtaling (301) 975-5745; pamelah@nist.gov.

COLLABORATION TO YIELD BIG DIVIDENDS TO THE CONSTRUCTION INDUSTRY

Research contributions to the construction industry's high-tech drive to reduce delivery time and life-cycle costs for industrial facilities are expected to pay big dividends in 2005.

According to a study by NIST economists, the past, present, and future collaborations between NIST and partners, including two private-sector organizations—the Construction Industry Institute and the new Fully

Integrated and Automated Technologies Consortium—will accelerate the industry's plans for commercial deployment of builder-relevant information-age products by at least 4 years.

NIST economists credit the partners' work on key enabling technologies, standard communications protocols and advanced measurement techniques for the expected advance in product and services marketplace readiness. The analysts estimate that product and service availability in 2005, rather than 2009, represent a cost savings to industrial facility owners, managers, and contractors approaching $150 million.

A report also describes methods for evaluating and comparing the economic impacts of alternative research investments. It defines the basis for the economic impact assessment and ways to reproduce the results. The impact study is expected to be useful to other government and private research groups wanting to evaluate the efficiency of their budget allocations.

Copies of *Benefits and Costs of Research: A Case Study of Construction Systems Integration and Automation Technologies in Industrial Facilities* (NIST Interim Report 6501) will be available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Media Contact: John Blair (301) 975-4261; john.blair@nist.gov

NEW MEASUREMENT SERVICE FOR RELATIVE INTENSITY NOISE OF LASERS

The demand for greater bandwidth in optical fiber communications has led to the development of laser transmitters and optical amplifiers with very low intensity noise. Transmitter noise is often specified by its relative intensity noise, which also can be used to determine the noise figure of optical amplifiers. Because it can have a frequency dependence, the acronym RIN is used to denote the spectral density of the relative intensity noise.

To meet industry demands for precise measurement of RIN, NIST has developed a transfer standard for calibrating RIN measurement systems that employs electrical spectrum analyzers to resolve the spectral density of the RIN. This new measurement service has been reviewed and certified as a formal calibration service as well as a measurement assurance program (known as a MAP). Customers are offered the choice of using the transfer standard to calibrate their own RIN system (a MAP) or sending their device to NIST for calibration.

The transfer standard is an erbium-doped fiber amplifier that is coupled to a linear polarizer and a narrow-band optical filter centered in the 1550 nm wavelength range. The device is characterized for frequencies between 0.1 GHz to 1.1 GHz. The spectral density of the RIN is stable and relatively constant to several tens of gigahertz, rendering it suitable for calibrations at even greater bandwidths. The transfer standard has been verified by a combination of theory and measurement; its accuracy also has been confirmed using a laboratory RIN measurement system and a second RIN reference source.

For more information, contact Gregory Obarski, NIST, MC 815.01, Boulder, CO 80305-3328; (303) 497-5747; obarski@boulder.nist.gov.

Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

NATIONAL STANDARDS STRATEGY APPROVED

A newly minted National Standards Strategy aims to strengthen U.S. participation in global standards-setting activities that influence access to export markets and to ensure that domestic health, safety, environmental and consumer needs continue to be addressed effectively.

Two years in the making, the National Standards Strategy was approved unanimously by the board of directors of the American National Standards Institute during its Aug. 31, 2000, meeting. ANSI is a federation of about 1000 organizations, including standards developers, industrial users of standards, consumer representatives and government agencies.

Steps toward a National Standards Strategy began with a 1998 challenge from then NIST Director Ray Kammer. In meetings with representatives from ANSI, industry, government agencies and individual standards-developing organizations, Kammer pointed out that the European Community and other economic competitors were using standardization activities to advance their national technology interests, sometimes to the disadvantage of U.S. business. Efforts to champion U.S. technology interests at the global level were uneven, he said.

In the United States, the voluntary standards system is highly decentralized, aligned with sectoral interests. In many other nations, the system is more hierarchical, with a national standards body at the top. Observers assert that the U.S. system is more open and responsive to industrial and marketplace needs. Decentralization, however, can complicate U.S. participation in multinational and global standards activities.

The new strategy establishes a framework to guide standards development in the United States and to champion U.S. technology interests in the international standards arena. Key to the framework is reliance on a flexible approach, which allows individual, different

needs to be met within an overall strategy. It also stresses the importance of key principles in the development process, such as consensus, openness and trans parency. In addition, the strategy includes 11 tactical initiatives, from increasing government reliance on voluntary standards to working proactively with U.S. trading partners to further mutual (shared) technical and policy interests.

The text of the National Standards Strategy is available on the World Wide Web at http//web.ansi.org/public/nss.html. NIST Director Kammer will discuss the strategy during a Sept. 13 Congressional hearing. His testimony will be available on the NIST web site at www.nist.gov/testimony/index.htm.

Media Contact: Mark Bello (301) 975-3776; mark.bello@nist.gov.

ARE YOU KEEPING PACE WITH THE GLOBAL ECONOMY?

Globalization is a fact of life. Succeeding in the global economy is not such a sure bet.

A survey confirmed that a majority of American chief executive officers recognize that they must strengthen their international strategies and performance if they are to succeed in the fast-evolving global marketplace. However, they are unsure about how to implement policies that will result in global success.

A new paper examines how CEOs are using the Baldrige Criteria for Performance Excellence of the NIST administered Malcolm Baldrige National Quality Award to help improve their strategies and operations and better address global opportunities.

The paper, "Baldrige: A Global Approach for a Global Economy," and the Baldrige Criteria for Performance Excellence are available on the World Wide Web at www.quality.nist.gov or by calling (301) 975-2036.

Media Contact: Jan Kosko (301) 975-2767; janice.kosko@nist.gov.

AERONAUTICS FIRM GETS IN STEP WITH STREAMLINED DATA EXCHANGE

STEP (also known as ISO 10303), the global Standard for the Exchange of Product model data, got another rousing endorsement from an industry leader when it initiated full production use of the standard for technical data exchange with its suppliers.

Traditionally, the individual manually transmitted large volumes of engineering data via hard-copy bid packages to potential suppliers. Data often had to be interpreted and re-entered into different systems, resulting in time delays and errors. Using STEP, data can be quickly and accurately sent electronically to first-tier suppliers and, if needed, retransmitted to lower-tier suppliers. What once took weeks is now accomplished in a matter of minutes.

From the definition of IGES (the Initial Graphics Exchange Specification) through the current STEP standard, NIST has been a leader in the quest to create a universal, unambiguous language for exchanging product information. From 1984 until 1998, NIST also served as the secretariat for the International Organization for Standardization (known as ISO) Subcommittee on Industrial Data. NIST still participates in STEP's evolution and implementation by developing testing methodologies for and making technical contributions to ISO 10303 as applied to different industries.

For more information on NIST's involvement in STEP, contact Simon Frechette, (301) 975-3335, or Steven Ray, (301) 975-3524.

Media Contact: Michael E. Newman, (301) 975-3025; michael.newman@nist.gov.

IMPROVED "VISION USING SOUND" SYSTEM WINS R&D 100 HONOR

An inexpensive acoustic wave transducer developed by NIST mechanical engineers has been selected as one of the top 100 technologies for the year 2000 by *Research and Development* Magazine. The device, known as the lensless line-focus broadband transducer, helps acoustic microscopes perform ultrasonic examinations of alloys, ceramics, crystals, composites and other industrially important materials simply, cheaply and with easier interpretation of the data.

The transducer sends a pulsed sound wave through a test sample that is submerged in water. The speed of the reflected wave provides a measure of the material's elasticity (its ability to flex under stress), while the direction of the reflected wave provides details about crystal planes or defects within the material.

Current acoustic microscopes use lenses to focus the ultrasonic beam and may cost hundreds of thousands of dollars. The NIST transducer costs less than $500, can be used with conventional ultrasonic systems costing about $20 000 and yields equivalent or better quality data on materials properties.

The cost savings result from NIST's use of an inexpensive piezoelectric, plastic film for the curved transducer. Electrical signals cause the film to emit relatively low-frequency, pulsed sound waves. The curvature of the film focuses the sound waves in the same way that curved mirrors are used in telescopes to focus light from distant stars. The transducer is

positioned above the sample and then scanned or rotated through different angles to get a full picture of the material's elastic properties.

For technical information on the NIST transducer, contact Gerry Blessing, (301) 975-6627, gblessing@nist.gov.
Media Contact: Michael E. Newman, (301) 975-3025; michael.newman@nist.gov.

NIST PIONEERS THE USE OF IMAGE PLATES FOR FAR UV SPECTROSCOPY

Researchers at NIST have demonstrated the effectiveness of photostimulable image plates for recording spectra in the far ultraviolet region of the electromagnetic spectrum. Although image plates have been used for higher energy applications such as x-ray crystallography, no one previously had evaluated them for far UV spectroscopy. Based on the NIST results, image plates eventually may replace the expensive, hard-to-handle and often hard-to-obtain photographic plates traditionally used to record spectra at these wavelengths.

Image plates are film-like sheets coated with a rare earth phosphor such as BaFBrEu (barium fluorobromide doped with a trace of europium). When an image plate is exposed to energetic radiation, electron-hole traps are created in the phosphor that can persist for very long periods of time, even weeks. When illuminated with a red laser, the traps decay by fluorescing in the blue. If an image plate that has been exposed to high energy radiation is scanned with a laser in a special reader, a two-dimensional map of the exposed region is created in a computer. Software developed for this application then can be used to process the data.

The image plate can be erased and reused. Furthermore, image plates have a response that is linear over a wide dynamic range. The NIST physicists successfully recorded spectra in the 5 nm to 60 nm region with the image plates, achieving sensitivity comparable to that of photographic emulsions made for this spectral region.

These results were published earlier this year in *Applied Optics,* Vol. 39, No. 4.

For technical information, contact Joseph Reader, (301) 975-3222, joseph.reader@nist.gov.
Media Contact: Michael Baum (301) 975-2763; michael.baum@nist.gov.

NEW STANDARD FOR STAB-RESISTANT BODY ARMOR

NIST recently completed a performance standard for stab-resistant body armor. This work was the culmination of a multiyear collaborative effort with the Police Scientific Development Branch in the United Kingdom. The standard was delivered to the sponsoring agency, the National Institute of Justice (NIJ), and published as NIJ Standard-0115.00. OLES then assisted NIJ with the establishment of a formal Compliance Test Program through which body manufacturers can have their stab-resistant body armor certified. This standard and program will allow law enforcement and corrections officers to purchase stab armor with confidence. To date, six models of stab armor have been tested under the program.
CONTACT: Kirk Rice, (301) 975-8071; kirk.rice@nist.gov.

NIST DISPLAY METROLOGY HELPS MAYO CLINIC SCOTTSDALE SAVE $1.5 MILLION PER YEAR

NIST has developed the measurement technology required to characterize flat-panel displays, including such properties as contrast ratio, reflection, and colorimetry, and is extending these techniques to emerging display technologies. Many of these techniques have been included in the Video Electronics Standards Association (VESA) Flat Panel Display Measurement (FPDM) Standard, the first scientifically-sound and comprehensive document on metrology for flat panel displays. This document, prepared in large part by NIST staff, is the basis for worldwide metrology between flat panel display suppliers and consumers. For example, the FPDM standard was relied upon heavily by the Mayo Clinic Scottsdale to specify the purchase of flat panel displays (1000 purchased so far) for radiology use. The use of high-quality flat panel displays has allowed the clinic to migrate from printed radiographs (x rays) to digital images viewed on flat panel displays. This technology has been estimated to save the clinic at least $1.5 million per year (1 million radiographs, at an estimated cost of $1.50 per radiograph).
CONTACT: Jim St. Pierre, (301) 975-4124; james.stpierre@nist.gov.

NIST AUTHORS CONTRIBUTE TO *ENCYCLOPEDIA OF COMPUTER SCIENCE*

The recently published Fourth Edition of the *Encyclopedia of Computer Science* contains articles by three NIST contributors. The encyclopedia is a comprehensive reference work on computers, computing, and computer science.

The article on "Markup Languages," explains what a markup language is and how it impacts work on the Web. Descriptions of several types of markup are included as well as methods to create markup. The article describes the origins of HTML, the Hypertext Markup Language, currently the lingua franca of the

Web that originated with SGML, the Standard Generalized Markup Language. SGML is also the basis for the Extensible Markup Language (XML), which is now a driving technology for e-commerce and future Web standards. In addition, the article describes how markup can be used to create documents for use by persons with disabilities, making the Web accessible.

The article on "Information Retrieval" details some of the basic principles behind today's search engines. The article describes some of the issues involved in indexing and searching electronic material, either gathered by a WebCrawler or as part of an in-house document collection, and points to areas of active research interest. Various types of retrieval applications are reviewed, along with discussion of some of the related legal and social issues raised by retrieval from open sources.

