The National Institute of Standards and Technology was established in 1988 by Congress to “assist industry in the development of technology... needed to improve product quality, to modernize manufacturing processes, to ensure product reliability... and to facilitate rapid commercialization... of products based on new scientific discoveries.”

NIST, originally founded as the National Bureau of Standards in 1901, works to strengthen U.S. industry’s competitiveness; advance science and engineering; and improve public health, safety, and the environment. One of the agency’s basic functions is to develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for comparing standards used in science, engineering, manufacturing, commerce, industry, and education with the standards adopted or recognized by the Federal Government.

As an agency of the U.S. Commerce Department’s Technology Administration, NIST conducts basic and applied research in the physical sciences and engineering, and develops measurement techniques, test methods, standards, and related services. The Institute does generic and precompetitive work on new and advanced technologies. NIST’s research facilities are located at Gaithersburg, MD 20899, and at Boulder, CO 80303. Major technical operating units and their principal activities are listed below. For more information contact the Public Inquiries Desk, 301-975-3058.

**Office of the Director**
- Advanced Technology Program
- Quality Programs
- International and Academic Affairs

**Technology Services**
- Manufacturing Extension Partnership
- Standards Services
- Technology Commercialization
- Measurement Services
- Technology Evaluation and Assessment
- Information Services

**Materials Science and Engineering Laboratory**
- Intelligent Processing of Materials
- Ceramics
- Materials Reliability
- Polymers
- Metallurgy
- Reactor Radiation

**Chemical Science and Technology Laboratory**
- Biotechnology
- Chemical Kinetics and Thermodynamics
- Analytical Chemical Research
- Process Measurements
- Surface and Microanalysis Science
- Thermophysics

**Physics Laboratory**
- Electron and Optical Physics
- Atomic Physics
- Molecular Physics
- Radiometric Physics
- Quantum Metrology
- Ionizing Radiation
- Time and Frequency
- Quantum Physics

**Manufacturing Engineering Laboratory**
- Precision Engineering
- Automated Production Technology
- Intelligent Systems
- Manufacturing Systems Integration
- Fabrication Technology

**Electronics and Electrical Engineering Laboratory**
- Microelectronics
- Law Enforcement Standards
- Electricity
- Semiconductor Electronics
- Electromagnetic Fields
- Electromagnetic Technology
- Optoelectronics

**Building and Fire Research Laboratory**
- Structures
- Building Materials
- Building Environment
- Fire Safety
- Fire Science

**Computer Systems Laboratory**
- Office of Enterprise Integration
- Information Systems Engineering
- Systems and Software Technology
- Computer Security
- Systems and Network Architecture
- Advanced Systems

**Computing and Applied Mathematics Laboratory**
- Applied and Computational Mathematics
- Statistical Engineering
- Scientific Computing Environments
- Computer Services
- Computer Systems and Communications
- Information Systems

---

1 At Boulder, CO 80303.
2 Some elements at Boulder, CO 80303.
The Journal of Research of the National Institute of Standards and Technology features advances in measurement methodology and analyses consistent with the NIST responsibility as the nation’s measurement science laboratory. It includes reports on instrumentation for making accurate and precise measurements in fields of physical science and engineering, as well as the mathematical models of phenomena which enable the predictive determination of information in regions where measurements may be absent. Papers on critical data, calibration techniques, quality assurance programs, and well-characterized reference materials reflect NIST programs in these areas. Special issues of the Journal are devoted to invited papers in a particular field of measurement science. Occasional survey articles and conference reports appear on topics related to the Institute’s technical and scientific programs.

