

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.

STANDARD FIRE SERVICE INTERFACE AND INCIDENT MANAGEMENT INFORMATION SYSTEM DEMONSTRATED

On April 3, NIST demonstrated the use of a new technology for fire alarm panels in an actual fire incident with the help of the NIST Fire Department. A multi-room test structure was constructed inside the Large Fire Laboratory for a series of full-scale fire experiments. The prototype alarm panel displayed multi-layer web pages viewable by ordinary web browsers which displayed sensor measurements, on-site video, and processed information such as the heat release rate. Text portions of the web pages were accessible by handheld, wireless devices.

Following ignition, fire detectors provided real time data that was verified against physical criteria to assure that the alarm was from an actual fire. The same information was transmitted to a laptop computer fitted with a wireless modem card to enable responding personnel to view and query the system for real time information so they could begin to formulate tactics in route. As the suppression team entered the structure, their position in the structure was monitored and displayed continuously.

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EFFECT OF POSTAL IRRADIATION ON DNA FORENSICS

NIST has demonstrated that the high doses of radiation used on postal mail to kill anthrax (and other pathogens) does not interfere with standard DNA profiling tests

that might be used to gather forensic evidence from letter pieces.

NIST high-dose ionizing radiation sources were used to treat envelopes under conditions approximating industrial processing. These envelopes were analyzed at NIST using standardized human DNA tests. Full DNA profiles were obtained from irradiated test envelopes using the FBI's primary DNA test. No procedural modifications were necessary; the standard DNA extraction procedures worked fine for obtaining DNA from envelopes, whether or not they have been irradiated.

This study removes the potential doubt about the continued validity of DNA testing, necessary information for federal and state law enforcement agencies and prosecutors.

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NIST AIRFLOW MODEL FEATURED IN INDUSTRY SMOKE CONTROL GUIDANCE

CONTAM, the airflow and contaminant transport model developed by NIST for airborne movement in buildings, has now been noted as the tool of choice for designing and analyzing smoke management systems. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) smoke control design manual, originally published in 1983, has just been reissued. This third edition contains an extensive description of the CONTAM model and its application to the design and analysis of pressurization smoke control systems. In this application, one can simulate the performance of elevator shaft, stairwell, and stairwell vestibule pressurization systems, as well as systems that exhaust from the fire zone. Having CONTAM featured in this document will facilitate greatly the design of smoke control systems that perform as intended and will allow the analysis of systems of greater complexity than can be analyzed with any other available tool.

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**NIST RESEARCHERS CHARACTERIZE
HIGH-SPEED PHOTORECEIVER TO 110 GHz**

NIST researchers have demonstrated that they can accurately characterize the modulation response (magnitude and phase) of a commercially available photoreceiver to frequencies as high as 110 GHz, nearly three times the bit rate of emerging 40 Gb/s optical communication systems. Measurement of the modulation response of a receiver over a frequency range much larger than its bandwidth is necessary for accurately modeling its response in the time-domain, providing critical information for digital communications systems.

NIST researchers have developed an electro-optic sampling system to sample high-speed electrical waveforms on a coplanar waveguide with ultrashort laser pulses via the electro-optic effect. Standard microwave techniques are used to calibrate the response of a photoreceiver at its 1 mm electrical port, which is physically removed from the sampling plane. The frequency range of the calibration is limited only by the 1 mm coaxial connectors. The characterized photoreceiver had a bandwidth of about 80 GHz; the signal to noise ratio of the measurement was greater than 150:1 at 110 GHz. A summary of the work has been submitted to the annual meeting of the IEEE Lasers and Electro-Optics Society.

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**NIST UNCOVERS CLUE TO SUCCESSFUL
MANIPULATION OF PAIRED ELECTRONS**

Nanoscale devices that manipulate single electrons of charge e with metrological accuracy are being used at NIST to develop new fundamental electrical standards, such as a capacitance standard based on counting electrons. The superconducting analogs of these devices, in which electrons are bound in “Cooper pairs” of charge $2e$, are attractive for two reasons. First, the coherent transfer of Cooper pairs is expected to be much faster than the incoherent transfer of unpaired electrons, providing much larger currents with metrological accuracy. Second, several schemes for quantum computation, in which information is processed using the unique properties of quantum bits or “qubits,” rely on the precise manipulation of Cooper pairs. Past attempts at manipulation of single Cooper pairs for both metrology and quantum computation have been hampered by the existence of a small number of residual unpaired electrons in the superconducting state. Furthermore, the conditions needed to avoid these unpaired electrons in a given device were not clearly

understood because different research groups have reported conflicting results on this question.