The article entitled "Program Libraries, Numerical and Statistical," traces the long history of reusable software libraries developed by researchers and commercial ventures for science and engineering applications. It summarizes current frameworks for the packaging of general-purpose mathematical and statistical software components and indicates sources of both research-grade and commercially supported software libraries.

Information about the encyclopedia is available at http://www.grovereference.com/science/Computer-Science.htm.

CONTACT: Ron Boisvert, (301) 975-3812; ronald.boisvert@nist.gov or Donna Harman, (301) 975-3569; donna.harman@nist.gov or Sandy Ressler, (301) 975-3549; sressler@nist.gov.

STUDY OF VIDEO CAMERA-BASED METROLOGY WILL DETERMINE NATURE OF MEASUREMENT ERRORS

NIST researchers are carrying out a study of video camera geometry effects that limit the accuracy of video-based dimensional measurements. These effects are investigated by scanning a small, 5 μm diameter spot of light across the camera chip in a controlled pattern. The camera is mounted on a coordinate measuring machine, which can be positioned reliably with an uncertainty of 0.05 μm. The camera is moved in a square raster pattern across the light spot, and data are taken at points forming a square matrix, with a point spacing of 2 μm. This study is aimed at understanding the accuracy of video-based dimensional measurements, particularly the properties of sub-pixel edge operators.

CONTACT: Ted Doiron (301) 975-3472; thodore.doiron@nist.gov.

SHORT NAMES REGISTRY TECHNOLOGY TRANSFER SUCCESS STORY

NIST has turned over maintenance of the ISO TC184/SC4 Short Names Registry to a vendor of software tools based on the ISO STEP standard (ISO 10303). The Registry is a software environment for maintaining a database of short names for each of the entity data types within a library of data model schemas specified using the EXPRESS language, and was created within MEL to support the ISO TC184/SC4 Secretariat. The Secretariat uses the registry to ensure that these identifiers are consistent across STEP and other SC4 standards. Since its inception, the Registry evolved from a simple character-based database update application to a web-accessible environment automating much of the drudgery of checking syntax, generating reports, and emailing requests to generate short names. These enhancements were possible thanks to strategic use of NISTs STEP Class Library (http://www.nist.gov/scl) and CGI.tcl library (http://expect.nist.gov/cgi.tcl). Now that the Registry has become a stable and robust service and industrial momentum behind STEP is strong, it is appropriate for MEL to turn over the Registry to a private organization.

CONTACT: Josh Lubell, (301) 975-3563; joshua.lubell@nist.gov.

SURF ATTAINS RECORD OPERATING ENERGY AND BEAM CURRENTS

The NIST Synchrotron Ultraviolet Radiation Facility, SURF III, is an electron storage ring that provides the Nations primary standard for source-based optical radiometry. SURF uses a relativistic electron beam, confined by a magnetic field to a circular orbit of 84 cm radius, that emits a broad continuum of radiation that spans the electromagnetic spectrum from the FM radio region to the soft x-ray domain. A major renovation of the SURF facility carried out during the past several years replaced the unit's main magnet. This upgrade improved the fractional uniformity of the magnetic field to 1×10^{-4} thereby enhancing SURF's capabilities as a calculable absolute radiometric source.

This upgrade has also led to an increase in SURF's operating energy, so that it is now possible to maintain consistent operation at an electron beam energy of 380 MeV (as compared to the 284 MeV energy characteristic of the previous configuration, SURF II). The peak wavelength of emitted light has correspondingly decreased from 12 nm to 6 nm, which will provide the facility a radiometric capability in the "water window," a region important to biological microscopy. In addition, recent improvements in the radio-frequency control system have substantially increased the electron current

injected into the machine, so that injection currents in excess of 500 mA have now been attained (as compared to the 300 mA characteristic of SURF II). Together, these improvements provide a dramatic increase of the optical power output and wavelength coverage of the SURF facility.

CONTACT: Alex Farrell, (301) 975-8372; alex.farrell @nist.gov or Mitch Furst, (301) 975-6378; mitchell. furst@nist.gov or Edward Hagley, (301) 975-6381; edward.hagley@nist.gov.

COLD CESIUM MYSTERIES SOLVED BY NIST

Researchers at NIST have solved a long-standing problem by constructing a quantitative model of collisions of ultracold cesium atoms. Atomic cesium is an important species that has been utilized in numerous cooling and trapping experiments; for example, laser-cooled cesium forms the basis of the new NIST-F1 cesium fountain atomic clock. A detailed understanding of the collision processes involving ultracold cesium atoms is necessary since collisions induce shifts in the cesium transition frequency that can adversely affect the performance of the fountain clock. In spite of many studies, a quantitative understanding of collisions of cold cesium atoms has proved elusive.

The researchers set out to explain all existing data on cold cesium collisions, including new data from experiments performed at Stanford University. The resulting quantitative model not only accounts for all known data on ground state cold cesium atom collisions, but also accurately predicted locations for a number of resonances in the Stanford experiment prior to measurements having been made. Contrary to previous expectations, the new model predicts that the collisional shift in a cesium fountain clock could be greatly reduced if the clock could be operated at a much lower temperature, in the range of 50 nK. The model also makes specific predictions for achieving Bose-Einstein condensation in cesium.

CONTACT: Paul Julienne, (301) 975-2596; paul. julienne@nist.gov.

NANOSCALE PHYSICS LABORATORY COMES ONLINE

A new nanoscale physics laboratory was recently commissioned by NIST researchers to support the development of new measurement methods for future nanotechnologies. This laboratory establishes a new state-of-the-art for nanostructure fabrication and measurement and positions NIST to be a major contributor in this rapidly emerging nanotechnology arena.

The laboratory will be used to fabricate electronic and magnetic nanostructures and measure their physical properties with atomic-scale resolution. Current research is focused on quantum and spin electronics, areas central to the emerging nanotechnology revolution. The laboratory came online with the successful operation of the main measurement system, a scanning tunneling microscope (STM) operating at cryogenic temperatures in an intense magnetic field.

The cryogenic STM was designed and built at NIST. Novel features of the microscope include a solid molybdenum body design (made possible by the high-speed machining capabilities at NIST), an integral three-axes positioning system of the sample and tip with picometer precision, optical access to the sample/tip junction, and non-magnetic construction. The microscope is a completely self-contained unit that can be translated between a room-temperature system and a liquid He cryostat. The microscope was designed to have very high spatial and energy resolution. It can measure displacements below 1 pm and resolve electron energy levels separated by 600 μV. Operating in cryogenic, high-magnetic field, and ultra-high vacuum environments, the microscope measures electronic and magnetic properties of nanostructures on an atom-by-atom basis. The microscope has achieved atomic resolution measurements on the surface of Cu(111) at 2.3 K and in magnetic fields up to 10 T. The stability of the microscope allows atomic resolution measurements to remain in registry while the magnetic field is swept. The laboratory contains facilities for the fabrication of samples, tips, and nanostructures. The facilities include traditional molecular beam epitaxy of III-V semiconductors, superconductors, and magnetic materials, as well as bottom-up nanofabrication using autonomous atom assembly.

For more information see http://physics.nist.gov/Divisions/Div841/Gp3/epg_files/quantum_prog.html.

CONTACT: Joseph A. Stroscio, (301) 975-3716; joseph.stroscio@nist.gov.

IMPROVED SPECTRAL IRRADIANCE SCALE OFFERED BY NIST

Researchers at NIST recently achieved realization of the NIST detector-based spectral irradiance scale using a high-temperature blackbody (HTBB) operated at 2950 K, with the temperature determined using absolute detectors calibrated for spectral irradiance responsivity. The detector-based spectral irradiances are assigned during a single transfer procedure using a spectroradiometer that compares the HTBB and the lamps' spectral irradiances.

For nearly 40 years, the U.S. spectral irradiance scales have relied upon radiometric transfers from a gold freezing-point blackbody (1337.33 K) to calibrate sources of spectral irradiance. Since the transfer standard of spectral irradiance, a 1 kW quartz halogen lamp, has a spectral distribution that approximates that of a blackbody radiator at 3000 K, this process of scale realization required five intermediate steps to increase the spectral irradiance output above that of the gold freezing-temperature blackbody.

The impact of the detector-based spectral irradiance scale is in reduced uncertainties in the spectral irradiance from 1 % to 0.5 % for the spectral region of 250 nm to 900 nm. In the short-wave infrared region (1000 nm to 2500 nm), the use of the detector-based scale reduces the uncertainties in the spectral irradiance by a factor of 5 % to 0.5 %. The spectral irradiance scale is transferred to customers lamp standards through the NIST Spectroradiometric Source Calibration Services. Industries and groups that rely on the improved spectral irradiance scale are aerospace, lighting, equipment manufacturers, other national measurement institutes, universities, and the precision measurement equipment laboratories (PMELs) for the Air Force, Navy, and Army.

CONTACT: Howard Yoon, (301) 975-2482; howard.yoon@nist.gov or Charles Gibson, (301) 975-2329; charles.gibson@nist.gov or P. Yvonne Barnes, (301) 975-2345.

FIRST MEASUREMENTS OF AC-COUPLED JOSEPHSON WAVEFORM SYNTHESIZER

NIST researchers have completed preliminary rms voltage measurements of the Josephson waveform synthesizer when it is biased using a new ac-coupled technique. AC coupling allows us to use distributed arrays of more than 4000 junctions that have larger output voltage as compared to the previously used lumped arrays with only 250 junctions. More importantly, this technique allows researchers to ground the Josephson array output voltage so that it can be directly measured using low impedance instruments, such as spectrum analyzers and thermal voltage converters. Direct connection to measurement instrumentation is required for optimum performance of calibrations because it avoids the possible gain and distortion errors that can be induced by intermediate amplifiers. NIST researchers have made the first spectral measurements of a directly coupled array and found that harmonic distortion was more than 80 dB below the amplitude of synthesized fundamental frequencies of 1 kHz and 50 kHz. This measurement was likely limited by distortion in the spectrum analyzer. They also used a thermal transfer standard to compare the rms voltages of synthesized sine waves at 3 kHz, 10 kHz, 20 kHz, and 50 kHz with a synthesized 1 kHz sine wave. The measured Type A uncertainty for each comparison was no more than one-tenth that of previous comparisons using lower-voltage lumped arrays.

CONTACT: Sam Benz, (301) 975-5258; benz@boulder.nist.gov.

NIST COLLABORATION USES MICROGRAVITY TO IMPROVE PROTEIN CRYSTAL GROWTH

NIST scientists are collaborating with a private company in the growth of ribonuclease crystals in space. X-ray diffraction topography, which has only recently been applied to protein crystals, was used to probe the differences between crystals grown on the space shuttle and crystals grown at the same time on the earth. The topographs from the space-grown crystals showed that they were of higher crystalline perfection than the ground-grown crystals. The images of the space-grown crystals were more uniform and sharply defined. The symmetry was consistent with nucleation followed by homogeneous symmetric growth. This growth mechanism is possible in microgravity but not likely on earth where there is sedimentation and convection-induced asymmetry. On the other hand, the earth-grown crystals had a less well-defined microstructure with no clearly identifiable features and there was no consistent symmetry of the images. All of these features indicate lower quality crystals with a higher-defect density. In addition to quality improvements, microgravity also improves crystal harvesting. Approximately 80 % of the crystals grown in microgravity were free-floating in the growth chamber, facilitating removal. In contrast, approximately 80 % of the earth-grown crystals grew attached to the growth chamber making harvesting more difficult. These results clearly demonstrate the advantages of a microgravity environment for growing protein crystals.

CONTACT: David Black, (301) 975-5976; david.black@nist.gov or Travis Gallagher, (301) 975-5726; travis.gallagher@nist.gov.

DATABASE ON LEAD-FREE SOLDERS

NIST is working with the Colorado School of Mines and the National Electronics Manufacturing Initiative (NEMI) to expand a database on the properties of lead-free solders. With product cycle time being slashed to keep up with consumer demand and competitive pressure, new electronic products are going directly from computer-aided design to full-scale production. The worldwide movement in the electronics industry to

replace lead-tin eutectic solders with lead-free solders creates a need for critical data on the industry's new lead-free solder compositions for these design and reliability models. The team is working with the NEMI Lead-Free Alloy Task Group to gather existing physical and mechanical property data that have been developed by researchers around the world into a single database. In addition, the team is working with NEMI to develop a list of missing high-priority data, with the list serving as a roadmap for research in lead-free solders. NIST and NEMI are planning to host a joint national workshop on these issues. The most recent version of the database is posted on the Materials Reliability Website at: <http://www.boulder.nist.gov/div853/eudora="autourl"> http://www.boulder.nist.gov/div853/. The team plans to add additional data and to critically evaluate more of the existing data each month.