ISSN 1044-677X  Coden: JRITF  Library of Congress Catalog Card No.: 89-656121

## Contents

### Articles

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The NIST Detector-Based Luminous Intensity Scale</td>
<td>C. L. Cromer, G. Eppeldauer, J. E. Hardis, T. C. Larason, Y. Ohno, and A. C. Parr</td>
<td>109</td>
</tr>
<tr>
<td>The NIST High Accuracy Scale for Absolute Spectral Response from 406 nm to 920 nm</td>
<td>T. C. Larason, S. S. Bruce, and C. L. Cromer</td>
<td>133</td>
</tr>
<tr>
<td>Irradiance of Horizontal Quartz-Halogen Standard Lamps</td>
<td>Edward A. Early and Ambler Thompson</td>
<td>141</td>
</tr>
<tr>
<td>Development of the Ion Exchange-Gravimetric Method for Sodium in Serum as a Definitive Method</td>
<td>John R. Moody and Thomas W. Vetter</td>
<td>155</td>
</tr>
<tr>
<td>The MasPar MP-1 As a Computer Arithmetic Laboratory</td>
<td>Michael A. Anuta, Daniel W. Lozier, and Peter R. Turner</td>
<td>165</td>
</tr>
<tr>
<td>Evidence That Voltage Rather Than Resistance is Quantized in Breakdown of the Quantum Hall Effect</td>
<td>M. E. Cage</td>
<td>175</td>
</tr>
</tbody>
</table>

### News Briefs

#### GENERAL DEVELOPMENTS

- Training Program for Former Soviet Experts Standards Specialists Assigned to Embassies
- New Videos on ‘95 Baldrige Award Winners Released
- Order-of-Magnitude Reduction Realized in Contribution of Alignment Errors to NIST Watt Balance Uncertainty
- Standard Developed for Rechargeable Batteries for Personal Transceivers
- Tutorial on Microwave Measurements Aids Wireless Communications Industry
- Unique 20-Year-Old High-Energy Laser Calorimeter Returned to NIST for Refurbishment
- Diode-Laser Wavelength Standard for Absolute Distance Measurement Delivered
- NIST’s Approach to Be Used for Unifying the International Rockwell Hardness Scales
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>184</td>
<td>Surface Waves</td>
</tr>
<tr>
<td>185</td>
<td>NIST/IEEE Co-Sponsor Smart Sensor Workshop</td>
</tr>
<tr>
<td></td>
<td>NIST Coordinates International Laboratory Test of DNA Profiling Method</td>
</tr>
<tr>
<td>186</td>
<td>Novel Measurement Method for Detecting Proton Pumping</td>
</tr>
<tr>
<td></td>
<td>Chemical Mechanism for Fluorocarbons Is Published</td>
</tr>
<tr>
<td></td>
<td>Femtochemistry at Surfaces Using Tunnel Junctions</td>
</tr>
<tr>
<td></td>
<td>Breakthrough in Discriminating Anthropogenic From Natural Sources of</td>
</tr>
<tr>
<td></td>
<td>Individual Chemical Compounds in the Atmosphere</td>
</tr>
<tr>
<td>187</td>
<td>New System Developed for the Direct Transfer of Fundamental Wavelength Standards</td>
</tr>
<tr>
<td></td>
<td>New Method to Fabricate Gratings for Coupling Light Into Planar Waveguide Sensors</td>
</tr>
<tr>
<td></td>
<td>Patent Issued for Flow Injection Immunoassay Technique</td>
</tr>
<tr>
<td>188</td>
<td>CGPM Eliminates Class of Supplementary Units in the SI</td>
</tr>
<tr>
<td>189</td>
<td>ISO TAG 4 Proposes Creation of FICOM</td>
</tr>
<tr>
<td></td>
<td>Spontaneous Pattern Formation in Growth of Iron Films</td>
</tr>
<tr>
<td></td>
<td>Liquid Crystal Displays: Buried Interfaces Characterized</td>
</tr>
<tr>
<td>190</td>
<td>A New Database of Optical Constants for X Rays</td>
</tr>
<tr>
<td></td>
<td>NIST-Designed Crystal Monochromators Provide Calibration Resources for Space Astronomy</td>
</tr>
<tr>
<td></td>
<td>CIRMS Holds Fourth Annual Meeting at NIST</td>
</tr>
<tr>
<td>191</td>
<td>Dosimetry for Intravascular Radiation Sources</td>
</tr>
<tr>
<td></td>
<td>Voltage Noise in Chemical Cells</td>
</tr>
<tr>
<td>192</td>
<td>Rabi Pedestal Shifts as a Diagnostic Tool in Primary Frequency Standards</td>
</tr>
<tr>
<td></td>
<td>An Improved Variance for Characterizing Oscillators</td>
</tr>
<tr>
<td></td>
<td>Observation of a Schrödinger Cat State</td>
</tr>
<tr>
<td></td>
<td>Improved CO₂ Laser</td>
</tr>
<tr>
<td>193</td>
<td>Fundamental Limits on the Frequency Stabilities of Crystal Oscillators</td>
</tr>
<tr>
<td></td>
<td>Improvements in the AT1 Time Scale</td>
</tr>
<tr>
<td></td>
<td>IR Laser Studies of Ozone Chemical Chain Reaction Kinetics</td>
</tr>
<tr>
<td>194</td>
<td>Workshop Addresses Moisture Effects on Polymer Performance</td>
</tr>
<tr>
<td></td>
<td>High-Speed Laser Polarimetry System Developed</td>
</tr>
<tr>
<td></td>
<td>Thermal Anisotropy in Polycrystalline Bi₂Te₃</td>
</tr>
<tr>
<td></td>
<td>Implementing Agreement Between NIST and Korean Institute of Energy Research</td>
</tr>
<tr>
<td></td>
<td>New Publication Presents Infoserver Case Study</td>
</tr>
<tr>
<td></td>
<td>Technique of Basis Set Testing Described</td>
</tr>
<tr>
<td></td>
<td>NIST Collaborates With the American National Standards Institute (ANSI)</td>
</tr>
<tr>
<td></td>
<td>on Electronic Access to Standards</td>
</tr>
<tr>
<td></td>
<td>Telecommunications Security Guidelines Issued</td>
</tr>
<tr>
<td></td>
<td>NIST Offers Improved Mammography X-Ray Standards</td>
</tr>
<tr>
<td>195</td>
<td>STEP Making Great Strides</td>
</tr>
<tr>
<td></td>
<td>Partners to Better Assess ‘‘Coats of Many Colors’’</td>
</tr>
<tr>
<td></td>
<td>High-Flying Experiment Seeks Safer Spaceflight</td>
</tr>
</tbody>
</table>
NIST Helps Power Grids Make “Lightning Saves”
Software Reduces Touch Probe Errors
Paper Shows Fiber Healthy for Commercial Sensors
Boiling Data Offers Cooler Tomorrow

