

News Briefs

General Developments

NSA AND NIST COMPUTER SECURITY PROJECT ANNOUNCED

The National Security Agency's (NSA) National Computer Security Center and NIST will jointly develop new criteria for evaluating the security of computer systems. Expected to last at least 2 years, this effort will lead to a new Federal Information Processing Standard, or FIPS, to specify computer security requirements for federal systems that process unclassified information. NIST and NSA will examine the applicability of the well-established U.S. Department of Defense Trusted Computer System Evaluation Criteria for the systems networking environment and will take into account the migration toward an open systems distributed environment. User and vendor experiences with existing trusted systems will be studied and will influence the direction of the new criteria. Also to be examined are various alternatives for evaluating products and determining their conformance to specified requirements.

COMPUTER SECURITY REVIEW REPORT ISSUED

A new report issued by NIST describes the computer security and privacy plan review effort conducted jointly by NIST and the National Security Agency's National Computer Security Center in response to the Computer Security Act of 1987 (Public Law 100-235). The act requires federal agencies to prepare and submit to NIST and NSA, for review and comment, security plans for all computer systems that contain sensitive information. The report, 1989 Computer Security and Privacy Plans (CSPP) Review Project: A First-Year Federal Response to the Computer Security Act of 1987

(Final Report), also discusses future directions for implementing the act. The goal of the act is to prompt federal agencies to take measures to improve the security and privacy of sensitive information in federal computer systems. Copies of the 189-page report (NISTIR 4409) are available from the National Technical Information Service, Springfield, VA 22161. Order by PB# 91-107540/AS for \$23 prepaid.

CRYOGENIC PROPERTIES OF COPPER

NIST and the International Copper Association (ICA) have developed a new wall chart presenting technical data on the properties of copper at cryogenic (super-cold) temperatures. Copper's excellent low-temperature resistivity, thermal conductivity, and reasonable mechanical properties have made it the metal of choice for numerous low-temperature applications in high-energy physics, fusion energy devices, and space experiments. As a result, the initial wall chart, produced in 1979, received wide distribution. The new chart is larger and contains more information, particularly on copper alloys and magnetic properties. Other properties presented include electrical resistivity, thermal conductivity, thermal diffusivity, fatigue, and specific heat/thermal expansion coefficient. Free copies of the chart are available from Fred Fickett, Div. 724.05, NIST, Boulder, CO 80303, or ICA, 708 Third Ave., New York, NY 10017.

PATENT ISSUED FOR "STANDARD CRACK"

NIST researchers have received a patent for a reference standard and a method for manufacturing that standard for use in calibrating eddy current testing systems. These systems are used by the airline industry, among others, to detect cracks and other signs of metal fatigue in aircraft. Until now, a difficulty of the eddy current technique has been the lack of well-defined "flaws" that accurately simulate fatigue cracks. NIST scientists have

produced a reference standard from a block of metal that is deformed by an indentation tool to provide a notch of prescribed dimensions. The reference standard is compressed to close the notch and can then be used to calibrate an eddy current measurement system. For licensing information contact Bruce Mattson, Office of Technology Commercialization, A343 Physics Building, Gaithersburg, MD 20899. For more information on the standard, contact Thomas Capobianco, Division 724.05, NIST, Boulder, CO 80303, 303/497-3141.

NEW TECHNIQUE MEASURES FIBER MATRIX IN COMPOSITES

A NIST researcher has been awarded a patent for a new technique to estimate the strength of the bonding between polymer matrix resin and reinforcements in polymer composites. The mechanical properties of composite materials are strongly influenced by the bonding of resins and fiber reinforcements. This method uses a laser to heat a very small, localized region of the sample. The thermal expansion between the fiber and resin produces an acoustical emission, which can be measured. The stronger the interface, the lower the acoustical signal. Previous methods to evaluate strength require highly trained personnel, are tedious to perform, and require special test specimens or destruction of the composite. The new technique is simple to use and nondestructive. The invention addresses one of the technical barriers to improved polymer composite processing identified by industry at two NIST workshops. For further information, contact Wen-li Wu, B320 Polymer Building, NIST, Gaithersburg, MD 20899, 301/975-6839.

DIAGRAM ADOPTED AS PART OF CODE

A ferrite prediction diagram, developed in a cooperative program between NIST and the Colorado School of Mines, has been adopted as part of the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code, fall 1990 addendum. This is one of the most important safety codes in the world as it controls much of the construction of large and complex vessels for applications such as petroleum and chemical processing. Many severe environments require the use of stainless steel vessels, and the code contains guidance on their construction. The amount of ferrite in these vessels is important because it controls the cracking resistance and corrosion resistance in the welds. The NIST-School of Mines diagram is considered to be

a substantial improvement over the 1974 diagram, which it replaces. More information can be obtained from Thomas Siewert, Division 430, NIST, Boulder, CO 80303, 303/497-3523.

NEW METHOD PREDICTS PRODUCT FIRE RISK

Combining traditional methods of analyzing a product's fire risk with powerful new computing tools, a team of researchers from NIST and private industry has developed a new way to measure the life-safety risk of a combustible product. The method can predict whether fire fatalities would increase or decrease if a product's fire performance characteristics were changed. The new technique uses HAZARD I, a computer model developed by NIST, together with statistics on past fires and information from fire tests. Combining all of these methods allows researchers and others to predict not only the probability and outcome of an individual fire, but also to sketch a picture of fires involving a particular product on a national scale. A series of reports describing the method and ways to use it is available from the National Fire Protection Research Foundation, 1 Batterymarch Park, Quincy, MA 02269.

BARRIERS IDENTIFIED FOR USE OF POLYMER COMPOSITES

The most important technical barrier to improved polymer composite processing for the next 5 to 15 years is industry's inability to control resin flow and fiber orientation, said a group of 24 leading composite users, suppliers, and fabricators in a 1990 workshop at NIST. The workshop was the second meeting at NIST in which representatives from industry were asked to target the most critical scientific and technical barriers in composite processing and to identify the serious performance issues that producers must address to meet increasing international competition. The industry group strongly supported conclusions from an earlier meeting, which ranked pressure molding and liquid molding as the two most important polymer processing methods for the future. Process monitoring and the measurement and control of fiber-matrix adhesion also were given high priority. Impact damage and environmental attack were selected as critical performance issues for all industry sectors. For a copy of the report, Second Industry Workshop on Polymer Composite Processing (NISTIR 4461), send a self-addressed mailing label to A209 Polymer Building NIST, Gaithersburg, MD 20899, 301/975-6837.