CONTACT: Tom Siewert, (301) 975-3523; siewert @boulder.nist.gov.

REFERENCE BIOMATERIAL FOR ORTHOPEDIC RESEARCH

Reference Material (RM) 8456, an orthopedic grade Ultra High Molecular Weight Polyethylene (UHMWPE), became available in October 2000. RM 8456 is intended primarily for use in mechanical characterization of material properties and laboratory-simulated performance of orthopedic joint replacement implants. The availability of this reference polyethylene is expected to aid in development of improved test methods and materials by providing a benchmark for comparisons. The need for this reference biomaterial was identified at a workshop on reference biomaterials held at NIST and its development was the result of collaboration among a materials supplier, the orthopedic research community, and NIST.

The material used to prepare RM 8456 was donated by a private company in a form similar to that from which many orthopedic components are machined: a cylindrical bar with nominal dimensions of 7.62 cm in diameter. Reference properties, reported as mean values with their expanded uncertainties, are Young's modulus, tensile yield strength, tensile ultimate strength, and tensile elongation-to-failure. These properties characterize the bar across the center 5.62 cm of its diameter and down the entire bar length. Material beyond the central 5.62 cm was found to differ significantly from that within.

CONTACT: John A. Tesk, (301) 975-6799; john.tesk@nist.gov.

NIST CO-SPONSORED EIGHTH INTERNATIONAL SYMPOSIUM ON BIOLOGICAL AND ENVIRONMENTAL REFERENCE MATERIALS (BERM-8)

NIST co-sponsored the "Eighth Symposium on Biological and Environmental Reference Materials" held in September 2000, at the Natcher Conference Center, NIH in Bethesda, MD. The symposium theme was "Reference Materials for the 21st Century" and NIST chaired the scientific program committee whose membership represented 15 different countries. The conference attendance was approximately 170, including 35 NIST participants. The technical program opened with presentations on current trends and requirements for reference materials and global activities surrounding reference materials needs, development, and use. Sessions throughout the week included inorganic and organic speciation, methodologies for determining trace elements in complex matrices, food characterization, advanced inorganic methodology, recent requirements for reference materials, dietary supplements, food characterization, and foundations for environmental measurements. The symposium week ended with a session on the certified reference materials/ user interface that promoted discussions on issues such as traceability, accreditation of reference materials producers, and estimating uncertainties resulting from the instability of matrix reference materials.

The highlight of the conference was a session entitled "Botanical and Dietary Supplements." This session was a direct outcome of an NIH workshop: "Bioavailability of Nutrients and other Bioactive Components of Dietary Supplements: Defining the Research Agenda" held in January 2000, at the Natcher Center. One outcome of the NIH workshop was a strong statement of the need for reference materials for botanicals and dietary supplements—a $60 billion a year industry.

The BERM-8 website at http://www.nist.gov/berm8 contains abstracts of the oral and poster presentations, as well as contact information on the authors. Conferee feedback on the conference is also provided on the website to enable input in the form of suggestions and comments for future symposia.

CONTACT: Thomas E. Gills, (301) 975-2016; thomas.gills@nist.gov.

NTEP TRANSFERRED TO NCWM, INC.

On Oct. 1, 2000, NIST transferred the administration and management of the National Type Evaluation Program (NTEP) to NCWM, Inc., the organization that

manages the National Conference on Weights and Measures. The transfer was smooth with minimal disruption to device manufacturers and the type evaluation process. The transfer of NTEP allows the NIST Weights and Measures Program to shift resources from the administration of NTEP to the conduct of more technical studies, to increase collaboration with industry to address new technologies and respond to changing market conditions, and to expand its technical assistance activities.

Through NTEP, uniform checklists and performance tests were established to determine compliance with the legal metrology requirements published in *NIST Handbook 44*. Device manufacturers and state and local weights and measures officials use these checklists and test procedures to evaluate if commercial measurement devices comply with the appropriate legal metrology requirements before the devices are used in the commercial measurement system. NTEP enables device manufacturers to obtain one type evaluation that satisfies virtually all the states. NTEP has significantly reduced type evaluation costs to manufacturers of commercial weighing and measuring devices. NTEP also provides assurance to weights and measures officials and businesses purchasing scales and metering devices that the devices comply with the applicable legal metrology requirements.

CONTACT: Henry Oppermann, (301) 975-5507; henry.oppermann@nist.gov.

IUPAC SUBCOMMITTEE ON TRANSPORT PROPERTIES MEETING AT NIST (BOULDER)

The Subcommittee on Transport Properties of the International Union of Pure and Applied Chemistry (IUPAC) held its annual meeting in June 2000, at NIST (Boulder, CO).

Several standard reference projects were declared completed during the subsequent business session of the meeting with publications to follow soon. Toluene will be the first liquid reference material for viscometer calibrations both at atmospheric as well as at elevated pressure. An improved correlation of the viscosity of isobutane has been published. A standard reference correlation for the viscosity of saturated liquid *n*-pentane will make it possible to use this fluid for calibrations of sealed gravitational capillary viscometers.

A broad discussion was devoted to the possible revision of the standard reference value for the viscosity of liquid water at 20 °C and atmospheric pressure. NIST researchers were asked to investigate the records at NIST about the crucial measurements which were published in 1952. Liquids suitable to establish a second viscosity standard at 1 Pa · s were discussed. It was agreed that hygroscopic compounds such as alcohols do not possess the required composition stability. The suggestion was made to "design" a fluid with the desired properties for a standard reference material.

The next meeting of the subcommittee is scheduled for September 2001, near Thessaloniki, Greece.

CONTACT: Arno Laesecke, (301) 975-3197; laesecke@boulder.nist.gov.

THIRD ANNUAL NIST ELECTRONIC BOOK 2000 CONFERENCE OPENS NEW CHAPTER TO DIGITAL RIGHTS MANAGEMENT (DRM) STANDARDS

A host of new reading devices, new publishing technologies, new business models, and new interest over electronic book file security made their appearance at the NIST/NISO "Electronic Book 2000: Changing the Fundamentals of Reading," demonstrating the growing interest and investment in e-book technology. The conference, held in September 2000, has evolved into the industry's premier gathering, the place where the pioneers, the insiders, and the up-and-comers meet to exchange ideas and strategies. Held at the Ronald Reagan International Trade Center, this years conference attracted more than 900 participants, 70 speakers, and over 35 exhibitors. The conference was co-sponsored with the National Information Standards Organization (NISO).

"The past two years have been devoted to developing a standard for electronic content, as well as pushing for content interoperability between the many interfaces it takes in the delivery chain to get digital content securely from content provider to end-user . . . We continue to push for standards in these areas so that consumers can get the content they want, anywhere they want," according to a NIST speaker.

Even with electronic content standards, there is still more work for standards in the area of digital rights management (DRM), the industry buzzword for software techniques that retard piracy of electronic content. At this meeting, the Open eBook Forum held a session to discuss DRM and identify the industry needs and possible future participation by NIST.

CONTACT: Victor McCrary, (301) 975-4321; victor.mccrary@nist.gov.

NIST CO-SPONSORS 23RD NATIONAL INFORMATION SYSTEM SECURITY CONFERENCE

In October 2000, NIST and the National Security Agency (NSA) co-sponsored the annual National Information System Security Conference (NISSC) in

Baltimore, MD. As a leading global forum on computer and information systems security, the conference brought together about 1600 information security and technology professionals from industry, academia, government, and foreign nations. This years conference theme was "Campaign for Security." The goals of the conference included:

- provoking debate, dialogue, and action on major information security issues for today and tomorrow;
- educating the IT community on major information security issues and solutions;
- promoting demand and investment in information security products, solutions, and research; and
- challenging the IT community to provide solutions, research, and applied technology that are usable, interoperable, scalable, and affordable.

Next year's NISSC will be held Oct. 29-31, 2001, in Baltimore.

CONTACT: Edward Roback, (301) 975-3696; edward.roback@nist.gov.

NIST SPONSORS MODES OF OPERATION WORKSHOP

In October 2000, NIST sponsored a workshop to discuss modes of operation for the proposed Advanced Encryption Standard (AES). The workshop, held in Baltimore, MD, followed the 23rd National Information Systems Security Conference.

A symmetric key block cipher algorithm, such as the Data Encryption Standard (DES) specified in Federal Information Processing Standard (FIPS) 46-3 and the proposed Advanced Encryption Standard (AES), are implemented in various modes, depending on specific applications. The modes to be used for DES were defined in 1980 in FIPS 81 and were written to be very specific to DES. As the AES development process nears its conclusion, the specific modes of operation for its use need to be addressed.

NIST will use the results of the workshop in developing a draft modes of operation standard. It is NIST's intention that the planned standard include the modes specified in FIPS 81, plus other modes needed for current applications and technology.

CONTACT: Elaine Barker, (301) 975-2911; elaine.barker@nist.gov.

SEALANT DURABILITY WORKSHOP

In September 2000, a Sealant Durability workshop was held as part of the Partnership in Advancing Technologies for Housing (PATH) activities at NIST. Nineteen sealant companies, representing over 90 % of the sealant manufacturers, along with representatives from universities, the insurance industry, and two federal agencies, attended this workshop. The workshop was held to explore the possibility of forming a consortium and the response was overwhelmingly positive.

The focus of this workshop was better metrology for accelerated determination of the service life of sealant formulations. Currently there is little confidence that accelerated testing yields meaningful predictions for in-service performance. The new NIST approach is to take a reliability database approach to predicting service life, something that is well accepted in the biological community for prediction of skin damage due to UV exposure.

More information on these efforts can be found at the Sealant Workshop website:http://www2.bfrl.nist.gov/consort/sealant/sealant.htm or the PATH website: http://www.pathnet.org.

CONTACT: Chris White, (301) 975-6016; christopher.white@nist.gov.

SYMPOSIUM ON OPTICAL FIBER MEASUREMENTS

Attendance at the 11th biennial Symposium on Optical Fiber Measurements (SOFM), held in September 2000 at the Boulder Laboratories, was over 300, up 65 % from the previous symposium. Eighteen countries were represented. The symposium is one of the principal international forums for reporting research results on meas-urement technology for optical fiber and other optoelectronic components. It was founded in 1980 by NIST staff and continues with the technical co-sponsorship of the Optical Society of America and the IEEE Lasers and Electro-Optics Society. Important topics this year were dispersion measurements, both polarization dispersion and chromatic dispersion, and nonlinear optical measurements. Interest in these topics arises primarily because of the dramatic growth in wavelength-division-multiplexed optical communication systems wherein 100 or more separate wavelength channels, each modulated at up to 40 Gbit/s, are transmitted over a single optical fiber. Dispersion and non-linear optical effects are among the primary

limitations to system performance. Copies of the *Technical Digest* are available from NIST (email: optoelectronics@boulder.nist.gov).
CONTACT: Gordon W. Day, (301) 975-5204; gwday @boulder.nist.gov.

BELGIAN FORMULA WINS COMPETITION TO BECOME ENCRYPTION STANDARD

NIST has named the Rijndael (pronounced Rhine-doll) data encryption formula as its choice for the nation's proposed new Advanced Encryption Standard (AES). The selection caps a 3 year international competition organized to develop a strong formula to protect sensitive information in federal computer systems. Many businesses are expected to use the AES as well. Rijndael was selected because it had the best combination of security, performance, efficiency, ease of implementation and flexibility.

Researchers from 12 different countries participated in the global competition. NIST invited the worldwide cryptographic community to "attack" the 15 candidate encryption formulas in an effort to break the codes. After narrowing the field down to five, NIST asked for intensified attacks on the finalists. Experts also evaluated the encoding formulas for factors such as security, speed and versatility.

The proposed selection of Rijndael as the AES will be announced formally in the Federal Register in several months, and NIST then will receive public comments on the draft Federal Information Processing Standard for 90 days. When approved by the spring of 2001, the AES will be a public algorithm designed to protect sensitive government information well into the 21st century. It will replace the aging Data Encryption Standard, which NIST adopted in 1977.

For more information, go to www.nist.gov/aes.
Media Contact: Philip Bulman (301) 975-5661; philip.bulman@nist.gov.

NEW READER SOON MAY GIVE THE BLIND ACCESS TO E-BOOKS

NIST recently unveiled the second generation of a device that soon may bring the benefits of electronic books to the blind.

The NIST Braille reader, which transforms the text of e-books into the patterns of raised dots used by sightless persons to read, also can be used for reviewing e-mail, browsing the World Wide Web and other text-based applications. The latest version of the reader incorporates several design improvements from the prototype tested during the past year.