Researchers at NIST uncovered an important clue to this mystery by showing that a previously unappreciated factor has a strong effect on the amount of unpaired electrons in Cooper pair devices. Each device consists of two layers of aluminum, and the strength of the pairing of electrons in each layer can be different. This slight difference has generally been thought to be unimportant. However, a study of more than a dozen devices in which this difference was varied in a controlled way, and independently measured in each device, shows that it directly affects device performance. In every device made the right way, unpaired electrons were very rare, allowing manipulation of single Cooper pairs over long time scales and over a wide range of temperature. In all devices made the wrong way, unpaired electrons dominated the device operation and the desired manipulation of single Cooper pairs was not possible. These results, which may also explain previous reports that seemed to be contradictory, point the way to a robust recipe for devices that can realize the promise of superconducting charge transfer for both metrology and quantum computation.

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**PROPERTIES AND APPLICATIONS OF
CARBON NANOTUBES EXPLORED**

Researchers at NIST are using carbon nanotubes for a variety of new experiments. Carbon nanotubes recently were discovered in the byproducts of carbon fullerene (Bucky balls) production. Nanotubes can range from a few to hundreds of nanometers in diameter and a few to tens of micrometers in length. The tubes are showing promise in a number of new areas. These include molecular electronics where the nanotubes are used as both wiring and, with modification of the nanotube itself, electronic devices. The NIST researchers are exploring the connection of nanotubes to surfaces to test the strength and electrical properties of various attachment methods. Electron beam carbon deposition (EBD) was used to attach a carbon nanotube to a tungsten force probe and to an atomic force microscope (AFM) tip. By pulling the force probe away from the AFM tip, the EBD bond survived a few micronewtons, which is a large force on a nanotube scale. Work in progress exploits the electrical properties of nanotubes for sub-micron electrical conduction mapping using nanotubes mounted on AFM tips. The nanotubes are used as very small thin wires that can be scanned across a sample and are much more durable than commonly

used metal coated AFM tips. The nanotube AFM tips also are being used to explore biological samples; since they are long and thin, they can access areas normal AFM tips cannot.

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MOLECULAR SPECTRA DATABASES NOW AVAILABLE ONLINE

NIST has made available on the Web three linked databases of the microwave and RF spectra of diatomic, triatomic, and hydrocarbon molecules. Originally published as spectral tables in the *Journal of Physical and Chemical Reference Data*, the online version includes additional molecules and allows advanced browsing and searching of the data by molecular species, type, or frequency.

Rotational spectral lines for 121 diatomic molecules, 55 triatomic molecules, and 91 hydrocarbon molecules are included. The isotopic molecular species, assigned quantum numbers, observed frequency, estimated measurement uncertainty, and reference are given for each transition. The spectral lines for many molecules and normal isotopic species have been refit to produce a comprehensive and consistent analysis of all the data obtained from many sources. The derived molecular properties, such as rotational and centrifugal distortion constants, hyperfine structure constants, electric dipole moments, rotational g -factors and internuclear distances (for diatomic molecules) are listed with one standard deviation uncertainties for all species.

The Diatomic, Triatomic, and Hydrocarbon Spectra Databases can be accessed on the Web at <http://physics.nist.gov/MWtables>. Further information on additional molecular spectroscopic databases developed by ECSED is available at <http://physics.nist.gov/data>. Development of these databases was supported in part by the Standard Reference Data Program (SRDP) and by NIST's Systems Integration for Manufacturing Applications (SIMA) Program.

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INTERNATIONAL SEARCH AND RESCUE ROBOTS COMPETE IN NIST-DESIGNED REFERENCE TEST ARENAS

The RoboCupRescue League hosted its first annual competition in Fukuoka, Japan, June 20-23, 2002, using Japanese versions of NIST's "Reference Test Arenas

for Autonomous Mobile Robots" that they built and installed at Fukuoka Dome Stadium. This robotic urban search and rescue competition augments RoboCup's leagues of autonomous soccer playing robot teams (small size, mid-size, four-legged, humanoid, and simulation leagues), which have evolved considerably over the past 6 years of competition. The goal of the RoboCupRescue competition, and others using the NIST arena design, is to provide a proving ground for fieldable robots such as those used at the World Trade Center collapse. A NIST researcher is a co-chairman of the RoboCup Rescue League Organizing Committee.