MANUFACTURING TECHNOLOGY CENTERS HELPING BUSINESS

NIST's Manufacturing Technology Centers program is off to a promising start toward improving the technological competitiveness of small and mid-sized businesses, the NIST Visiting Committee on Advanced Technology said in a report to Commerce Secretary Robert A. Mosbacher. The centers are intended to bridge the gap between sources of manufacturing technology and the companies that need it. The nine-member committee praised the technology-transfer efforts of the New York, Ohio, and South Carolina centers, noting local business support for such efforts as direct project assistance, technical training courses, and demonstrations of hardware and software. The report, Manufacturing Technology Centers Program, looks at the program strategies, operations, and financial support of the three centers. It is available from Dale E. Hall, A527 Administration Building, NIST, Gaithersburg, MD 20899, 301/975-2158.

FIPS REVISIONS OF I/O INTERFACE STANDARDS APPROVED

The Secretary of Commerce has approved revisions to the Federal Information Processing Standards (FIPS) family of input/output (I/O) interface standards to make them non-mandatory. He also has approved discontinuation of the exclusion and verification lists for these standards. Included in the revisions are I/O Channel Interface (60-2), Channel Level Power Control Interface (61-1), Operational Specifications for Magnetic Tape Subsystems (62), Operational Specifications for Variable Block Rotating Mass Storage Subsystems (63-1), Operational Specifications for Fixed Block Rotating Mass Storage Subsystems (97), Storage Module Interfaces (111), Intelligent Peripheral Interface (IPI) (130), and Small Computer System Interface (SCSI) (131). Technical information is available from Shirley Radack, 301/975-2833. Interested parties may obtain copies of the FIPS publications from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

CURRENT SUPPLY DESIGNED FOR HIGH- T_c TESTING

Precise and accurate measurements of the DC critical current of high-critical-temperature (high- T_c)

superconductors often put stringent demands on the current supply. A simple and inexpensive design for such a current supply has been developed by NIST, based on a common deep-cycle, 12 V, wet-cell battery of the type used in boats and recreational vehicles. A description of the circuit, including diagram, was published in Measurement Science and Technology, Vol. 1 (1990). Reprints are available from Steven Bray, Mail Code 814.05, NIST, Boulder, CO 80303, 303/497-5631.

NEW LIBRARY FOR ALTERNATIVE REFRIGERANT ANALYSIS

Intensive efforts are under way to evaluate environmentally acceptable alternatives to fully halogenated chlorofluorocarbon fluids for air conditioning and refrigeration equipment and aerosol propellants. The evaluation process requires a complete set of thermophysical property data so relevant engineering properties can be mathematically modeled or correlated. Also, thermophysical measurements often are carried out at elevated temperatures and pressures, where decomposition and chemical reactions may occur. Thus there is a need for reliable identification of contaminants and reaction products in these fluids. Spectroscopic Library for Alternative Refrigerant Analysis (NIST SP 794) assembles a collection of infrared and mass spectra on chloro-fluoro-bromo ethanes and ethylenes to assist in this identification. The library also includes other physical properties where possible. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-03036-8 for \$12 prepaid.

U.S. SPEED SKIERS TO GAIN COMPETITIVE EDGE

Six computer software and hardware companies and a sports helmet firm have combined forces at NIST to give America's top speed skiers and small machine shop operators a competitive edge. The companies used NIST's Shop of the 90s facility to design an aerodynamic helmet for athletes that flash down slopes at speeds up to 224 km/h (139 mph). The facility is used to research and demonstrate how small machine shops can rapidly produce sophisticated, competitive products with commercially available technology. The firms donated material and personnel to the helmet project under a cooperative research agreement with NIST.

ACC, NIST TO IMPROVE POLYMER COMPOSITES PROCESSING

NIST and the Automotive Composites Consortium (ACC) have agreed to improve the processing of structural polymer composite materials. The ACC partnership is aimed at developing the technology industry needs for processing reliable, cost-effective structural polymer composite materials. The cooperative project will focus on composites made by resin transfer molding and structural reaction injection molding. NIST researchers will develop and use computer models for both processing methods to simulate the fabrication of a complex demonstration part made by the ACC using the latest processing and performance technologies. The NIST computer models are designed to predict flow patterns and pressures during processing. For information, contact Donald L. Hunston, A209 Polymer Building, NIST, Gaithersburg, MD 20899, 301/975-6837.

NEW SUPERCONDUCTOR POLYMER COMPOSITES DEVELOPED

Composites made by mixing powdered ceramic superconducting materials with a polymer may be a practical way to fabricate a new generation of materials with the magnetic levitation properties of superconductors, even though they do not conduct electric current, say NIST researchers. The superconductor-polymer composites were developed by NIST scientists, who have received a patent for their innovation. Laboratory work has demonstrated that a ceramic superconductor placed in a matrix of polyvinylidene fluoride displays the magnetic levitation properties of a superconductor. When a magnetic field is applied to the composite at superconducting temperatures, an electric current flows around the surface of each particle, creating a counter-magnetic field that gives the composite its levitating properties. The polymer acts as a binder and shields the particles from exposure to moisture and other chemically active substances that can destroy superconductivity. For information, contact Aime S. DeReggi, B320 Polymer Building, NIST, Gaithersburg, MD 20899, 301/975-6725.

MATERIALS FOR MAGNETIC FUSION ENERGY

NIST has published the 13th report in a series on research to determine the properties of materials that may be used in cryogenic structures for superconducting magnets for fusion energy power plants. Materials Studies for Magnetic Fusion

Energy Applications at Low Temperatures—XIII (NISTIR 3944) presents research results for 1989-90 under four headings: structural alloys, welding, test standards, and technology transfer. The research is managed by NIST, sponsored by the Department of Energy's Office of Fusion Energy, and conducted at NIST and other laboratories through cooperative agreements. Available from the National Technical Information Service, Springfield, VA 22161. Order by PB# 91-107086/AS for \$39 prepaid.