For example, many blind and visually impaired people prefer to read Braille using several fingers, and the original design only allowed for reading with a single finger. The new Braille reader also is more compact and mechanically simpler than the original.

The NIST reader employs software to translate text into Braille, and features variable speed that allows people to read faster or slower, or to pause the device.

NIST estimates that the reader could be manufactured for about $1000. Braille readers currently on the market carry price tags as high as $15 000. Much of the cost savings result from the fact that the new NIST reader uses only three actuators—the mechanical devices that form Braille letters. Commercial Braille readers usually have hundreds of actuators.

NIST is seeking to transfer the technology to the private sector, where it can be commercialized. For more information, contact Victor McCrary, (301) 975-4321, victor.mccrary@nist.gov.
Media Contact: Philip Bulman (301) 975-5661; philip.bulman@nist.gov.

STATE-OF-THE-ART LAB UNDER CONSTRUCTION

NIST has awarded the $174 million contract to construct one of the most technologically advanced buildings in the world, the NIST Advanced Measurement Laboratory, in Gaithersburg, MD.

When it is ready for occupancy in 2004, the 47 480 m^2 (511 070 ft^2) AML will allow NIST to provide U.S. industry and science with improved measurements and standards, and more rapidly developed research advances. It will feature stringent controls on particulate matter, temperature, vibration and humidity that are unattainable in current NIST buildings. Such conditions are vital for housing the institute's most advanced metrology, physics, chemistry, electronics, engineering and materials science research, and will enable NIST to keep pace with rapid developments in semiconductors, industrial robots, computers, pharmaceuticals and emerging technologies requiring molecular and atomic-level precision.

For more information on the AML project, including details on the Clark/Gilford award and artist renditions of the planned facility, go to www.nist.gov/public_affairs/releases/g00-173.htm.
Media Contact: Michael E. Newman (301) 975-3025; michael.newman@nist.gov.

NEW CALIBRATION SERVICE FOR HIGH-POWER LASER DETECTORS

Who says NIST doesn't make house calls? In an innovative way to calibrate high-power laser detectors, NIST has devised a measurement system that can utilize a company's laser on location at the work site.

Multi-kilowatt high-power lasers are used for a variety of industrial applications, including the processing of materials, cutting and welding. Although detectors used with these laser systems need measurement traceability, the high cost and size of these systems previously limited NIST to only providing calibration services at powers up to 1 kW. Recently, a NIST scientist developed, tested, and implemented a system to perform calibrations at powers up to 10 kW or more at off-site laser locations.

Using a special transportable calibration system composed of various optical components, a characterized transfer standard, and a compact, stable water-flow system, the customer's own high-power laser can be used as the radiation source for detector calibrations. In the first test of this system, the NIST scientist recently performed successful calibrations for a U.S. manufacturer of high-power laser systems utilizing the company's own multi-kilowatt carbon dioxide laser source. This off-site system significantly extends NIST's high-power measurement capability, allows NIST to better support the laser-based materials processing industry, and avoids any need for NIST to purchase expensive, high-power lasers.

For more information, contact Xiaoyu Li, NIST, MC 815.01, Boulder, CO 80305-3328; (303) 497-3621; xiaoyu@boulder.nist.gov.
Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

SYMPOSIUM ON OPTICAL FIBER MEASUREMENTS CHRONICLED

Persons interested in metrology for fiber-optic telecommunication will want to get a copy of the *Technical Digest, Symposium on Optical Fiber Measurements, 2000.* The 20th annual symposium was held in September 2000, at the NIST Laboratories in Boulder, CO.

In their preface to the digest, the symposium chairs note that after 20 years, "fiber-optic metrology is not only still important, but we are seeing a rise in metrology needs for the technologies resulting from fiber optics—components, integrated optics and fiber systems."

The majority of the papers in the digest fall into one of three categoriesdispersion, components, and non-linear optics. Dispersion is the largest category and contains two sessions on polarization mode dispersion, and one session each on chromatic dispersion and group-delay measurements on fiber Bragg gratings. Papers on components include grating metrology as well as receiver and amplifier characterization. The category of non-linear measurements includes papers on measurements of non-linear coefficient and effective area.

In all, the digest consists of 44 papers (9 invited and 35 contributed), with slightly more than half of the papers originating outside the United States.

Copies of *Technical Digest, Symposium on Optical Fiber Measurements, 2000* (NIST Special Publication 953), are available at no charge while supplies last. Contact the NIST Optoelectronics Division at (303) 497-5342.
Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

DEBUT SET FOR COMPLEX COMPUTING "ALL FOR ONE" STANDARD

Scientists and engineers who have to make extremely complex calculations favor a computing approach known as parallel processing. Parallel processing is a way to break up a computing problem into pieces that various processors—the "brains" inside computers—can work on simultaneously. It produces extraordinary results, allowing people to make calculations in a week that previously would have taken a year.

While parallel processing has been around for years, many scientists have been frustrated in their efforts to use it. It is easy to create a parallel processing computer network if the computers were all made by the same company. Yet harnessing the combined computing power of machines made by different manufacturers has been much more difficult. A new voluntary standard, the Interoperable Message Passing Interface, eliminates many of those problems.

The first public demonstrations of the IMPI took place at the Supercomputing 2000 conference in Dallas in November 2000.

Computer scientists at NIST have coordinated work on the new standard. NIST teamed up with some of the world's largest computer hardware and software manufacturers to develop the IMPI. NIST also has created a web-based conformance tester for IMPI.

More information about the standard is available online at http//impi.nist.gov/IMPI/. The web site for the conference may be found at www.sc2000.org/.
Media Contact: Philip Bulman (301) 975-5661 philip.bulman@nist.gov.

COOL SITE YIELDS HOT DATA ON HEAT TRANSMISSION

For what purpose would NIST researchers use a 1 m diameter hot plate? If you guessed, "to heat up a mighty big pot of coffee," you're wrong. However, data derived from this device and previous hot plates have helped make the daily life of Americans more comfortable for nearly 80 years.

For example, heat transmission values gained from calculating the thermal conductivity properties of materials measured in hot plates have enabled industry to build more efficient heating, refrigeration and air-conditioning systems as well as improving wall insulation properties. NIST-tabulated values for heat transmission properties of common building and insulating materials also have contributed to the development of modern building technology standards.

Now, researchers at NIST have compiled the test data for steady-state heat transmission measurements in an Internet database. This database currently contains all of the evaluated thermal conductivity measurements produced by NIST from 1932 to 1983 using a 200 mm guarded hot plate apparatus. The data were previously unavailable because they were reported only to an individual sponsor or researcher, or simply recorded in handwritten test logs. Additional data from other NIST heat transmission experiments will be added in the future.

The new web site contains more than 2100 records of thermal conductivity data for a variety of thermal insulation materials such as cellular plastics, corkboard and glass fiber, as well as building materials such as fiberboard and light-weight concrete.

The NIST Standard Reference Database 81 on Heat Transmission Properties of Insulating and Building Materials may be accessed at http//srdata.nist.gov/insulation. For historical background on the guarded hot-plate apparatus, go to www.bfrl.nist.gov/863/hotplate/.

Media Contact: John Blair (301) 975-4261; john.blair@nist.gov.

REFINED PROCEDURES IMPROVE REFRIGERATION PROPERTIES RESEARCH

Damage to the Earth's ozone layer caused by use of chlorofluorocarbons has prompted an international effort to measure and correlate the thermophysical properties of alternative refrigerant fluids such as hydrochloro-fluorocarbons and hydrofluorocarbons. Scientists around the world who compared their measurement results discovered wide discrepancies. For one property, viscosity, data differed by as much as 15 % to 30 % between laboratories.

The situation led the International Union of Pure and Applied Chemistry to conduct a tightly managed round-robin measurement study organized by NIST to attempt to reduce the uncertainties. For this study, samples from a carefully prepared, high-purity source of a refrigerant known as 1,1,1,2-tetrafluoroethane, or R134a, were distributed to the nine participating labs in meticulously cleaned containers. Each lab made measurements following procedures that maintained the sample's purity and allowed sample recovery for subsequent analysis.

When these procedures were followed, measurement discrepancies were reduced dramatically. For example, the largest discrepancy for viscosity was 6 % using a variety of measurement techniques.

NIST not only contributed measurements as a round-robin member but also analyzed the data deviations among all of the laboratories for IUPAC.

The study proved that sample purity must be maintained throughout the measurement process, and even the sample container and measurement apparatus must be regarded as a source of contamination. NIST is now working with IUPAC on the development of improved standard reference correlations based on the study data to enable the design of more efficient and compact refrigeration equipment.

For more information, contact Richard A. Perkins, NIST, MC 838.07, Boulder, CO 80305-3328; (303) 497-5499; richard.perkins@nist.gov.

Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

ATOMIC CLOCK AMONG *POPULAR SCIENCE'S* "BEST OF WHAT'S NEW"

The editors of *Popular Science* reviewed thousands of recent products and technology developments before selecting 100 of them for inclusion in their 13th annual "Best of What's New" list in the December 2000 issue. One of the awards goes to the most recent in NIST's 51 year long line of ever-more-precise atomic clocks, the NIST-F1 cesium fountain clock, unveiled in December 1999.

NIST-F1, the nation's primary standard of frequency and time, was built at the NIST Boulder Laboratories. Operating with a relative uncertainty of less than 2×10^{-15} (corresponding to neither gaining nor losing 1 second in nearly 20 million years), NIST-F1 is among the most accurate standards of measurement ever constructed. It is used to evaluate and enhance the performance of the other clocks in NIST's timekeeping system; its extreme accuracy also is incorporated into the time signals broadcast by NIST's radio stations and other time services.

For more information on NIST F-1, go online to www.nist.gov/fountainclock.
Media Contact: Collier Smith (303) 497-3198; smithcn @boulder.nist.gov.

"FULL OF HOT AIR" TAKES ON NEW MEANING AT NIST

Atmospheric air is a mixture of fluids including nitrogen, oxygen, argon, carbon dioxide, water vapor, and other trace elements. That's more than most of us need to know, but for others—including researchers and staff at liquefaction companies, manufacturing firms, laboratories and wind tunnels—it isn't nearly enough.

That's where a collaboration between NIST and the University of Idaho (UI) has made the difference. The partners measured and developed an equation of state for the thermodynamic properties of natural air, along with mixtures of nitrogen, argon and oxygen. The standard air measured and correlated by NIST and the UI is dry and contains no carbon dioxide or trace elements. The thermodynamic property formulation is valid for liquid, vapor, and supercritical air at temperatures from 59.75 K to 2000 K at pressures up to 2000 mPa.

The model is published in the current issue of the *Journal of Physical and Chemical Reference Data* (Vol. 29, No. 3), a joint venture of NIST and the American Institute of Physics.

For a copy of the journal article, go online to http:// ojps.aip. org/jpcrd/.
Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

WR-22 NOISE-TEMPERATURE MEASUREMENT SERVICE OPENED

NIST has completed construction and verification of a new radiometer system for measuring the noise temperature of sources with WR-22 waveguide flanges. The system offers continuous frequency coverage of the 40 GHz to 50 GHz portion of the WR-22 band. The lower portion of the band (33 GHz to 40 GHz) can be measured through adapters on the existing WR-28 system. The new WR-22 system is a total-power radiometer, with an internal six-port reflectometer to measure relevant reflection coefficients. Its design is similar to that of existing NIST waveguide systems. It is capable of measuring sources with noise temperatures from about 50 K to 15 000 K, with typical relative expanded uncertainties ($k = 2$) expected to be about 1.6 % or 1.7 % for sources with noise temperatures from 1000 K to about 12 000 K and reflection coefficients of less than about 0.1. With this new WR-22 measurement service and the recent upgrade of its WR-90 service, NIST now offers noise-temperature measurement services for waveguide noise sources for any frequency from 8.2 GHz to 65 GHz, with the exception of the 26.01 GHz to 26.5 GHz range of the WR-42 band.
CONTACT: Jim Randa, (303) 497-3150; randa@ boulder.nist.gov.

NIST TRANSFERS NEW POLYMER STRUCTURE ANALYSIS METHOD TO INDUSTRY

A new method, developed by NIST for determining the molecular architecture of polymers was transferred successfully to a private company. The transfer was facilitated by a recently completed Cooperative Research and Development Agreement (CRADA) in which NIST staff demonstrated their method on materials custom-designed by the private company. The technique was applied to commercial materials to reveal aspects of the chemical structure that were unexpected and impossible to detect by other means.