The overall RoboCup-2002 event (<http://www.robocup2002.org/>) attracted 188 robot teams (over 1000 researchers) from 29 countries, cheered on by 117 000 spectators over 5 days of competition. Ten teams (over 40 researchers) participated in the RoboCupRescue competition from countries such as Japan, Iran, Germany, New Zealand, and the United States. Several different robot implementations competed, including tracked vehicles, wheeled vehicles, and a small blimp. The performance metric used for scoring encourages multiple robot teams, minimal operators and generation of practical maps showing the location of simulated victims throughout the arenas. Two teams from Iran and Japan scored above the minimum threshold required to earn an award, with the Iranian team taking the top honors.

The Japanese versions of NIST's arenas will reside year-round at the National Museum of Emerging Science and Technology in Tokyo. They follow the NIST design, with changes to materials and furnishings to be representative of those typically found in Japanese buildings. Next year's RoboCupRescue competition will be held in Padova, Italy, and discussions are under way to fabricate Italian versions of the arenas for year-round use. Additional arenas are being discussed for Japan, Germany, Portugal, and the United States. Proliferation of these arenas around the world supports research in this critical domain by providing venues for practice, objective evaluation, direct comparison of performance, and international collaboration among robot researchers. It also helps raise awareness of the challenges involved in robotic search and rescue applications and encourages new researchers to enter the field. Funding support for development of the arenas has been provided by the Defense Advanced Research Projects Agency (DARPA).

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NIST WORKS WITH SMALL BUSINESSES TO PROTECT INFORMATION ASSETS

On July 11, 2002, NIST in co-sponsorship with the U.S. Small Business Administration and the National Infrastructure Protection Center, delivered the first of three workshops planned for this quarter focused on small business information security. The purpose of the series of workshops and the partnership is to promote information security awareness within the small business community. The workshop is designed to teach the fundamentals of information security, to help small businesses understand common threats, and to give them practical tools and techniques that a small business owner can use. Covering topics such as security policies, risk mitigation, and cost benefits analysis, the workshop delivers training on the knowledge and tools necessary for a small business owner to mitigate security risks in cost-effective ways that support the business mission.

Small businesses are a vital part of the U.S. economy. As such, protecting their information and guarding their entry points to the Internet are critical. Cyber-security guidance documents created by NIST are currently used in public and private sectors around the world. Through this partnership, NIST is making a concerted effort to get that guidance into the hands of U.S. small business owners.

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ARMY CORPS OF ENGINEERS HONORS NIST PARTICIPANTS IN THE PENTAGON REBUILDING EFFORT

Following the terrorist incidents of Sept. 11, 2001, the Army Corps of Engineers organized a group to advise the Pentagon renovation construction effort to ensure that best practices were followed during rehabilitation of the Pentagon in order to mitigate such attacks in the future. The team included a wide range of expertise in safety, security, and construction, including including NIST staff members. They have been recognized by the Corps in a special citation that reads, in part:

“The cross disciplinary team, including John Gross, Walter Jones and Long Phan of NIST is officially commended for valuable contributions as members of the Pentagon Rebuild Retrofit Program Study in the aftermath of the September 2001 terrorist attack. This study was conducted in support of the Headquarters, U.S. Army Corps of Engineer, and team members came from several Army laboratories as well as other federal agencies and civilian institutions. This extremely high visibility study resulted in a number of options to

improve the efficiency or performance of protective measures for the Pentagon.”

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BUYERS GUIDE FEATURES NIST DATA PRODUCT

The lead article in the annual *Buyer's Guide of the American Institute of Physics* features five pages of values of the fundamental physical constants, such as the speed of light, the Newtonian constant of gravitation, the Planck constant, the fine-structure constant, and energy-unit conversion factors. The guide was distributed as a supplement to the August issue of *Physics Today*, a monthly publication with a circulation of about 123 000 worldwide. The numbers published in the tables were obtained from the 1998 CODATA least-squares adjustment of their values carried out in the Fundamental Constants Data Center at NIST in 1999. Other publications, such as the *CRC Handbook of Chemistry and Physics*, also quote the values obtained at NIST.