USE OF IRDS STANDARD IN CALS PUBLICATION ISSUED

Use of the IRDS Standard in CALS (NISTIR 89-4169), a paper authored by NIST scientists, shows how the Information Resource Dictionary System (IRDS) can fulfill critical design and operational requirements for CALS (Computer-aided Acquisition and Logistic Support program of the Department of Defense) Phase II. The authors provide examples as well as a schedule to illustrate that the IRDS and other data management standards will be available when needed to meet the immediate requirements of CALS. An architecture is presented to show additional standards required to achieve longer-range goals of distributed database, and development tasks are recommended. Available from the National Technical Information Service, Springfield, VA 22161. Order by PB# 90-130295 for \$23 prepaid.

SYMPOSIUM DIGEST PUBLISHED

The digest of papers presented at the sixth biennial Symposium on Optical Fiber Measurements (Boulder, CO, Sept. 11-12, 1990) is now available. Topics discussed in the 45 papers include optical time domain reflectometry, fiber geometry measurements, integrated optics, laboratory intercomparisons, refractive index measurements, fiber amplifiers and sensors, and connector measurements. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-03025-2 for \$11 prepaid.

CONSORTIUM TO DEVELOP NEW WAY TO FIND PAINT FLAWS

A government-industry consortium is being explored by NIST to develop an automated non-destructive process to detect and evaluate defects in paints on metal products such as automobiles. An automated detection system using computer image processing and robotics along with techniques to

"map" the surface of a product would be faster and more precise than current detection systems, says a materials research engineer at NIST. Research on coating defects, robotics, and non-destructive evaluation techniques currently being conducted by researchers at NIST could provide the basis for the new inspection technique. NIST is sponsoring a workshop at its Gaithersburg, MD, headquarters on May 9 and 10 to get industry reaction to the consortium idea. Organizations interested in attending the workshop should contact Jonathan Martin at 301/975-6717 or Theodore Vorburger at 301/975-3493.

MICROSTRIP PATCH ANTENNA DEVELOPED

Calibration laboratories will be interested in a new development from NIST that makes certain antenna measurements and electro-magnetic interference/compatibility tests more convenient. NIST researchers have developed a small (20 cm²) microstrip patch antenna that can be used as a standard transmitting and receiving antenna at frequencies below 500 MHz in an anechoic chamber. Up to now, well-characterized pyramidal horns and open-ended waveguides have been used, but at frequencies below 500 MHz, these instruments become very large and impractical. NIST researchers proved that the resonant frequency, driving point impedance, antenna radiation pattern, and radiated field strength of the microstrip patch antenna could be calculated theoretically from its geometry and are accurate to within 3 percent. Paper No. 2-91 describes the antenna in detail and is available from Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237.

OBTAINING LIQUID NEON AT LOWER COSTS

NIST researchers have designed and constructed a small-scale plant capable of recycling liquid neon for about \$20 per liter, \$150 per liter less than liquid neon can be obtained commercially. The plant was designed to capture, purify, and refrigerate neon boiling off from calorimetry experiments in the low-temperature measurement of the thermal conductivity of insulating materials. The recycling plant consists of a purification section, a heat exchanger, liquid neon and liquid hydrogen storage dewars, and a fully automated control system. After purification, neon is liquefied in the heat exchanger by liquid hydrogen flowing countercurrently through stainless steel cooling coils. Hydrogen flow is automatically adjusted to keep the neon at its normal saturation temperature of 27 K. The liquefied neon

is stored in a dewar directly below the heat exchanger; a low-temperature refrigerator provides cooling during extended storage or low-flow applications. Paper No. 4-91 describes the plant in more detail and is available from Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237.

USDA ADOPTS HANDBOOKS 133 AND 44

The Food Safety and Inspection Service of the U.S. Department of Agriculture (USDA) has adopted new rules that amend federal meat and poultry products inspection regulations. The rules incorporate NIST Handbook 133, Checking the Net Contents of Prepackaged Goods, and NIST Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices, by reference. The rules are intended to establish federal uniformity with state and local net weight requirements. As of May 1991, meat and poultry plants will be required to follow sampling and testing procedures as provided in Handbook 133 to demonstrate compliance with federal regulations. Operators of federally inspected establishments will be required to have their scales tested at least annually and to maintain accuracy as defined by applicable tolerances in Handbook 44. State weights and measures officials, USDA officials, and state-licensed or registered scale repair firms will be able to inspect and test scales within the plant. Approximately 12,000 meat and poultry plants in the United States and abroad operate under USDA inspection criteria, and there are approximately 7,000 USDA meat and poultry inspectors.

CHARPY IMPACT TESTS NEAR ABSOLUTE ZERO

Research initiated by NIST with the cooperation of the Massachusetts Institute of Technology and the Japan Atomic Energy Research Institute has led to the re-evaluation of Charpy impact test procedures at extreme cryogenic temperatures. The conventional approach does not work for tests at liquid helium temperature (4 K) because excessive adiabatic heating occurs during impact. Thermocouple measurements reveal that austenitic steel specimens actually heat to about 130 K upon impact. NIST has presented the findings to the appropriate American Society for Testing and Materials (ASTM) subcommittee. Based on this research the existing standard, ASTM Methods for Notched Bar Impact Testing of Metallic Materials (E 23-88), is currently being revised to limit its applicability to test temperatures of 77 K and higher.

JOHNS HOPKINS TO PARTICIPATE IN NEUTRON RESEARCH AND INSTRUMENTATION

The Department of Physics and Astronomy at The Johns Hopkins University has agreed to participate with NIST in the development of a cold neutron scattering spectrometer for materials research at the NIST Cold Neutron Research Facility (CNRF), as part of a new cooperative research effort in the area of condensed matter physics and magnetic material characterization, including heavy fermion systems.