The new measurement procedure developed at NIST facilitates elucidation of the molecular structure of a class of materials called silsesquioxanes, which have application in a wide array of industries from microelectronics to dental implants. Silsesquioxanes are based on a trifunctional silicon-oxygen monomer having pendant organic side groups. The trifunctional property of the monomer results in condensation polymers with a wide variety of possible three-dimensional configurations. However, industry lacked methods to accurately determine the structure, how the structure develops during manufacture and how the structure influences properties. The analysis challenge was further complicated by a chemical composition that resulted from the use of two different monomers co-polymerized together.

NIST researchers had developed a method using matrix-assisted time-of-flight mass spectrometry (MALDI-TOF-MS), along with autocorrelation analysis of the resulting mass spectra, to determine the topological nature of the molecules as a function of molecular mass. For any molecule having a particular number of silicon atoms, the method can determine the relative number that show a closed topology—polyhedral in shape—versus the number that show an open topology—highly branched in shape. A manuscript that will report on the general method and the results for this example is in preparation.
CONTACT: William E. Wallace, (301) 975-5886; william.wallace@nist.gov.

FEDERAL CIO COUNCIL PROMOTES NIST GUIDELINES TO FEDERAL AGENCIES

The Federal Chief Information Officers (CIO) Council recently issued a memorandum to federal agency CIOs encouraging agencies to take advantage of a new guidance document published by NIST. NIST Special Publication 800-23, *Guidelines to Federal Organizations on Security Assurance and Acquisition/Use of Tested/Evaluated Products—Recommendations of the National Institute of Standards and Technology,* provides advice to agencies for sensitive (i.e., non-national security) unclassified systems on the acquisition and use of security-related IT products. The document describes two government programs of particular interest—the National Information Assurance Partnership (NIAP)s Common Criteria Evaluation and Validation Program and NIST's Cryptographic Module Validation Program (CMVP).

The document is available at http://csrc.nist.gov/publications/nistpubs/index.html.

CONTACT: Edward Roback, (301) 975-2934; edward.roback@nist.gov.

NIST'S CRYPTOGRAPHIC MODULE VALIDATION PROGRAM ADDS FIFTH TESTING LABORATORY

The Cryptographic Module Validation Program (CMVP) achieved another milestone by adding a fifth National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory. The five CMVP laboratories test cryptographic modules to the requirements of Federal Information Processing Standard (FIPS) 140-1, *Security Requirements for Cryptographic Modules.* In addition, the CMVP continues its exponential growth by issuing the programs 122nd validation certificate. These 122 certificates actually represent over 142 separate modules by 39 different vendors. The program also validated an additional four security level 4 modules, which is the highest security level specified in FIPS 140-1.

The CMVP is a joint effort between NIST and the Communications Security Establishment (CSE) of the Government of Canada.

CONTACT: Ray Snouffer, (301) 975-4436; ray.snouffer@nist.gov.

LIMITATIONS DETERMINED IN "NOSE-TO-NOSE" IMPULSE RESPONSE METHOD

NIST researchers have determined certain limitations on the nose-to-nose technique for characterizing the impulse response of diode-bridge type, high-frequency samplers used in certain commercial 20 GHz and 50 GHz (3 dB bandwidth) equivalent-time, digitizing oscilloscopes. In general, having an accurate estimate for the impulse response of these samplers is important for measurement accuracy; moreover, these diode-bridge type samplers are used by NIST for providing pulse waveform calibration services. Poor estimates for the impulse response of these samplers can degrade the uncertainties quoted for the calibration services.

In particular, it has established that there are regions of nonlinear behavior in the amplitude and bandwidth of the "kickout" pulses from the diode bridge sampler as a function of offset voltage. The basic technique assumes that these pulses are stable and symmetrical between the samplers used for the nose-to-nose testing procedure. Also, a temperature-dependent time shift (drift) in the kickout pulse was also observed over the manufacturers recommended operating temperature range (15 °C to 35 °C). The amplitude of the pulses changed, as expected, but the pulse width was unchanged. These studies have been documented in two papers: "The Effect of Offset voltage on the Kick-Out Pulses Used in the Nose-to-Nose Sampler Impulse Response Characterization Method"; and "Temperature Effects on the High Speed Response of Digitizing Sampling Oscilloscopes, at the 2000 National Conference of Standards Laboratories Workshop and Symposium in July.

CONTACT: Barry Bell, (301) 975-2419; barry.bell@nist.gov.

RARE-EARTH DOPING USED TO CONTROL HIGH-SPEED DYNAMICS OF MAGNETIC DATA STORAGE COMPONENTS

NIST staff have explored the use of rare-earth dopants to control the high-speed dynamics in magnetic thin films used in magnetic recording heads and magnetic random access memory (MRAM). They discovered that a few percent of Tb dopants in Ni-Fe films can dramatically increase the magnetic damping without substantially changing the other magnetic properties. The films can be engineered to be underdamped, critically damped, or overdamped by varying the dopant concentration from 0 % to 4 %. High-speed measurements were made at frequencies up to 6 GHz using a pulsed inductive technique.

Rare earths have long been known to increase magnetic damping in ferrite materials used in microwave devices. For microwave applications, damping is undesirable, and efforts have concentrated on eliminating rare-earth impurities. However, for magnetic data storage applications, critically damped behavior is desirable to prevent ringing and magnetic

turbulence when magnetic elements are rotated or switched. For instance, a typical "spin-valve" read sensor, in response to a 250 ps pulsed field from a magnetic bit, will ring for approximately 2 ns after the applied bit field. Similarly, when an MRAM element is switched, the magnetic energy will cause the element to oscillate or break up into a disordered high-temperature magnetic state. The switching properties of the element will be dramatically altered until the magnetic energy is removed from the system. This can lead to undesirable switching in MRAM arrays if the clock speeds are faster than the magnetic cooling rate.

Further temperature-dependent measurements and characterization of films doped with different rare earths indicate that the increased damping is due to local lattice distortions at the rare-earth sites due to anisotropic orbitals that are strongly coupled to the film magnetization. The ability to engineer the high-speed dynamical properties of magnetic systems will become critical in the next few years when both magnetic recording and MRAM operation will be pushed into the gigahertz regime.

CONTACT: Stephen Russek, (304) 497-5097; russek@boulder.nist.gov.

NIJ GUIDE 100-00 "GUIDE FOR THE SELECTION OF CHEMICAL AGENT AND TOXIC INDUSTRIAL MATERIAL DETECTION EQUIPMENT FOR EMERGENCY FIRST RESPONDERS"

NIST developed this guide through an interagency agreement with the Chemical and Biological Information Analysis Center of the Department of Defense. The guide, which was released in October 2000 by the National Institute of Justice (NIJ), is the first of five planned guides dealing with chemical and biological (CB) agent protection equipment for emergency first-responders against terrorist release of CB weapons. The primary purpose of the guide is to provide emergency first-responders with information to aid them in the selection and utilization of chemical agent and toxic industrial material (TIM) detection equipment. The guide provides information on a variety of factors that can be considered when purchasing detection equipment, including sensitivity, detection states and levels, and portability. The guide is separated into two volumes: Volume I represents the actual guide and Volume II serves as a supplement to Volume I and contains the detection equipment manufacturers specifications. Technical information is included in sections describing how the various detection technologies work. Sixteen selection factors have been identified. These factors were compiled by a panel of scientists and engineers with multiple years of experience in chemical agent and TIM detection and analysis, domestic preparedness, and identification of emergency first-responder needs.

CONTACT: Alim Fatah, (301) 975-2757; alim.fatah@nist.gov.

SOFTWARE PROTOTYPES

A prototype Java-based tool has been developed for authoring and browsing taxonomies and ontologies of information. The tool has been developed as part of the NIST Design Repository Project, but functions in a completely stand-alone mode. The tool allows the user to develop a hierarchical classification of terms with associated formal and informal definitions. The tool also allows merging of independently created taxonomies or branches of taxonomies.

CONTACT: Simone Szykman, (301) 975-4466; simone.szykman@nist.gov.

NEW NIST MEASUREMENT CAPABILITIES FOR SUBMILLIMETER HOLES

Dimensions of small holes play a critical role in a wide range of technologies, from fiber-optic connectors to fuel injectors. In the past, researchers have been unable to measure small features such as the inner diameter of a submillimeter hole, but NIST has recently demonstrated the ability to measure holes as small as 700 μm in diameter. Surprisingly, NIST's most accurate method for meas-uring these tiny features is to use a room-size coordinate measuring machine, which is more typically employed to measure objects with dimensions a little under 1 m. The measuring machine has been equipped with a miniature, 300 μm diameter touch probe. In spite of its large size, the machine is capable of positioning the probe tip with submicrometer precision and measuring small objects with uncertainties on the order of 100 nm.

CONTACT: Ted Doiron, (301) 975-5638; theodore.doiron@nist.gov or John Stoup, (301) 975-3476; john.stoup@nist.gov.

SUCCESSFUL ISEMATECH/NIST EXPERIMENT WITH "SHARP-TIP" EMITTERS USED IN CD-SEM

The value of nano-tips as replacement electron sources in production field emission critical dimension scanning electron microscopes (CD-SEMs) is being explored in a two-part study for ISEMATECH. In the first part of the work, an intermediate to the experiments with atomically sharp, nano-emitter tips, a "sharp tip" was

placed into the S-6000 CD-SEM. The resolution of the CD-SEM improved substantially. These results proved that the expected improvement over the conventional, so-called rounded tip (which is due to smaller tip radius) can be realized as a definite improvement in the resolving power of the SEM. The success of this first step presents the prospect of an even better outcome for the nano-tips. ISEMATECH expressed interest in this work and promised further funding.

CONTACT: Andras Vladar, (301) 975-2399; andras.vladar@nist.gov or Michael Postek, (301) 975-2299; michael.postek@nist.gov.

NONDESTRUCTIVE TESTING OF CABLES

Cables formed by twisting steel wires together to form a flexible rope with high-strength properties are found throughout industry. However, the nondestructive detection of internal flaws such as cracks or corrosion in the innermost wires is very difficult for conventional nondestructive testing techniques because of the naturally inhomogeneous nature of the cables construction. Recently, the Colorado School of Mines and NIST (Boulder) collaborated on the development of a novel method of inspection of copper cables used for grounding power transformers in electrical substations. Here, the cables run underground with the only access being a short length between the transformer frame and the surface of the ground. A special ultrasonic transducer was designed that could be clamped around the exposed end of the cable. The transducer sends a torsional ultrasonic wave along the cable buried under the substation. By detecting and signal processing the echo signals returned by corroded regions, the damage can not only be located but its severity can be estimated. This inspection technique is now being applied to high-voltage transmission line cables made of steel and aluminum wires twisted together to optimize the conductivity-to-strength ratio.

CONTACT: George Alers, (303) 497-7899; alers@boulder.nist.gov.

NEW X-RAY IMAGING TECHNIQUE REVEALS CRYSTAL DEFECTS

The deformation of metals takes place primarily by the motion and interaction of defects in the crystal structure known as dislocations. Quantitative understanding of this deformation, needed for modeling of metal-forming processes, has been hampered by a lack of knowledge about the complex configurations assumed by these defect microstructures when the metals are deformed.

A new experimental technique, ultra small angle x-ray scattering (USAXS) imaging, has been shown by NIST to hold promise as a useful tool for studying microstructures in situ. The technique is based on forming an image of the sample using x rays which have been scattered from defects in the crystal structure. Although these x rays scattered from defects are very weak, the USAXS technique allows them to be isolated from the high-intensity background to form an image of the defects only. The scattering from these components can be detected down to around one seventh to one tenth of the intensity of the main transmitted x-ray beam. Preliminary tests of this technique were made in March 2000, using copper samples in which defects had been produced by a very slow deformation treatment. A more thorough study was conducted in May 2000. The tests were very successful and microscopic damage was imaged using several different scattering conditions. A basic theory for the image formation process in USAXS imaging has been worked out and it was validated by experiments completed in September 2000. The technique is believed to be a major breakthrough with broad potential applications, including the study of the defects which control metal deformation behavior. A paper on USAXS imaging has been accepted for publication.

CONTACT: Lyle Levine, (301) 975-6032; lyle.levine@nist.gov.

NCNR SETS THE STANDARD FOR QUANTITATIVE PHASE ANALYSIS

Personnel from the NIST Center for Neutron Research (NCNR) recently participated in an international round-robin on the use of diffraction techniques for the quantification of phase abundance in multiphase mixtures. This type of analysis is essential for the characterization, development, and performance of many industrial materials, such as thermal barrier coatings employed in aircraft engines. The round-robin included participants from x-ray, synchrotron, and neutron facilities worldwide, and was sponsored by the Commission on Powder Diffraction of the International Union of Crystallography.