Values of the constants can be found on the Web site at <http://physics.nist.gov/constants>. This site averages well over 100 000 downloads per month from outside of NIST. The Fundamental Constants Data Center also distributes wallet card and page-sized tables of values of the constants. These may be obtained from NIST at (301) 975-NIST (6478).

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FAULT DETECTION AND DIAGNOSTIC TOOLS

NIST has developed two fault detection and diagnostic tools to assist operators in monitoring the performance of Heating, Ventilating, and Air Conditioning systems: Air Handling Unit Performance Assessment Rules (APAR) and Variable Air Volume (VAV) Box Performance Assessment Control Charts (VPACC).

APAR uses a set of expert rules to detect common mechanical faults or control problems in air-handling units. VPACC uses statistical quality control measures to detect faults or control problems in VAV boxes.

Both tools were tested using the NIST Virtual Cybernetic Building Testbed, now equipped with fault models, and found to be successful at detecting and diagnosing a wide variety of faults. Both tools appear to be suitable for embedding in commercial control products.

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INTERNATIONAL COMPARISON OF GUARDED HOT PLATE LABORATORIES

NIST has published Technical Note 1444, *International Comparison of Guarded Hot Plate Apparatus Using National and Regional Reference Materials*, culminating a 5 year effort to compare measurement results from five national metrology laboratories on four national and regional thermal insulation reference materials. The technical note presents thermal conductivity data from JTCCM, LNE, NPL, NRC Canada, and NIST for thermal insulation standard reference materials 1451 and 1453, IRMM 440, and a candidate reference material from Japan. The major finding of the comparison is that there are laboratory-to-laboratory differences for three of the four materials, and that these differences change from material to material. The report provides several recommendations for improving ASTM and ISO standard test methods for guarded hot plate apparatus. CONTACT: Robert Zarr, (301) 975-6436; robert.zarr@nist.gov.

NIST PUBLISHES ONLINE e-HANDBOOK OF STATISTICAL METHODS

NIST teamed up with International SEMATECH and a consortium of worldwide major semiconductor companies to produce the *NIST/Sematech e-Handbook of Statistical Methods*. The e-handbook expands and updates Handbook 91, *Experimental Statistics*, originally published by NIST in 1963. Engineers and scientists worldwide have relied on the printed version for nearly four decades. The e-handbook will also be available on CD later this year and is now available at <http://www.nist.gov/stat.handbook>.

The e-handbook provides a comprehensive overview of statistical methods, including experiment design, data analysis, and quality control, and is tailored to the needs of engineers and scientists for rapid understanding and quick solution of statistical problems. The approach is problem-oriented and includes detailed case studies from the semiconductor industry and NIST laboratories to illustrate statistical approaches to solving engineering and scientific problems.

A demonstration of the e-handbook was featured as part of the Quality and Productivity Research Conference, hosted by International SEMATECH in Austin, Texas. Thousands of scientists and engineers from industry, academia, and government have used a beta-test version of the Web site and have contributed valuable suggestions that have been implemented. Already, users in more than 24 foreign countries, multiple federal agencies, universities, and industries have praised the e-handbook for coverage of statistical

topics, relevance of the case studies, and for the ease of application of statistical methodology.

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NIST RESEARCHERS COMPLETE UNCERTAINTY ANALYSIS FOR LINKING ECCS TO SI Farad

NIST researchers have completed an uncertainty analysis for the comparison of a cryogenic vacuum-gap capacitor against the NIST calculable capacitor. This work is a critical step in the development of the Electron-Counting Capacitance Standard (ECCS).

The essential idea of the ECCS is to place an accurately known electric charge, by counting individually each of about 10^8 electrons, onto the plate of a cryogenic vacuum-gap capacitor and then to measure the charging voltage with high accuracy. The capacitance of the device is determined directly from the charge-to-voltage ratio. Three valuable uses have been identified for the ECCS. It will serve as a “turnkey” primary representation for capacitance, provide an additional route for the measurement of the fine-structure constant and provide a means to close the “quantum metrology triangle” formed by the Josephson voltage, the quantum Hall resistance, and the fundamental electron charge.