The instrument is the new cold neutron triple-axis spectrometer to be installed at guide NG-5 of the CNRF. The instrument will have state-of-the-art capabilities in resolution and data collection efficiency, and will have several unique features which will place it among the most versatile in the world. Initial measurements will be devoted to fundamental studies of the microscopic properties of new magnetic materials.

CRITERIA FOR ACCREDITING FASTENER TESTING LABORATORIES

Public Law 101-592, the Fastener Quality Act, was signed into law by President Bush on November 16, 1990. The law requires that critical fasteners (e.g., high-strength aircraft bolts and nuts) conform to the specifications to which they are represented, and provides for the accreditation of testing laboratories to certify this conformance. NIST, through its National Voluntary Laboratory Accreditation Program (NVLAP), is charged with developing and administering the accreditation program for fastener testing laboratories. NIST has accepted the responsibility for establishing the technical criteria which NVLAP will use to assess candidate laboratories. NIST scientists will review the current specifications for the many categories of fasteners that are covered by the act and will draft procedures for evaluating the capabilities of laboratories for carrying out the standard mechanical test methods cited in these specifications. They will also design proficiency test programs to serve as part of the evaluation procedures. Regulations governing the accreditation of fastener testing laboratories are expected to be announced in May 1991.

NEW PUBLICATION PRESENTS GUIDELINES FOR REALIZING THE NEW INTERNATIONAL TEMPERATURE SCALE

NIST Technical Note 1265, Guidelines for Realizing the International Temperature Scale of 1990 (ITS-90), is available to those who need information on the ITS-90. This technical note describes

the ITS-90, the techniques by which the ITS-90 can be realized, and the uncertainties associated with its realization. It instructs the user on how to convert calibrations of thermometers recently calibrated on the International Practical Temperature Scale of 1968 (IPTS-68) to approximate calibrations on the ITS-90. The publication gives details of the changes of the ITS-90 from the IPTS-68 and describes the extension of the ITS-90 from the lower limit of the IPTS-68 at 13.81 K to the newer lower limit of 0.65 K.

Several improvements to the new scale enhance the reproducibility of measurements: replacing the use of the thermocouple as a standard instrument of the scale; extending the range of the precision platinum resistance thermometer upward to the silver freezing-point temperature (961.78 °C); and extending the radiation thermometry range downward to the silver freezing-point temperature. Several new defining fixed points have been adopted for the ITS-90 in order to reduce the non-uniqueness of the scale, i.e., the disagreement of temperature values indicated by different standard thermometers at temperatures intermediate to the defining fixed points of the scale. Alternative definitions were incorporated for certain ranges of the ITS-90 so that the use of the scale would be more convenient.

PRECISION LASER SPECTROSCOPY REVEALS UNEXPECTED WAVELENGTH SHIFT

In a recent experiment, NIST physicists were able to measure a particular atomic transition wavelength in helium 10 times more accurately than ever before. This improvement allowed a precision test of subtle quantum effects and yielded surprising results that may have a fundamental impact on our understanding of quantum interactions.

The NIST team used an atomic beam and laser interferometers to measure the singlet 2S-3P helium wavelength with an error of less than 10 millionths of an atomic diameter. At this level of accuracy, ordinary quantum mechanics breaks down and one needs a quantum field theory known as "quantum electrodynamics," or "QED" in order to explain the observations.

The new NIST measurement is of interest because it was carried out on an atomic system that is both simple enough to be treated rigorously from first principles and complicated enough to show how the effect of QED on one electron can be influenced by the presence of another nearby electron. Such effects are only beginning to be treated accurately at the quantum level. Previous high-precision

measurements on triplet transitions in helium had shown good agreement with theoretical prediction, leading researchers to believe that a firm theoretical understanding was at hand. For the singlet transition studied by the NIST team, however, the Pauli exclusion principle allows the two electrons to spend more time close together, thereby amplifying the effects of interest. When the NIST measurement was complete, it showed that the wavelength for the helium single transition was significantly different from the theoretical prediction. This finding has been recently confirmed in an independent laboratory at Yale University. Further theoretical work will be needed to explain these results.

YALE MEDICAL SCHOOL AND NIST PIONEER NEW METHOD OF MAPPING RADIATION DOSE FROM GAMMA-RAY BRACHYTHERAPY SOURCES

Researchers in the Department of Therapeutic Radiology at Yale and NIST have developed a novel technique of mapping radiation doses to tissue in two and three dimensions using radiochromic films. In a paper submitted to Medical Physics, these investigators describe the method of mapping the dose from a gamma-ray brachytherapy source of the radionuclide iridium-192. ("Brachy-" is from the Greek meaning "near.") Because of its ideal low-energy spectrum, iridium-192 has largely replaced radium for intracavitary therapy. Improved methods are needed for routine quality assurance for this therapy.

Radiochromic films, which have a reproducible color response to ionizing radiation, are superior to photographic silver halide films in that they have a fairly flat energy response and can be calibrated at NIST for absorbed dose measurement. By scanning the autoradiographs with a laser-scanning densitometer, a high-resolution digital image is obtained. The digital information (optical density) is then converted to absorbed dose using the film calibration. The medical uses of these films present the most demanding accuracy requirement yet encountered. The goal of this work will be to determine absorbed dose to tissue to within ± 5 percent.

INTEROPERABILITY TESTS PUBLISHED

Two new NIST publications describe the interoperability test suites of Open Systems Interconnection (OSI) applications covered by Federal Information Processing Standard (FIPS) 146, Government OSI Profile (GOSIP), Version 1. NISTIR 4435, FTAM Interoperability Test, contains the file transfer,

access, and management (FTAM) interoperability test suite, while NISTIR 4452, Message Handling Systems Interoperability Tests, presents the X.400 interoperability test suite. GOSIP, Version 1, became effective in federal procurements on August 15, 1990. Future versions of the GOSIP standard will incorporate additional OSI applications.

NIST ESTABLISHES GRAPHICS IN GOVERNMENT (GIG) USERS GROUP

NIST recently hosted the first meeting of the newly formed GIG Users Group. Sponsored by the graphics software group of the Information Systems Engineering Division, the GIG Users Group provides a forum for federal government colleagues to exchange ideas on computer graphics and to increase NIST's understanding of the specific and unique graphics technology needs of federal agencies. The GIG Users Group attracted about 40 participants. The next meeting is planned for the spring or summer of 1991.