Results to date show a wide variation in performance for various methods. For example, in one standard mixture containing 34.2 % zinc oxide, results obtained using laboratory x-ray sources ranged from 25 % to 42 %, results from synchrotron sources ranged from 29 % to 35 %, and those from neutron sources ranged from 32 % to 35 %. NCNR analysis gave 34.4 %. For all 10 mixtures analyzed, the NCNR results agreed within statistical limits with the nominal compositions and, overall, gave the best results in the study.

The results of this study again emphasize the importance of neutron methods in providing accurate data on phase composition in industrial materials.
CONTACT: Judith Stalick, (301) 975-6223; judith.stalick@nist.gov.

NIST MAPS ENERGY LEVELS OF FIRST ION OF MERCURY

NIST scientists have succeeded in creating an extensive map of the electronic energy levels of the singly-ionized mercury atom, Hg^+. The wavelengths and levels determined in this work are important for many applications, including space astronomy with the Hubble Space Telescope. Scientists at NIST (Boulder) are using the results to estimate the shift due to external fields that might be expected to occur in an optical frequency standard based on the Hg^+ transition at 281.5 nm; this is one of the most precise frequency standards currently under development.

The mapping was carried out by observing the spectrum of mercury ions over a wide wavelength region from the far ultraviolet to the near infrared. Over 100 energy levels of Hg^+ were determined in the process, some of them lying near or above the ionization limit. Nearly 500 spectral lines were measured to high accuracy and used to determine the level values. The spectral lines were excited in a special light source that used pulsed radio-frequency waves to create a plasma with a high density of mercury ions.
CONTACT: Craig Sansonetti, (301) 975-3223; craig.sansonetti@nist.gov.

NIST'S SEMPA FACILITY UPGRADED

The ability of NIST scientists to image small magnetic structures has been recently improved by the installation of a new, ultra-high vacuum, field emission scanning electron microscope in the NIST Scanning Electron Microscopy with Polarization Analysis (SEMPA) facility. This new instrument, when coupled to the NIST polarization detection system, will allow faster imaging with higher resolution.

The new microscope replaces two older units and provides a high-intensity field emission electron source and state-of-the-art electron optics. NIST will now be able to image the magnetization of magnetic nanostructures with 10 nm spatial resolution, the highest of any SEMPA system worldwide. The improved performance is essential to keep pace with the shrinking length scales of magnetic structures in magnetic media, spintronic devices, and magnetic sensors. The microscope is also an Auger microprobe with facilities for in situ thin film growth and tools for nanoscale compositional and structural analysis. The microscopes operation is fully automated and under computer control, permitting remote control of the microscope, and immediate electronic transfer of SEMPA images and measurements to NIST customers.
CONTACT: John Unguris, (301) 975-3712; john.unguris@nist.gov.

IMPROVED MEASUREMENT SYSTEM FOR INFRARED PROPERTIES OF MATERIALS

NIST has a new instrument to provide enhanced characterization of infrared optical properties of materials. The instrument is currently being used to calibrate gold mirrors for use as reference standards by a manufacturer of reflectance and scattering distribution measurement systems. This work is being done under the auspices of the Optical Properties of Materials Consortium. The Consortium is geared for partners interested in the development of standard reference materials and calibration services to characterize optical properties such as transmittance, reflectance, emittance, and polarization over the wavelength regions of UV to far IR.

The instrument uses a precision goniometer and has a Fourier-transform infrared (FTIR) spectrophotometer as a source. The system can measure variable angle absolute reflectance and transmittance from 12° (and 0°) to >80°, over the 1 μm to 5μm wavelength range with an expanded (k = 2) uncertainty of 0.002. Improvements to the new measurement system are underway: the wavelength range will be expanded to 20 μm and IR ellipsometry measurement capability will be established. These improvements are expected to improve the accuracy in the determination of IR optical constants of opaque materials.
CONTACT: Simon Kaplan, (301) 975-2336; simon.kaplan@nist.gov or Leonard Hanssen, (301) 975-2344; leonard.hanssen@nist.gov.

E-CALIBRATION SERVICE SUCCESSFULLY DEMONSTRATED BY NIST

NIST is expanding into a new frontier in the delivery of measurement services by using the Internet to provide industry with electronic traceability to national standards. This is a radical departure from the traditional modes of traceability and presents many new challenges. This service employs an Internet-based system for fast, remote calibration of high-dose radiation sources against the U.S. national standard.

The new service will deliver calibration results to industry customers on-demand, in real-time, at a lower cost, and the calibration results can be rapidly

incorporated into the production process to ensure the highest quality manufacturing. Moreover, the e-calibration service is a technological solution to the rapidly growing demand on NIST for industrial calibrations.

At a recent ASTM International Workshop on Radiation Dosimetry, an instrument used to perform calibrations was connected to the Internet in the conference hotel in San Diego and was remotely controlled by a NIST server in Gaithersburg, MD. A "hole" was created through the NIST firewall for this application. A calibration on the San Diego instrument was performed solely by the NIST server without the direct involvement of NIST staff. The following week at the Council on Ionizing Radiation Measurements and Standards annual meeting, the remote calibration process was repeated from the NIST Administration Building. With the fundamental features now in place, additional features and safeguards are being incorporated before field testing of this technology. Several industrial partners are poised to begin collaborative trials at their facilities. These tests should foster confidence in the system prior to its inauguration as NISTs first e-calibration service. Electronic calibrations through the global connectivity of the Internet will serve to expand the dissemination of NIST standards, harmonize ionizing radiation measurements, and facilitate trade.

CONTACT: Marc Desrosiers, (301) 975-5639; marc.desrosiers@nist.gov or Robert Glenn, (301) 975-3667; robert.glenn@nist.gov.

MEMS MODELING WORKSHOP DRAWS SPECIALISTS AND VENDORS FROM DC AREA

The MEMS Modeling Workshop was held at NIST in October 2000. During the day-long workshop, organizations that specialize in the development of simulation tools for modeling MicroElectroMechanical Systems (MEMS) presented overviews and demonstrations of their software tools. This workshop was the first ever held where all of the companies specializing in MEMS simulation tools were brought together so that MEMS specialists could learn about, compare, and provide comments on the products by interacting with the vendors.

MEMS modeling/simulation efforts allow the exploration and optimization of new device designs in a very cost-effective manner. The MEMS Modeling Workshop was highly successful, drawing approximately 50 attendees from local universities, government laboratories, and companies. The MEMS Alliance is planning a second workshop, this time concentrating on MEMS fabrication services. The upcoming workshop is tentatively being scheduled for Spring 2001 at the University of Maryland.

CONTACT: Michael Gaitan, (301) 975-2070; michael.gaitan@nist.gov.

NIST HOSTS WORKSHOP ON COMPUTATIONAL METHODS FOR FEW-BODY DYNAMICAL SYSTEMS

In November 2000, NIST hosted the Workshop on Computational Methods for Few-Body Dynamical Systems, a meeting of approximately 70 researchers co-sponsored by the National Science Foundation, the American Physical Society, and the University of Maryland. Workshop presentations focused on the computational study of atomic and molecular structure and collisions, Bose-Einstein condensation, chemical reactions, and other areas of applied quantum mechanics in which computational methods are having significant impact. In opening remarks to the attendees, the Director of the NIST Physics Laboratory reminded them of the noteworthy historical NIST/NBS contributions to few-body physics: the discovery of multiply-excited states of atoms at the SURF synchrotron facility; the theory of spectral line shapes; the development of iterative methods for solving large linear algebra problems; and the infrastructure for scientific computation provided by the Handbook of Mathematical Functions. The workshop Web page can be found at http://www.ipst.umd.edu/~fewbody/FewBody.htm.

CONTACT: Charles W. Clark, (301) 975-3709; charles.clark@nist.gov.

CIRMS HOLDS NINTH ANNUAL MEETING AT NIST

The Council on Ionizing Radiation Measurements and Standards (CIRMS) held its ninth annual meeting at NIST in late 2000. The organization represents thousands of users of ionizing radiation and radioactive sources engaged in medical radiation diagnostics and therapy, brachytherapy source production, worker radiation protection, industrial radiation processing, sterilization and materials effects, and radioanalytical environmental services. More than 160 participants from industry, federal and state agencies, and national laboratories attended the meeting, and presented lectures and posters in four parallel workshops that addressed the specialties of the four CIRMS subcommittees: Medical Applications, Occupational Radiation Protection, Public and Environmental Radiation Protection, and Industrial Applications and Materials Effects.

CIRMS provides a forum for discussing common ionizing radiation issues; identifying, defining and prioritizing needed work; disseminating information on standards; and organizing workshops and meetings to advance safe and efficacious uses of ionizing radiation technology. The annual gathering of the radiation user community is a key element of the planning processes for state and federal agencies. CIRMS encourages one-on-one interactions, open group discussions, and

prioritization of the national measurements and standards needs through consensus.
CONTACT: Bert Coursey, (301) 975-5584; bert.coursey@nist.gov.

TWO NEW PRECISION MEASUREMENT GRANTS AWARDED FOR FY 2001

Two new $50 000 NIST Precision Measurement grants have been awarded for fiscal year 2001. The recipients, David P. DeMille of Yale University and Michael V. Romalis of the University of Washington, were selected from an initial group of 27 candidates. NIST sponsors these grants to promote fundamental research in measurement science in U. S. colleges and universities, and to foster contacts between NIST scientists and researchers in the academic community actively engaged in such work.

The aim of DeMille's project, "Search for the Electron Electric Dipole Moment in the a(1) State of PbO," is to use the paramagnetic, metastable excited state a(1) of PbO to search for an electron electric dipole moment (EDM) with a detection limit of 10^{-31} e-cm, 10^{-4} times the current detection limit of 10^{-27} e-cm. This 10^4 improvement will allow DeMille to provide stringent tests of the Standard Model of particle physics (SM), which does not allow a finite EDM, and extensions of the SM such as super symmetry (SUSY), which in fact predict an EDM in the range of DeMilles proposed detection limit. Thus, this project should shed some experimental light on physics beyond the Standard Model—a topic that is currently of the highest priority in the physics community.

The aim of Romalis' project, "A Test of CPT Symmetry Using a New K-^{3}He Self-Compensating Magnetometer," is to perform a high-precision test of combined charge conjugation, parity inversion, and time reversal (CPT) invariance and local Lorentz invariance by comparing the Larmor precession frequencies of potassium (K) and helium 3 (^{3}He) atoms in the same cell as a function of time, i.e., the daily rotation of the Earth about its axis and the movement of the Earth relative to the cosmic microwave background radiation. The experiment will improve the existing tests of these important fundamental symmetries of nature by a factor of 1000 and should provide tests of various theories of quantum gravity, such as string theory, which predict violations of CPT and Lorentz invariance. These theories attempt to treat gravity in the framework of quantum mechanics—a recognized necessity if the picture of the physical world is to be complete and internally consistent.
CONTACT: Barry N. Taylor, (301) 975-4220; barry.taylor@nist.gov.

WORKSHOP ON MEASUREMENT TRACE ABILITY FOR CLINICAL LABORATORY TESTING AND IN VITRO DIAGNOSTIC (IVD) TEST SYSTEMS

In early November 2000, representatives of government, the IVD industry, and the medical professions from 15 nations representing four continents gathered at NIST to participate in the "Workshop on Measurement Traceability for Clinical Laboratory Testing and In Vitro Diagnostic Test Systems." Their goal: to develop recommendations regarding the needs for measurement traceability for health status markers to (1) address IVD industry needs for compliance with international standards (e.g., EU IVD Directive) and (2) improve comparability of clinical measurement data to facilitate better decision-making by medical professionals. The workshop was attended by 135 scientific experts and stakeholders from around the globe (25 % were from outside the United States).

Traceability to internationally recognized and accepted standards is an important component in assuring the accuracy and comparability of clinical laboratory measurements. In addition, the global marketplace is presenting new demands for measurement traceability. Recently, an important opportunity has emerged that applies new pressure to the quest for traceability and the demand for reference systems. Prompted by the European Union's In Vitro Diagnostics Directive (IVDD), the European Committee for Standardizations Technical Committee 140 (CEN/TC 140), in vitro diagnostic systems, began drafting a standard on metrological traceability. Full implementation of the IVD Directive is expected by December 2003 and will require that calibration of all IVD assays be traceable to available reference materials or methods of higher metrological order.