A recently reported advance for the capacitor was to increase its capacitance to a value of approximately 10 pF (within a few percent), thus allowing a direct comparison of the vacuum-gap capacitor to the NIST calculable capacitor using existing high-precision instrumentation. The calculable capacitor is a large mechanical capacitor which, through a fundamental theorem of electrostatics, provides the SI realization of the Farad. The comparison of the two capacitors is crucial for the ECCS, both for demonstrating its usefulness as a representation of capacitance, and for determination of the fine-structure constant or closure of the quantum metrology triangle.

The advance noted here is the completion of the detailed uncertainty analysis of this comparison, including statistical and systematic uncertainties. This analysis shows that the total relative uncertainty of the comparison is about 4×10^{-8} . This compares favorably with the total relative uncertainty of 4×10^{-8} , which is achieved for the highly optimized comparisons against the calculable capacitor that are performed as part of the regular maintenance of NIST’s primary bank of capacitance standards. Indeed, this measurement of the

cryogenic capacitor was designed to utilize, as closely as feasible, the same instrumentation and measurement procedures as those routinely used for measurements of the room-temperature transfer standard. The close similarity both simplified this uncertainty analysis and contributed to the ultimate quality of the result. Future improvements in the measurement system could reduce the uncertainty to a value even closer to that for the highly optimized measurements.

With the completion of the uncertainty analysis, the new 10 pF cryogenic capacitor is now fully ready to be used in the ECCS, with a route to tie the ECCS to the SI unit of capacitance with an uncertainty of about 4×10^{-8} .

A paper describing this work has been submitted for publication in the *IEEE Transactions on Instrumentation and Measurement*.

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2002 UPDATE OF MASS SPECTRAL LIBRARY RELEASED

A major update to the NIST Mass Spectral Library was released in July. Four years of painstaking work has led to significant enhancements in the coverage and quality of this widely used reference collection. Originating from a number of laboratories, including measurements at NIST for compounds of special importance, over 45 000 high quality reference mass spectra have been added, increasing the number of spectra from 129 138 to 174 948. This has led to an increase in numbers of compounds represented from 108 886 to 147 370, an expansion of more than one-third. Spectra for thousands of compounds have been replaced by higher quality versions, and over 6500 high quality replicate spectra were added. These replacements, along with the policy of adding only complete spectra, have led to an increase in the average number of peaks per spectrum from 96 to 111, and a decline in percentage of spectra having fewer than 10 peaks from 4 % to 0.5 %.

The NIST team of evaluators also has made significant improvements in the representation of the chemical substances in the library. A manual, compound-by-compound examination of chemical names and structures was completed, leading to consistent chemical representation throughout the database. Compounds not fully identified by their chemical structure were removed from the collection, ambiguous representations were eliminated, and thousands of chemical names originating from the laboratory that provided the spectrum were replaced by clearer, more systematic names. In addition, in cooperation with the Chemical Abstracts Service (CAS), all CAS registry

numbers were verified by matching against chemical structures, thereby eliminating many inconsistencies and leading to the addition of 35 000 registry numbers. Using a structure-to-name program, tens of thousands of IUPAC-consistent chemical names have been added as synonyms.

Within the next 6 months, we expect that virtually all of the approximately twenty active distributors will provide this update to new and current library customers. Considering the fact that approximately 3 000 new versions of the library are installed on mass spectrometer data systems each year, and at least 30 000 copies of earlier versions have been installed over the years, we anticipate that this effort will have an even more substantial impact.

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PRODUCTION COMPLETE FOR NEW PROTEIN DATA BANK CD-ROM SETS

NIST has completed production of a new Protein Data Bank (PDB) CD-ROM set of the macromolecular structures of proteins and nucleic acids and the corresponding experimental data. This set, Issue 101, contains 18 528 structures in gzip format and requires 9 CD-ROMs per set.

The customer base is 463 domestic and 926 foreign subscribers, with about 120 additional requests for each release. The number of structures increases by about 70 per week, so each quarterly release contains about 800 more structures than the previous. The number of subscribers also increases with each quarterly release of the PDB CD-ROM set.

The masters for this CD-ROM release were produced using a new web-based tool that adds flexibility to allow production of incremental sets of PDB holdings or separate CD-ROM products for structures and x-ray or NMR experimental data.