ASTM ACCEPTS NIST-DEVELOPED INTERLABORATORY TEST SOFTWARE

Interlaboratory results are the ultimate test of a standard method of analysis. Unfortunately, the measurement data and associated statistics required to evaluate an interlaboratory test tend to be lengthy. NIST researchers have developed a PC-computer program to perform this task, which should lead to greater uniformity in the evaluation and reporting of different standard methods.

Working with the ASTM Subcommittee E-11.04 on Development and Evaluation of Test Methods, NIST researchers designed a computer package which consists of the PC software, a 40-page user's manual, and a reprint of the parent ASTM standard E691-87 for evaluating interlaboratory results. The package is available for purchase from ASTM at a nominal cost. The software package has been well received during the 6 months that it has been available. It is hoped that most ASTM standard test methods will eventually use the E691-87 standard and computer program for development and documentation.

For each material of the interlaboratory study, the program examines both the individual data points for within- and between-laboratory variabilities, and derives summary within- and between-laboratory components of precision for the complete study. Computer graphics play a prominent role in the evaluation and reporting of the data. The program produces both tables and graphs for screen or hard copy.

INADVERTENT TEMPERATURE RISES MAY CAUSE POOR MAGNET PERFORMANCE

NIST scientists have carried out experiments that point to enhanced flux creep driven by inadvertent increases in operating temperature of large superconducting magnets as a cause of an heretofore unexplained degradation in the magnetic fields produced by the magnets. Flux creep is a thermally driven phenomenon that results in a slow decay in the magnetization of superconducting cables and a concomitant decrease in their magnetic field. Since 1988, researchers have been confronted with a significant difference between magnetization decay rates measured in specimens of superconductor cable and decay rates observed in accelerator magnets made from the same kind of cable. The difference can be important. For example, in the superconducting super collider (SSC) the reduced performance could cause loss of the accelerator's proton beam.

The NIST work examines magnetization decay rates in specimen SSC cables and attributes the enhanced decay rate, not accounted for by simple thermal activation, to a supercritical state in which shielding currents temporarily flow at a density greater than the new critical current density at the higher temperature.

CAPABILITY ESTABLISHED FOR QUANTIZED HALL RESISTOR FABRICATION AT NIST

NIST has completed a fabrication and test laboratory for quantized Hall resistors and has fabricated structures that appear to be of standards quality. These Hall-bar structures were etched from gallium arsenide wafers having gallium arsenide-aluminum gallium arsenide heterostructures grown by the NIST molecular beam epitaxy system. Thus NIST now has the capability to produce its own high-quality QHR structures, both to implement the national QHR resistance standard and for research. Although NIST counterpart laboratories and others are taking steps to address the supply issue, heretofore there have been relatively few high-quality QHR specimens available. The new laboratory provides a cleanliness level of class 10 and incorporates a mask aligner, an alloying station for etching and forming low-resistance indium or tin-alloyed contacts, and a probe station and related equipment for evaluating specimens as they are made.

AC IMPEDANCE METHOD MEASURES HIGH-RESISTIVITY SILICON INGOTS AND SLICES

NIST researchers have developed an ac impedance method for measuring the bulk resistivity of high-resistivity silicon ingots and slices. The method is non-destructive in character and only requires that easily removable contacts, such as may be formed from silver paint, be applied to the end faces of the specimen crystal.

In the method, the impedance of the paint-crystal-paint capacitive sandwich is measured as a function of frequency from 100 Hz to 40 MHz. The resistivity is then calculated from the frequency at which the negative peak occurs in a plot of the imaginary component of the impedance and from the absolute values of the real and imaginary components of the impedance at that frequency. In addition to its intended application for measuring bulk resistivity, the method is useful for determining the quality of applied contacts and the effect of surface treatments which result in a significant depletion layer.

The NIST scientists have made extensive measurements of the resistivity of high-resistivity silicon in order to compare the results of the new method with existing dc resistance, van der Pauw, and four-probe methods. The typical agreement between these methods and the new method is within 5 percent for slices and ingot sections greater than 1 mm in length and resistivity above 5000 ohm-cm. The method is applicable to any high-resistivity material, and measurements have also been made on semi-insulating gallium arsenide.

COLLABORATIVE STUDIES USING SYNCHROTRON RADIATION UNLOCK ATOMIC BOND SECRETS

NIST scientists have shown for the first time how the atoms in a GeSi crystal arrange themselves when GeSi is grown epitaxially on the slightly smaller crystal lattice of silicon. The scientists are using synchrotron radiation to study the bonds between atoms in strained GeSi layers and between antimony and silicon atoms on silicon surfaces; the synchrotron radiation is generated at the National Synchrotron Light Source at Brookhaven National Laboratory by electrons traveling around an evacuated ring at relativistic velocities.

Understanding the physical arrangement of atoms of GeSi on silicon is prerequisite to exploiting the potential use of heterojunctions of this type

for high-speed bipolar transistors. The advantage of using GeSi alloys is that the energy bandgap can be tuned by controlling the concentration of germanium in the alloy; at the same time, devices using this technology can be fabricated using the highly developed silicon processing technology available. The studies of antimony on silicon illuminate the complementary role of surface geometry and electronic structure in determining how metal-semiconductor contacts are formed.

The measurement techniques employed in these studies include extended x-ray absorption fine structure, x-ray diffraction, and photoemission. A collaborating research team at Stanford Electronics Laboratory prepares test specimens, and a team at the University of Washington makes the x-ray diffraction measurements.