At the conclusion of the workshop, there was general agreement on some critical issues. The need for global reference systems composed of reference methods, reference materials, and a mechanism for demonstrating competence and equivalence was of paramount importance. Internationally recognized and accepted reference laboratories should implement these reference systems, using a networked approach. In order to meet the immediate requirements of the IVD Directive, a catalog of the available reference methods and reference materials must be communicated to the IVD manufacturers. There was concurrence, that when properly implemented, traceability is a value-added exercise that will improve patient care, testing accuracy, reliability and availability, market access, and, in the long run, reduce costs. However, it was emphasized that

efforts undertaken must be designed to minimize redundancy and barriers, encourage new technologies, and facilitate global collaborations.
CONTACT: William F. Koch, (301) 975-8301; william.koch@nist.gov.

NIST SCIENTIST RECEIVES CODATA PRIZE 2000

Barry N. Taylor, manager of the NIST Physics Laboratory Fundamental Constants Data Center, received the CODATA Prize 2000 at the 17th biennial International CODATA Conference held in October 2000 in Baveno, Italy. The CODATA prize is a newly established award to recognize outstanding achievement in the world of scientific and technical data. Taylor, the first recipient of the prize, was chosen for his many contributions during the last 35 years to improvement of our knowledge of the values of the fundamental physical constants.

CODATA, The Committee on Data for Science and Technology, was established in 1966 as an interdisciplinary committee of the International Council for Science (ICSU), formerly the International Council of Scientific Unions. It seeks to improve the quality, reliability, processing, management, and accessibility of data of importance to science and technology.
CONTACT: Barry N. Taylor, (301) 975-4220; barry.taylor@nist.gov.

NIST JOINS THE NATIONAL PARTICULATE MATTER RESEARCH PROGRAM

With the signing of a recent agreement, NIST has joined an interagency effort led by the Environmental Protection Agency (EPA)—the National Particulate Matter Research Program—aimed at improving the nation's air quality and public health. NIST will develop and provide the fundamental chemical measurements and standard reference materials that will serve as the basis for improved monitoring of air quality by government and industry.

Particulate matter is a mix of coarse and fine particles in the air produced by natural processes as well as human activities. About 10 to 100 times smaller than the diameter of a human hair, fine particulate matter can consist of dust, ashes, soot and sea salt aerosols. The challenge is to identify and measure accurately the chemical components—specifically, the toxic ones—and collect enough particulate to constitute a representative sample. Under the 2 year agreement with the EPA, NIST and its partners will develop urban particulate matter reference materials, a special thin-film glass standard for x-ray fluorescence analysis and technology for large-scale collection of fine airborne particulate matter. This work will enable the accurate measurement of emissions from various pollutant sources such as industrial plants and vehicles.

For more information about NIST's particulate matter research, contact chemist Mike Verkouteren, NIST's representative to the interagency coordinating committee, (301) 975-3933, r.verkouteren@nist.gov.
Media Contact: Pamela A. Houghtaling (301) 975-5745; pamela.houghtaling@nist.gov.

LOOKING FOR A QUALITY-SYSTEM REGISTRAR?

NIST's semi-annually updated listing of North American organizations that register quality and environmental-management systems is now available over the Internet.

For each of the 96 registrars listed, entries specify the status and scope of accreditation, other types of recognition, contacts, web addresses and related items. Information was compiled from a periodic NIST survey focusing on so-called "9000 series" quality standards and on "ISO 14000," the family of Environmental Management System standards issued by the International Organization for Standardization (known as ISO).

Using the 80-page directory, a business can identify registrars that serve its particular industry and decide whether registration by a particular organization will be honored by customers and regulators. Increasingly, businesses require sup- pliers to meet quality standards. Also, regulators in export markets may waive product-certification requirements for companies whose quality systems are registered by organizations recognized as competent.

Available in Adobe Acrobat PDF format, *Semi-Annual ListingNorth American Quality System Registration Organizations (NAQSRO)* (NISTIR 6515) may be downloaded from http//ts.nist.gov/ts/htdocs/210/216/iso9000.htm. For more information, contact Michael E. Squires, (301) 975-4039; michael.squires@nist.gov.
Media Contact: Mark Bello (301) 975-3776; mark.bello@nist.gov.

VIDEO SHOWS SMALL BUSINESSES ARE BIG ON BALDRIGE

Small businesses are responsible for 51 % of the U.S. gross national product, employ 52 % of workers, represent 96 % of all U.S. exporters, and provide almost 75 % of America's net new jobs. Keeping this segment strong and competitive is key to the U.S. economy. Many small businesses have found that the Baldrige performance excellence criteria and the competition process for the Baldrige Award are a great way to improve performance and the bottom line.

A new 16 minute video, "Take the Journey! A Baldrige Invitation to American Small Business," includes interviews with top executives of several of the 10 small business Baldrige Award winners explaining why the Baldrige program leads to the kind of improvements that translate into bottom-line success.

Two examples of what the small business CEOs have to say:

"The Baldrige based criteria is a very practical process that I think applies to all business, large and small. It's about doing things that make a lot of good common sense," says Jerry Rose, president of Sunny Fresh Foods, a 1999 winner.

And Bruce Woolpert, president and CEO of Granite Rock Co., a 1992 winner, says, "There is no better assessment of your organization's performance available than applying for the Award."

The video (in either VHS or CD formats), the Baldrige performance excellence criteria and other material are available free of charge by calling (301) 975-2036 or sending e-mail to nqp@nist.gov.

Media Contact: Jan Kosko (301) 975-2767; janice.kosko@nist.gov.

FOUR U.S. FIRMS RECOGNIZED FOR QUALITY AND BUSINESS EXCELLENCE

Two manufacturers, one service company and one small business have been named the recipients of the 2000 Malcolm Baldrige National Quality Award. The companies (and Baldrige category) are Dana Corporation-Spicer Driveshaft Division, Toledo, Ohio (manufacturing); KARLEE Company Inc., Garland, Texas (manufacturing); Operations Management International Inc., Greenwood Village, Colo. (service); and Los Alamos National Bank, Los Alamos, N.M. (small business). No awards were given in the education and health care categories.

This is the first time that a water treatment company and a bank have been honored. The two manufacturing recipients, Spicer Driveshaft and KARLEE, make driveshafts and precision sheet metal/machined components, respectively.

The award was established by Congress in 1987 to enhance the competitiveness of U.S. businesses by promoting quality awareness, recognizing quality and performance achievements of U.S. organizations, and publicizing successful performance strategies. The award is not given for specific products or services. Since 1988, 41 companies have received the Baldrige Award.

Baldrige Awards may be given in manufacturing, service, small business, education and health care. The companies are expected to receive their Baldrige Awards at a ceremony in Washington, DC, later this year.

Go to the NIST web site at www.nist.gov and click on "News," or call (301) 975-2762, for details on the 2000 Baldrige Award and the recipient companies. Further information on the Baldrige National Quality Program is available at www.quality.nist.gov or by calling (301) 975-2036.

Media Contact: Jan Kosko (301) 975-2767; janice.kosko@nist.gov

TRC: DÉJÀ VU ALL OVER AGAIN

In 1942, NIST established a Thermodynamics Research Center (TRC) to provide thermophysical data as background for the development of new refinery technologies. In 1955, the center moved to the Carnegie Institute of Technology in Pittsburgh and then, in 1961, migrated to Texas A&M University in College Station, TX. Now, 58 years after its founding, the center has come "home" to NIST, in Boulder, CO.

The center, which still provides data for the oil industry, now offers much more. Its hard-copy outputs include two series of tables on hydrocarbons and non-hydrocarbons, six categories of spectral data and a series of reference books. It also provides more than a dozen commercial databases of thermophysical properties, including a Source Database and a Table Database. TRC produces customized data evaluation reports covering certain compounds and properties, along with providing industrial consortia with unlimited access to all TRC products (including those on the Internet).

Looking to the future, TRC hopes to establish a very fast method of compiling data. Presently, critical data evaluation can take 2 to 3 years to complete, by which time the data can be out-dated. Dynamic compilation of data is based on a very efficient data entry operation and allows the user to produce critical data compilation "to order." TRC also hopes to establish an exchange with 20 world data centers, electronically expediting the delivery of data from producers to users.

For more information, contact TRC Director Michael Frenkel, NIST, MC 838, Boulder, CO 80305-3328; (303) 497-3952; michael.frenkel@nist.gov.

Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

GOVERNMENT TEAM ADDRESSES NATION'S AGING WIRE SYSTEMS

Modern life is virtually unimaginable without electricity and the wire systems that carry and distribute it. Electric wiring is critical to the operation of virtually all homes, workplaces and modes of transportation. Poor design, use of defective materials, improper installation or other problems with wiring can lead to catastrophe.

Risks increase as wire systems age due to the cumulative effects of environmental stresses (such as heat, cold, moisture or vibration), inadvertent damage during maintenance and the "wear and tear" of constant use.

For the past 3 months, wire safety experts from 17 different federal agencies, including NIST, analyzed government science and technology initiatives concerned with the issue of aging wiring. Known as the Wire Safety Interagency Working Group, the team is a subgroup of the National Science and Technology Council's Committee on Technology. On Nov. 15, 2000, the working group submitted a report to President Clinton that assesses wire safety issues in the nation, describes the current practices of federal agencies in managing the aging of wiring, outlines specific science and technology initiatives aimed at aging wiring, and recommends strategies for improving wire system safety.

The report's recommendations include a national change in the perception of wiring (an end to treating wiring as a "fit and forget" commodity); increased data collection and sharing between industry, academia and the government; the creation of standardized tools that detect conditions leading to system failures; the development of rapid, reliable repair processes and methods of automated replacement of wire systems; increased training in the installation, inspection and maintenance of wire systems; and the development of advanced wire technologies and materials (such as wireless, microelectronic, multiplexing and fiber-optic systems).

The report, *Review of Federal Programs for Wire System Safety,* is available at http://ostp.gov/NSTC/html/nstc_pubs.html.

Media Contact: John Blair (301) 975-4261; john.blair@nist.gov

NEW "RECOGNITION ARRANGEMENT" COULD LOWER EXPORT BARRIERS

World trade could begin shedding some red tape on Jan. 31, 2001—the starting date for a recently signed "mutual recognition arrangement" among accreditation bodies in 28 economies.

Under the arrangement, NIST's National Voluntary Laboratory Accreditation Program (NVLAP) and 36 counterpart organizations in North America, Europe, Asia, Africa and South America agree to use the same international standards and guides when accrediting testing and calibration laboratories. If a laboratory is judged to be competent by any one of the signatories, then test results issued by the accredited laboratory will be accepted by all. This mutual recognition is intended to reduce the amount of duplicative testing that many businesses now encounter when selling products and services in various foreign markets.

The arrangement comes under the umbrella of the International Laboratory Accreditation Cooperation (ILAC). Headquartered in Australia, the 23 year old organization is devoted to harmonizing laboratory accreditation procedures and to boosting industry, consumer and government confidence in laboratory testing and calibrations.

More than 750 laboratories are accredited by NVLAP in 18 major fields, including computer security, electronics testing, ionizing radiation dosimetry, and time and frequency measurements. Goods or services tested by any one of these laboratories should be accepted more readily by authorities in economies represented by the signers of the ILAC arrangement.

Besides NVLAP, two other U.S.-based accreditation bodies—the American Association for Laboratory Accreditation and the ICBO Evaluation Service—signed the arrangement.

For more information on NVLAP and the ILAC Mutual Recognition Arrangement, contact Jeffrey Horlick, (301) 975-4016, jeffrey.horlick@nist.gov, or visit the NVLAP web site at http//ts.nist.gov/nvlap. A downloadable copy of the ILAC MRA is available on the ILAC web site at www.ilac.org/downloads/ilacmra.pdf.

Media Contact: Mark Bello (301) 975-3776; mark.bello@nist.gov.

FOURTH REVISION OF BODY ARMOR STANDARD ISSUED

Ballistic-resistant armor (more commonly, but incorrectly called bulletproof vests) has saved the lives of more than 2500 law enforcement officers since 1975. That year, the first bullet-resistant soft body armor meeting new national standards—developed 3 years earlier for the National Institute of Justice (NIJ) by the National Institute of Standards and Technology's Office of Law Enforcement Standards (OLES)—was issued to 5000 officers in 15 major cities.

OLES recently marked a significant milestone in this story when it completed the fourth revision of the performance standard for the ballistic resistance of personal body armor. The revised standard updates the test methods for measuring ballistic resistance and improves test consistency. A formal compliance test program, sponsored by NIJ, is under way so that body armor can be certified to the revised standard.

The NIJ has published the revision as NIJ Standard-0101.04.

For technical information, contact Kirk Rice, (301) 975-8071, kirk.rice@nist.gov. For a copy of NIJ Standard-0101.04, go to www.ojp.usdoj.gov/nij/pubs-sum/183651.htm on the World Wide Web.

Media Contact: Philip Bulman (301) 975-5661; philip.bulman@nist.gov.