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POLARON GLASS IN COLOSSAL MAGNETORESISTIVE OXIDES RESEARCHED

The magnetic properties of the lanthanum manganese oxide class of materials have attracted tremendous interest recently because of the dramatic increase in conductivity these systems exhibit when the magnetic moments order ferromagnetically, either by lowering the temperature or applying a magnetic field. This huge increase in the carrier mobility, which has been given the name "colossal magnetoresistivity" (CMR), is both of scientific and technological interest. In particular, it

is anticipated that the half-metallic behavior these materials exhibit will provide fully spin-polarized electrons for use in spintronics applications, for sensors in a variety of applications such as in the automotive industry, and may also provide the next generation of read/write heads for the magnetic data storage industry.

The colossal magnetoresistivity originates from a magnetically driven insulator-metal transition, where the magnetic, electronic, and structural degrees of freedom are intimately intertwined. A research collaboration involving scientists from NIST, the University of Maryland, and Argonne National Laboratory, has recently used neutron scattering measurements to discover that the transition from the low temperature ferromagnetic-metallic state to the paramagnetic-insulator state is caused by the formation of combined structural/magnetic polarons, which have a size of about one nanometer. The formation of these nanoscale polarons truncates the ferromagnetic phase, and thus explains the first-order nature of the transition. These polarons form a well-defined thermodynamic glass phase above the ferromagnetic ordering temperature, which then melts into a polaron fluid at higher temperatures.

There is a strong similarity between these nanoscale polarons observed in the CMR materials, the polar nanoregions that cause the dramatic piezoelectric response of relaxor ferroelectrics, and the formation of stripes in the high temperature superconducting cuprates. Recent progress in our understanding of these intrinsic nanoscale structures has enabled a deeper understanding of the fundamental properties and shared concepts of these perovskite-based materials.

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NIST PUBLISHES GUIDANCE ON SECURING INTERCONNECTING IT SYSTEMS

NIST Special Publication 800-47, Security Guide for Interconnecting Information Technology Systems has recently been issued. The document provides guidance for planning, establishing, maintaining, and terminating interconnections between information technology (IT) systems that are owned and operated by different organizations. The guidance is consistent with the requirements specified in the Office of Management and Budget (OMB) Circular A-130, Appendix III, for system interconnection and information sharing.

A system interconnection is defined as the direct connection of two or more IT systems for the purpose of sharing data and other information resources. The document describes the benefits of interconnecting IT systems, defines the basic components of an inter-

connection, identifies methods and levels of interconnectivity, and discusses potential security risks. The document then presents a life-cycle approach for system interconnections, with an emphasis on security. The following four phases are addressed:

- Planning the interconnection: the organizations perform preliminary activities; examine technical, security, and administrative issues; and form an agreement governing the management, operation, and use of the interconnection.
- Establishing the interconnection: the organizations develop and execute a plan for establishing the interconnection, including implementing or configuring security controls.
- Maintaining the interconnection: the organizations maintain the interconnection after it is established to ensure that it operates properly and securely.
- Disconnecting the interconnection: one or both organizations may terminate the interconnection. The termination should be conducted in a planned manner to avoid disrupting the other party's system. In an emergency, however, one or both organizations may choose to terminate the interconnection immediately.

The new publication is available online at <http://csrc.nist.gov/publications/nistpubs/index.html>.

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NEW X-RAY WAVELENGTH REFERENCE TABLE TO BE PUBLISHED

In January 1967, an x-ray wavelength table was published in *Reviews of Modern Physics* by the late J. A. Bearden (The Johns Hopkins University). For the past 35 years, it has been a standard reference in the field, reprinted in a number of standard reference books. However, scientists engaged in precision x-ray wavelength measurements have recognized for the past 10 years that important experimental and theoretical developments have created the need for a modern revision.

NIST, in collaboration with theorists at the École Normale Supérieure et Université Pierre et Marie Curie (Paris) and Stockholm University, has developed a new, comprehensive x-ray wavelength reference table that has been accepted for publication in *Reviews of Modern Physics* (likely issue, January 2003). This is the culmination of a long-term NIST effort led by the late Richard Deslattes. The compilation contains K- and L-x-ray transition and absorption edge energies for all of the elements from neon to fermium and includes carefully selected and evaluated experimental data and

trusted estimates obtained from state-of-the-art theoretical procedures.