COLLABORATION WITH INDUSTRY ON THE DEVELOPMENT OF A FASTENER WORKSTATION

NIST has begun a joint R&D project with the Portsmouth Naval Shipyard and industry to develop an automated fastener workstation in the Automated Manufacturing Research Facility (AMRF). Precision fasteners used in such critical applications as aircraft and submarines must conform to federal and industrial standards for accuracy and performance. Besides meeting such criteria, the fasteners must meet material traceability requirements as well. *The joint R&D effort involves the development of the technology, methodology, and computer control systems necessary for the production of highly accurate fasteners.*

These fasteners are now manufactured from both k-monel and nickel copper material, which are excellent for their resistance to corrosion. However, this type of fastener is expensive to produce because the high tolerance specified for the parts requires frequent inspection at different stages of the production process. An automated fastener workstation would offer a significant reduction in production time as well as cost. These objectives can be achieved by using a multispindle, multiturret turning/machining center for the increase in production efficiency, while integrating statistical process control and in-process inspection into the overall manufacturing process, thus enhancing quality control.

NIST DEVELOPS TEST PROCEDURE FOR BUILDING GASEOUS FILTER EQUIPMENT

NIST staff have developed a laboratory test procedure for determining the performance of air filtra-

tion equipment that removes gaseous air contaminants from building air streams. The application of filtration equipment in commercial buildings has dramatically increased because of the concern for indoor air quality. Industry standards exist for testing and rating particulate filters but to date have not been developed for gaseous filtration. The laboratory procedure developed at NIST calls for the filtration equipment to be challenged with the contaminant at a fixed concentration and measurements made of the penetration of the contaminant over time. Results from testing with different contaminants and at different challenge concentrations are used for estimating the useful life of the air cleaning filter media. The procedure will be offered for adoption as a standard test method to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

U.S. STANDARDS ORGANIZATIONS

NIST has issued Standards Activities of Organizations in the United States (NIST SP 806). This publication identifies and describes activities of more than 750 U.S. public- and private-sector organizations that develop, publish, and revise standards; participate in this process; or identify standards and make them available through information centers or distribution channels. NIST SP 806, a revision of NBS SP 681 (dated August 1984), provides expanded and updated coverage of activities regarding both mandatory and voluntary U.S. standards. It is designed to serve as a reference for all who need and use standards or who wish to identify organizations involved in standardization.

PATENT ISSUED ON NIST

TRANSCONDUCTANCE AMPLIFIER DESIGN

The Commissioner of Patents and Trademarks has issued United States Patent 4,965,529 to a NIST scientist for his invention of a high current, very wide band transconductance amplifier. This patent has 14 claims, covering the inventions implemented in the design of the NIST model 20A-2 transconductance amplifier. The instrument can source currents up to 35 A rms at 100 kHz, with short-term instability of less than plus or minus 25 parts per million. This combination of output current and frequency exceeds by a factor of 15 the previous best for transconductance amplifiers. An important application of the amplifier is in calibrations of current-related quantities. For example, its extended current and frequency capabilities permit the calibration of current shunts, ammeters, and thermal current converters to be carried out over signifi-

cantly broader ranges of these quantities than heretofore. Several companies have expressed strong interest in the NIST amplifier; and one is finalizing a licensing agreement that will permit it to market a commercial product based on the NIST design. Details of the NIST instrument were published in the Institute of Electrical and Electronics Engineers Transactions on Instrumentation and Measurement, Vol. 39, No 1.

CONSORTIUM ON AUTOMATED ANALYTICAL LABORATORY SYSTEMS (CAALS) HOLDS WORKSHOP

A CAALS workshop on communication standards for remotely controlling analytical chemistry instrumentation was recently held at NIST. A presentation was made by a representative from one of the CAALS members on the work of the Consortium on Standard Commands for Programmable Instruments (SCPI), which is comprised of the major vendors in the U.S. electronic test and measurement community. The SCPI consortium has developed an open standard for test equipment commands primarily utilizing IEEE-488 control interfaces. The development of similar commands for analytical chemistry instrumentation is a primary goal of the CAALS Modularity Project.

The workshop was devoted mainly to developing both generic and specific models for analytical chemical instruments. Such models are built principally by defining instrument command sets and specifying how the instruments respond to those commands. A major effort was expended in culling generic commands (those that are mandatory on every standardized instrument) from common commands (those which may be active on most equipment) and specific commands (those which are pertinent to only certain instruments or techniques). Once the instrument models are constructed, future workshops will address the full content of messages needed for remote control of analytical chemistry instrumentation.

MOVING SHEET FACILITY FOR ON-LINE QUALITY MEASUREMENTS

NIST has collaborated with industry to develop a test bed to demonstrate the feasibility of measuring the formability of rapidly moving steel sheets. The test bed is a device which propels sheet specimens along a track at controlled, repeatable velocities that can be increased up to about 150 m/min. The device consists of: a pneumatic cylinder/piston arrangement, which is connected by cable to a sled; precision-machined track, which guides the sled; a bridge, which spans across the track and provides

locations for mounting ultrasonic transducers; and a braking system, which stops the sled at the end of the track. The ultrasonic formability sensor developed by NIST will be mounted on the bridge. This system gives NIST a unique measurement facility of use to the producers and fabricators of sheet steel.

SOLDER: MATERIALS FOR ELECTRONIC PACKAGING

Although solder has been used since the time of the Egyptians, it was not until this century that its bulk properties were understood. More recently, it has been recognized that failure of solder joints often occurs at the joint interface where brittle intermetallics can form. This can lead to malfunction in critical applications such as aircraft and automobile electronic components, which are increasingly computerized. In an ongoing program NIST researchers have obtained detailed information on the mechanisms responsible for interface fracture, which may lead to the development of a realistic interface fracture model. One of three modes occurs, depending on the thicknesses of the intermetallic layers. For very thin layers (less than about 1 μm), classic ductile fracture occurs in the bulk solder. For thicker layers, fracture can occur on either side of the intermetallic zone. On the $\text{Cu}_3\text{Sn}/\text{Cu}$ side, a brittle fracture occurs. On the $\text{Cu}_6\text{Sn}_5/\text{solder}$ side, only the Pb phase of the solder adheres leading to the formation of ductile fracture ligaments of Pb. By using metallurgical techniques to limit the formation of brittle intermetallics at the interface, the researchers expect to double the strength of solder joints and bring an ancient material up to date.