Standard Reference Materials

SRM 2071B, SINUSOIDAL ROUGHNESS STANDARD, RELEASED FOR DISTRIBUTION

NIST completed the measurements, certification, and final packaging of Standard Reference Material (SRM) 2071b, the sinusoidal roughness block. The units are now available from the Standard Reference Materials Program. SRM 2071b has a calibrated roughness height of 0.3137 μm ± 0.0083 μm and calibrated pitch of 99.99 μm ± 0.16 μm ($k = 2$). The SRM was calibrated by a stylus profiling instrument integrated with a laser interferometer, a system previously reported in an article published in *Precision Engineering*. SRM 2071b is a replacement for SRM2071and SRM2071a, which have been sold out. Twenty-three units of SRM 2071b were released for distribution. This SRM is needed by industry for calibrations of roughness measurements performed in the automobile, aerospace, and other mechanical parts industries. It is one of a set of five SRMs having different roughness wavelengths and roughness heights. The new SRM carries the smoothest sinusoidal profile of the set. In addition, it has a considerably more perfect sinusoidal profile than those previous two generations of SRM 2071 and SRM 2071a.
CONTACT: Theodore Vorburger, (301) 975-3493; theodore.vorburger@nist.gov or Nancy Trahey, (301) 975-2021; nancy.trahey@nist.gov.

NIST DEVELOPS LOW-LEVEL RADIONUCLIDE SEAWEED: SRM 4356

In collaboration with the International Committee on Radionuclide Metrology (ICRM), NIST is leading an international group of experienced laboratories in the development of a unique seaweed standard reference material for low-level radionuclides in seaweed specimens. Seaweed is one of the most important oceanic biological sinks for a number of long-lived radionuclides, and accurate determination of the radionuclides in seaweed specimens is essential for improving geokinetics modeling and assessing the spread of radionuclide waste repository contamination. However, lack of a seaweed standard for method validation and quality control in analytical measurements limits the reliability of the current analytical results and the data comparability among national and international laboratories. An interlaboratory comparison among experienced radioecology metrology laboratories will determine the massic activities of ^{90}Sr, ^{226}Ra, ^{230}Th, ^{232}Th, ^{234}U, ^{238}U, ^{238}Pu, $^{(239+240)}$Pu, and $^{(243+244)}$Cm using a variety of radiochemical procedures and detection methods. Statistical techniques, including analysis of variance, data distribution fitting, and bootstrap analysis, will be used for the evaluation of the analytical results.
CONTACT: Ciara McMahon, (301) 975-4336; ciara.mcmahon@nist.gov or Kenneth G.W. Inn, (301) 975-5541; kenneth.inn@nist.gov.

Standard Reference Data

DATABASE COMPLETED ON HEAT TRANSMISSION PROPERTIES OF THERMAL INSULATION AND BUILDING MATERIALS

NIST has just completed NIST Standard Reference Database 81 on Heat Transmission Properties of Insulating and Building Materials (Web Version 1.0). The database is a collection of thermal conductivity data produced by NIST from 1932 to 1983 using the NIST 200 mm guarded-hot-plate apparatus. During its service, the apparatus was the U.S. national standard for thermal conductivity measurements of insulating and building materials. The database contains 2175 records of thermal conductivity data for a variety of thermal insulation materials such as cellular plastics, corkboard, glass fiber, among others, as well as building materials such as fiberboard and lightweights concrete.

The proper design of heating, refrigeration, and air-conditioning equipment for buildings and industrial applications depends, in part, on accurate computation of heat transmission through the components of the building envelope. Accurate heat transmission computations, in turn, require reliable values for heat transmission properties. For several decades, tabulated values of heat transmission properties of insulating and building materials such as those found in the *ASHRAE Fundamentals Handbook* have provided typical values for the heat transmission properties of common insulating and building materials. The NIST database is intended primarily as an authoritative reference for tabulated handbook data for the heat transmission properties of insulating and building materials.
CONTACT: Robert R. Zarr, (301) 975-6436; robert.zarr@nist.gov or Geraldine Dalton, (301) 975-2214; geraldine.dalton@nist.gov.

AT $31.00 A YEAR, CAN YOU AFFORD NOT TO KNOW WHAT'S GOING ON AT THE NATION'S MEASUREMENT SCIENCE LABORATORY?

The *Journal of Research* Brings You Up-to-Date Scientific Articles and Information on:

- Measurement Science and Technology
- Calibration Services
- Standard Reference Materials
- Cooperative Research Opportunities and Grants
- Conference Reports

AND MUCH MORE!

It's All At Your Fingertips In the ***Journal of Research of the*** **NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY**

SUBSCRIBE TODAY !

Journal of Research of the
National Institute of Standards and Technology

Superintendent of Documents **Subscription** Order Form

☐ **YES,** send me ___ subscriptions to the **JOURNAL OF RESEARCH OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY** at $31 per subscription (6 times a year) so I can stay up to date on the latest developments in measurement science and technology.

Order Processing Code
6596

1. Please Type or Print

(Company or personal name)

(Additional address/attention line)

(Street address)

(City, State, ZIP Code)

( )
(Daytime phone including area code)

May we make your name/address available to other mailers? **YES** ☐ **NO** ☐

2. The total cost of my order is $_____ . All prices include domestic postage and handling. International customers please add 25 percent.

3. Please Choose Method of Payment:

☐ Check payable to the Superintendent of Documents

☐ GPO Deposit Account ☐☐☐☐☐☐☐–☐

☐ VISA ☐ MasterCard ☐ Discover/NOVUS

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

_____ *Thank you for your order!*
(Credit Card Expiration Date)

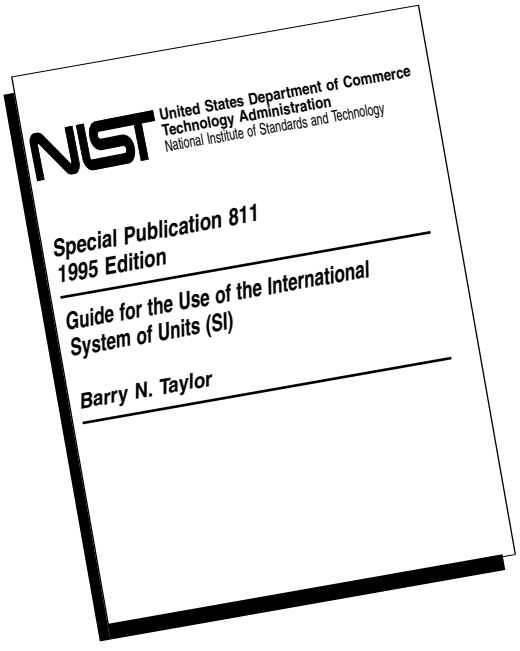
_____
(Purchase Order No.)

_____
(Signature) (10-99)

4. MAIL TO: New Orders, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250–7954.

The International System of Units (SI)

The Modern Metric System



Uncertain about the International System of Units (universally abbreviated SI), the modern metric system used throughout the world? Do you need to know the proper way to express the results of measurements and the values of quantities in units of the SI? Do you need to know the NIST policy on the use of the SI? Then you need the 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*.

The 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*, by Barry N. Taylor, is now available.

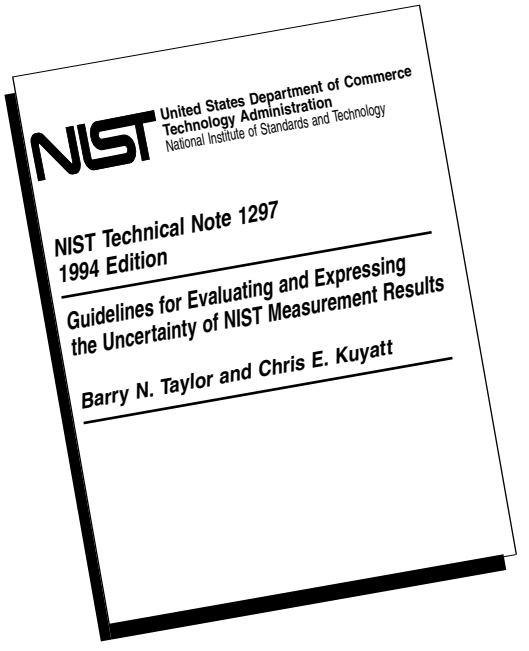
The 1995 edition of SP 811 corrects a number of misprints in the 1991 edition, incorporates a significant amount of additional material intended to answer frequently asked questions concerning the SI and SI usage, and updates the bibliography. The added material includes a check list for reviewing the consistency of written documents with the SI. Some changes in format have also been made in an attempt to improve the ease of use of SP 811.

The topics covered by SP 811 include:

- NIST policy on the use of the SI in NIST publications.
- Classes of SI units, those SI derived units that have special names and symbols, and the SI prefixes that are used to form decimal multiples and submultiples of SI units.
- Those units outside the SI that may be used with the SI and those that may not.
- Rules and style conventions for printing and using quantity symbols, unit symbols, and prefix symbols, and for spelling unit names.
- Rules and style conventions for expressing the results of measurements and the values of quantities.
- Definitions of the SI base units.
- Conversion factors for converting values of quantities expressed in units that are mainly unacceptable for use with the SI to values expressed mainly in units of the SI.
- Rounding numbers and rounding converted numerical values of quantities.

Single copies of the 84-page SP 811 may be obtained from the NIST Calibration Program, 100 Bureau Dr., Building 820, Room 236, Stop 2330, Gaithersburg, MD 20899-2330, telephone: 301-975-2002, fax: 301-869-3548.

Evaluating and Expressing the Uncertainty of Measurement Results



Uncertain about expressing measurement uncertainty? Do you need to know how NIST states the uncertainty of its measurement results and how you can implement their internationally accepted method in your own laboratory? Then you need the newly available 1994 edition of the National Institute of Standards and Technology Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results.*

The 1994 edition of the National Institute of Standards and Technology Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, by Barry N. Taylor and Chris E. Kuyatt is now available.

The 1994 edition of TN 1297 includes a new appendix—Appendix D—which clarifies and gives additional guidance on a number of topics related to measurement uncertainty, including the use of certain terms such as accuracy and precision. Very minor word changes have also been made in a few portions of the text of the 1993 edition in order to recognize the official publication in October 1993 by the International Organization for Standardization (ISO) of the *Guide to the Expression of Uncertainty in Measurement* on which TN 1297 is based. However, the NIST policy on measurement uncertainty, Statements of Uncertainty Associated with Measurement Results, which is reproduced as Appendix C of TN 1297, is unchanged.

It is expected that the 1994 edition of TN 1297 will be even more useful than its immediate predecessor, the 1993 edition, of which 10 000 copies were distributed worldwide.

Those United States readers who wish to delve into the subject of measurement uncertainty in greater depth may purchase a copy of the 100-page ISO *Guide* from the Sales Department of the American National Standards Institute (ANSI), 105-111 South State Street, Hackensack, NJ 07601. Copies may also be purchased from the ISO Central Secretariat, 1 rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland.

Single copies of the 20-page TN 1297 may be obtained from the NIST Calibration Program, 100 Bureau Dr., Building 820, Room 236, Stop 2330, Gaithersburg, MD 20899-2330, telephone: 301-975-2002, fax: 301-869-3548.

NIST Technical Publications

Periodical

Journal of Research of the National Institute of Standards and Technology—Reports NIST research and development in those disciplines of the physical and engineering sciences in which the Institute is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Institute's technical and scientific programs. Issued six times a year.

Nonperiodicals

Monographs—Major contributions to the technical literature on various subjects related to the Institute's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NIST, NIST annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NIST under the authority of the National Standard Data Act (Public Law 90-396). NOTE: The Journal of Physical and Chemical Reference Data (JPCRD) is published bimonthly for NIST by the American Institute of Physics (AIP). Subscription orders and renewals are available from AIP, P.O. Box 503284, St. Louis, MO 63150-3284.

Building Science Series—Disseminates technical information developed at the Institute on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NIST under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NIST administers this program in support of the efforts of private-sector standardizing organizations.

Order the **following** *NIST publications—FIPS and NISTIRs—from the National Technical Information Service, Springfield, VA 22161.*

Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NIST pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NIST Interagency or Internal Reports (NISTIR)—The series includes interim or final reports on work performed by NIST for outside sponsors (both government and nongovernment). In general, initial distribution is handled by the sponsor; public distribution is handled by sales through the National Technical Information Service, Springfield, VA 22161, in hard copy, electronic media, or microfiche form. NISTIR's may also report results of NIST projects of transitory or limited interest, including those that will be published subsequently in more comprehensive form.

U.S. Department of Commerce
National Institute of Standards & Technology
Gaithersburg, MD 20899-0001