The new table makes use of the accurate linkage of x-ray wavelengths, optical wavelengths, and the SI definition of the meter made possible by combined x-ray and optical interferometry. It includes accurate measurements of specific x-ray reference lines, systematic studies of x-ray transitions and absorption edges, and other accurate x-ray wavelength measurements that have occurred since 1967. The table also reflects the continued development of physical theory that produces results in excellent agreement with high-quality experimental data. Theoretically predicted values of missing or poorly measured experimental data help to complete the reference. The new table also makes use of the most recent values of the fundamental physical constants.

In addition to print publication, the new x-ray wavelength table will soon be available on the NIST Physical Reference Data Web site at <http://physics.nist.gov/PhysRefData/contents.html>.

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between 360 nm and 780 nm. This standard will help ensure that the measured properties of the special-effect paints are independent of the instrument manufacturer or locale. The standard was produced using the NIST Spectral Tri-function Automated Reference Reflectometer (STARR) facility.

The appeal of these novel paints to consumers ensures that they will attract an increasingly larger fraction of the color pigment market, estimated to be about \$3.5 billion in 2005. The value that these coatings add to products is even greater, as yearly there is approximately \$700 billion worth of shipped goods for which overall appearance is critical to their sale.

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Standard Reference Materials

NIST ANNOUNCES STANDARD REFERENCE MATERIAL (SRM) 2017 FOR THE PAINT INDUSTRY

NIST has developed SRM 2017 to aid the many industries dependent on gonioapparent (special visual effect) paints and coatings to improve the appearance of their products. Examples of gonioapparent paints include the pearlescent and metal-flake coating found on automobiles, which change color or brightness with viewing and/or illumination angle. The successful use of these special-effect paints, particularly in automobile manufacturing, requires measurement of the optical reflectance of the coatings as a function of angle to ensure that the paint application is performed correctly, is reproducible between manufacturing plants, is constant over time, and can be replicated during a repair.

SRM 2017 is an opal-glass white reflectance standard that was developed in response to industry demands for multi-angle reflectance standards to calibrate bi-directional spectrometers used to measure the optical properties of gonioapparent paints. The reflectance of the opal-glass sample has been accurately measured for an illumination angle of 45° and viewing angles of 15°, 25°, 45°, 75°, and 110° at 10 nm wavelength increments

The International System of Units (SI)

The Definitive Reference on the Modern Metric System

NIST Special Publication 330, 2001 Edition



Do you need to know about the current form of the modern metric system, which is officially called the International System of Units (universally abbreviated SI)? Do you want to know the origin of the SI, how it was established, and how it has progressed to its present-day form? Then you need NIST Special Publication (SP) 330, 2001 Edition. This publication is the U.S. version of the English text of the seventh edition (the most current) of the definitive reference on the SI published in 1998 by the International Bureau of Weights and Measures (BIPM) under the title *Le Système International d'Unités (SI)*. However, the 2001 Edition of SP 330 also incorporates the contents of *Supplément 2000: additions et corrections à la 7^e édition (1998)* published by the BIPM in June 2000.

The main body of NIST SP 330 gives the essentials of the current form of the SI. However, Appendix 1 provides the Resolutions, Recommendations, and Declarations put forward on units of measurement and on the SI since 1889 by the General Conference on Weights and Measures (CGPM) and the International Committee for Weights and Measures (CIPM). Further, Appendix 2 summarizes the current state of the practical realizations of some important SI units, while Appendix 3 gives a brief description of the bodies established by the Meter Convention (the CGPM, CIPM, and BIPM), which was signed in Paris on 20 May 1875 by 17 States including the United States.

The 2001 Edition of SP 330 replaces its immediate predecessor, the 1991 Edition, which was based on the sixth edition of the BIPM SI publication. Like its predecessor, the 2001 Edition of SP 330 was edited by NIST physicist Barry N. Taylor.

Single copies of the 75-page NIST SP 330, 2001 Edition, may be obtained by contacting the NIST Metric Program, 100 Bureau Drive, Stop 2000, Gaithersburg, MD 20899-2000; telephone: 301-975-3690; fax: 301-948-1416; email: metric_prg@nist.gov. NIST SP 330 is also available online at the NIST Web site entitled "NIST Reference on Constants, Units, and Uncertainty," physics.nist.gov/cuu.

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