   for Geometrical Optical Fiber and Connector Parameters
New Software Advances Measurements for Wireless Applications

NIST Calibrates Probes for Industry and for Near-field Microwave Antenna Testing
NIST Hosts Radar Cross Section Working Group
NIST Identifies a Major Source of Bias in the Industrial Measurement of
   Moisture in Transformer Oils

Two New NIST Precision Measurement Grants Awarded for FY 96
New Calibration of $^{65}$Ni Performed, Confirms Previous NIST Calibrations Over Past 27 Years

Potential Bone Pain Palliation Radiopharmaceutical $^{117}$mSn Calibrated
IUPAC Sets Wavenumber Standards for the Infrared
NIST and NSF Collaborate on LCD Research

Development of a New Temperature Measurement Sensor for Plastics Processing
Phase-Field Modeling of Alloy Solidification
Quasi-Laue Neutron Diffraction for Biological Structure
Simulation of Stairwell Fires

BFRL Supports Major Demonstration of BACnet
NIST Hosts Delegation from the Japanese Science and Technology Agency
NIST Sponsors Symposium on Usability Engineering

New Report Focuses on Virtual Environments and Related Technologies for Health Care
New Publication Surveys Open Management Approaches for Distributed Systems
Performance Measurement Research Advances
Standard Generalized Markup Language (SGML) Test Suites Evaluated

STANDARD REFERENCE MATERIALS

Major Revision of Coating Thickness Standard Reference Materials 1357 through 1364a

New SRM for Plasma-Spray Powders

STANDARD REFERENCE DATA

New and Improved REFPROP Ready for Market