INSTRUMENTS OPERATIONAL IN CNRF

Two experimental stations are now operational in NIST's Cold Neutron Research Facility (CNRF): the 8 m small-angle neutron scattering spectrometer (SANS) and the cold neutron depth-profiling instrument (CNDP).

The SANS, which had been installed on the cold source in the reactor hall, began operation in the guide hall on Oct. 18, 1990. Measured neutron intensity on the sample in the new configuration is greater than 85 percent of the intensity in the reactor hall with a signal-to-noise ratio more than four times better. A variety of experiments have already been conducted, including studies of colloidal mixtures under shear, temperature dependence of bonded phase structure in microporous silica, polymer conformations in blends, ultrathin films and solutions, microemulsions, and high T_c superconductors.

The CNDP instrument, which measures near-surface elemental composition vs. depth in semi-conductors and thin films, is installed on the cold source in the reactor hall, and began operation Nov. 1, 1990. The new 61 cm diameter stainless steel depth-profiling chamber is capable of operating at UHV pressures and incorporates many design features that significantly enhance the capabilities that currently exist at the thermal depth-profiling instrument in the reactor hall. A measurement sensitivity approximately 20 times that of the present thermal neutron facility for the same efficiency particle detectors has been determined.

A profile of O^{17} in a Co-Ni-Oxide film was among the first obtained with the new facility, reported to be the first nondestructive determination of near-surface oxygen made anywhere in the world for this type of sample.

COLLABORATION WITH AUTOMOTIVE CONSORTIUM ON POLYMER COMPOSITES PROCESSING

NIST scientists will participate with the Automotive Composites Consortium in a program to improve structural polymer composites made by the resin transfer molding (RTM) process. The cooperative program aims at developing the technology that industry needs for processing reliable, cost-effective polymer composite materials. Under the cooperative agreement, NIST will develop and apply computer models that predict polymer flows and pressures in RTM processing to a complex structural automotive part. The part will be fabricated by the consortium. The RTM process involves injection of resin into a mold that already contains the fiber reinforcements. The technical challenge is to achieve the optimal resin flow so that the mold is completely filled in the shortest time while avoiding excess pressures or voids. The computer modeling will assist in the design of molds and processing conditions that optimize mold filling.

EFFECT OF FILAMENT GEOMETRY ON CVD DIAMOND FILMS

In order to increase the deposition area in hot filament chemical vapor deposition (CVD) of diamond films, one must understand how the filament geometry will affect the growth rate and morphology of the films. To address this question NIST researchers deposited a series of diamond films. Three factors were varied: the number of helical

turns in a filament—5, 10, or 15; the number of filaments present—1 or 2; and the methane fraction in the methane/hydrogen feed gas mixture—0.25 percent, 0.5 percent, 0.75 percent, or 1 percent. While the general trend was an increase in growth rate with increasing methane fraction, increasing the number of filament turns and using dual filaments rather than single filaments sometimes resulted in lower than expected growth rates. In the case of 15 turn filaments, the growth rates were lower in the dual filament system than in the single filament system. In addition, the films that grew at lower than expected growth rates showed morphologies indicative of single filament depositions conducted at lower methane concentrations. These results suggest that there is a depletion of the carbon necessary for diamond film growth associated with using multiple filaments. It is possible that more carbon is necessary to maintain the carburization of the filament leaving less for diamond film growth. Further investigations are under way to confirm this explanation. The coverage with dual filaments, however, was double the coverage with single filaments.

NIST UPDATES FIRE HAZARD ASSESSMENT METHODOLOGY

A NIST scientist has produced a revised version (18.5) of FAST, a model of fire growth and smoke transport. This is in preparation for the first update of HAZARD I, scheduled for release early this summer. HAZARD I is a prototype methodology to assess the relative contributions of potentially flammable commercial products (e.g., furniture, beds) to deaths in building fires. The method helps the user define first the fire problem of concern and then the specific fire factors contributing to the problem. These factors include not only the flammable item(s), but also such important features as the building design, the people inside, the weather, and the time of day. NIST-developed (PC compatible) software then calculates the outcome of each of the fires, enabling the user to analyze the impact of making changes in the product or other features of the fire. The new modifications allow for more complex fuels, enable hydrogen chloride to deposit on walls, and include the effects of forced ventilation on smoke transport, as well as a number of improvements in the software. The documentation has been released as NIST Technical Note 1282.

NOVEL TURBULENCE DIAGNOSTIC DEVELOPED

A NIST scientist and university colleagues have produced a new technique for characterizing turbulent flow fields. This combines two unique instruments. The first is a line camera, which uses Rayleigh light scattering to measure species concentration. The second, located just downstream, is an array of fine hot wire anemometers. The combination enables simultaneous, real-time multipoint measurements of concentration and velocity along a line. Using this technique, the researchers have demonstrated the importance of organized large-scale motions to the turbulent mixing process. Their work also shows that there are periods during which the fluid near the perimeter of a turbulent jet is simply convected by an external coflow. A report of this work will appear in *Applications of Laser Techniques in Fluid Mechanics* (Springer-Verlag, 1991).

CH RADICALS MEASURED IN DIFFUSION FLAMES

NIST scientists have made the first quantitative measurements of CH \cdot profiles in a diffusion flame. CH \cdot is a highly reactive species that contributes to soot formation in flames and nitrogen oxide generation in engines. Using laser-induced fluorescence, the scientists showed that the peak CH \cdot concentration appears on the fuel-rich side of the flame. Combined with profiles of other species in the same flame measured by the NIST researchers it was possible to derive a profile for the important triplet methylene radical $^3\text{CH}_2$. The work will be published in *Combustion Science and Technology*. This growing, systematic documentation of a methane/air diffusion flame has become a prime resource for modelers of flame chemistry worldwide.

NIST SCIENTISTS MEASURE EFFECT OF OXYGEN CONCENTRATION ON CO AND SOOT IN FLAMES

NIST scientists have collaborated with scientists from the Japanese Building Research Institute and the U.S. National Forest Products Association to measure vitiation effects on pollution formation. For the study, they used the cone calorimeter, a bench-scale device for measuring radiation-enhanced combustion. The fuels included were methane, propane, an ABS plastic, a polyethylene, and Douglas fir. The team found that decreasing the oxygen concentration in the combustion air from 21 to 14 percent increased the CO yields by at least a factor of 2. The soot yields from the solid materials were insensitive to the vitiation, changing

less than 30 percent. Results for air vitiated alternatively by carbon dioxide and by nitrogen suggest that the CO yield is controlled mainly by the flame temperature. These results will be presented at the 3rd International Symposium on Fire Safety Science in July 1991 and will be published in the proceedings.

ASCE COMPLETES STANDARD ON STRUCTURAL CONDITION ASSESSMENT OF BUILDINGS

A standards committee of the American Society of Civil Engineers (ASCE) chaired by a NIST scientist has prepared ASCE 11-90 "Standard Guideline for Structural Condition Assessment of Existing Buildings." The standard provides information on the structural condition assessment procedure; assessment techniques for concrete, metals, masonry, and wood components; guidance on evaluation techniques; and the format of the assessment report. The need for the standard was identified by NIST researchers studying building rehabilitation who required a standardized procedure for assessing the condition of a building being considered for adaptive re-use, rehabilitation, or improvement.

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT FOR A BASIC TEST SUITE ESTABLISHED

NIST has established a Cooperative Research and Development Agreement with a private company to develop a test suite for evaluating BASIC implementations for conformance to FIPS 68-2, BASIC. This is the first time such an Agreement has been used to obtain the needed tests for federal programming language standards. Under the Agreement, NIST will provide administrative and scientific direction and the company will provide the research associate(s) for building and maintaining the test suite. The company will own and market the resulting BASIC test suite, while NIST will receive a nonexclusive, transferrable, irrevocable, paid-up license to use the test suite for any government purpose.

FEDERAL INFORMATION PROCESSING STANDARDS (FIPS) ACTIVITIES

On Dec. 27, 1990, the Secretary of Commerce approved FIPS 159, "Detail Specification for 62.5 μm Core Diameter/125 μm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibers" (former Federal Standard 1070). FIPS 159 adopts for federal agency use the voluntary industry American National Standard/EIA/TIA-492AAA33A-1989, dated February 1989.

To be effective July 1, 1991, FIPS 159 specifies standard characteristics for multimode optical fiber waveguides for use in electro-optical communications systems applications. The standard will facilitate interoperability among telecommunication facilities and systems of the federal government.

Also approved by Secretary Mosbacher, effective Dec. 18, 1990, were revisions to eight I/O interface FIPS to make them non-mandatory for federal agencies and to discontinue the exclusion and verification lists that NIST had been maintaining for these standards. The I/O interface standards family includes: FIPS 60-2, "I/O Channel Interface"; FIPS 61-1, "Channel Level Power Control Interface"; FIPS 62, "Operational Specifications for Magnetic Tape Subsystems"; FIPS 63-1, "Operational Specifications for Variable Block Rotating Mass Storage Subsystems"; FIPS 97, "Operational Specifications for Fixed Block Rotating Mass Storage Subsystems"; FIPS 111, "Storage Module Interfaces"; FIPS 130, "Intelligent Peripheral Interface"; and "FIPS 131, Small Computer System Interface (SCSI)."

COMPUTER SECURITY GUIDANCE PUBLISHED

Two new publications report on computer security studies and guidelines developed by federal and private-sector organizations. U.S. Department of Commerce Methodology for Certifying Sensitive Computer Applications (NISTIR 4451) describes a standard certification methodology employed to ensure that sensitive applications meet applicable federal policies, regulations, and standards. SRI International's Improving the Security of Your UNIX System (NISTIR 4453) provides various suggestions for improving the security of systems operating under the UNIX operating system. NIST published these documents as part of a continuing effort to assist federal agencies in improving the security of their information systems and to make useful information available to the federal community.

Standard Reference Materials

MEASURING FOOD COMPONENTS AIM OF NEW MATERIALS

Scientists studying health and disease aspects of food consumption depend on accurate measure-

ments of nutrients and contaminants in food samples. But to ensure the reliability of instruments and analytical methods, they need standards—ideally standards containing a variety of foods representative of an average American diet. A standard reference material (SRM) now available from NIST offers a typical diet combined into a bottled freeze-dried powder. Foods such as eggs, pizza, hamburgers, and beer are all included. The material contains certified concentrations of 14 chemical elements as well as ash, fat, dietary fiber, cholesterol, and caloric content. Chemists can analyze these materials as they would any food sample and compare their analysis to the numbers provided. The U.S. Department of Agriculture prepared the SRMs for NIST from foods obtained through the Total Diet Study, an on-going Food and Drug Administration program that monitors foods from various U.S. regions for pesticides, toxins, and nutrients. Total Diet (SRM 1548) costs \$251 for two 6.5 g bottles and is available from the Standard Reference Materials Program, Rm. 204 Building 202, NIST, Gaithersburg, MD 20899, 301/975-6776.

PRODUCTION OF ULTRA-PURE ^{242}Pu SOURCES AND SRMS FOR ENVIRONMENTAL AND PERSONNEL MONITORING

Ultra-pure reference samples and radiation sources of ^{242}Pu are now available from NIST.

For several years there has been a severe shortage of ^{242}Pu of sufficient radiochemical purity to be used as a tracer in radiochemical analysis, including environmental and personnel monitoring. Such environmental and personnel monitoring is required by law for nuclear installations to remain in operation. The Lawrence Livermore National Laboratory of the U.S. Department of Energy (DOE) has now mass separated and chemically purified several milligrams of ultra-pure ^{242}Pu .

In the past, the Isotope Sales Division at the Oak Ridge National Laboratory of the DOE handled the sale and distribution of such materials. Due to a change in DOE policy, this is no longer possible. NIST will now handle the sale and distribution of this ultra-pure ^{242}Pu in the form of special sources at higher activity levels and in the form of a standard reference material, SRM 4334D, at a lower activity level (approximately 25 Bq g^{-1}).

The ^{242}Pu special sources and SRM 4334D are now available from NIST. U.S. government facilities have first priority for the special sources. It appears that enough material is available to provide standards for several years.