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*NBS Special Publication 305
Supplement 16*

Publications of the National Bureau of Standards 1984 Catalog

PUBLICATIONS



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1984

**U.S. Department of Commerce
National Bureau of Standards**

The National Bureau of Standards¹ was established by an act of Congress on March 3, 1901. The Bureau's overall goal is to strengthen and advance the nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau's technical work is performed by the National Measurement Laboratory, the National Engineering Laboratory, the Institute for Computer Sciences and Technology, and the Center for Materials Science.

The National Measurement Laboratory

Provides the national system of physical and chemical measurement; coordinates the system with measurement systems of other nations and furnishes essential services leading to accurate and uniform physical and chemical measurement throughout the nation's scientific community, industry, and commerce; provides advisory and research services to other Government agencies; conducts physical and chemical research; develops, produces, and distributes Standard Reference Materials; and provides calibration services. The Laboratory consists of the following centers:

- Basic Standards²
- Radiation Research
- Chemical Physics
- Analytical Chemistry

The National Engineering Laboratory

Provides technology and technical services to the public and private sectors to address national needs and to solve national problems; conducts research in engineering and applied science in support of these efforts; builds and maintains competence in the necessary disciplines required to carry out this research and technical service; develops engineering data and measurement capabilities; provides engineering measurement traceability services; develops test methods and proposes engineering standards and code changes; develops and proposes new engineering practices; and develops and improves mechanisms to transfer results of its research to the ultimate user. The Laboratory consists of the following centers:

- Applied Mathematics
- Electronics and Electrical Engineering²
- Manufacturing Engineering
- Building Technology
- Fire Research
- Chemical Engineering²

The Institute for Computer Sciences and Technology

Conducts research and provides scientific and technical services to aid Federal agencies in the selection, acquisition, application, and use of computer technology to improve effectiveness and economy in Government operations in accordance with Public Law 89-306 (40 U.S.C. 759), relevant Executive Orders, and other directives; carries out this mission by managing the Federal Information Processing Standards Program, developing Federal ADP standards guidelines, and managing Federal participation in ADP voluntary standardization activities; provides scientific and technological advisory services and assistance to Federal agencies; and provides the technical foundation for computer-related policies of the Federal Government. The Institute consists of the following centers:

- Programming Science and Technology
- Computer Systems Engineering

The Center for Materials Science

Conducts research and provides measurements, data, standards, reference materials, quantitative understanding and other technical information fundamental to the processing, structure, properties and performance of materials; addresses the scientific basis for new advanced materials technologies; plans research around cross-country scientific themes such as nondestructive evaluation and phase diagram development; oversees Bureau-wide technical programs in nuclear reactor radiation research and nondestructive evaluation; and broadly disseminates generic technical information resulting from its programs. The Center consists of the following Divisions:

- Inorganic Materials
- Fracture and Deformation³
- Polymers
- Metallurgy
- Reactor Radiation

¹Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Gaithersburg, MD 20899.

²Some divisions within the center are located at Boulder, CO 80303.

³Located at Boulder, CO, with some elements at Gaithersburg, MD.

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*NBS Special Publication 305
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Rebecca J. Morehouse, Editor

*Information Resources and Services Division
National Bureau of Standards
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Ernest Ambler, Director*

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CATALOG STRUCTURE

Bibliographic citations, keywords, and abstracts for National Bureau of Standards papers published and entered into the National Technical Information Service collection are cited herein in the NTIS format. (Also included are NBS papers published prior to 1984 but not reported in previous supplements of this annual catalog.)

Entries are arranged by COSATI (Committee on Scientific and Technical Information) classification. The COSATI

system includes 22 broad subject categories (see back cover) and 178 subcategories. A booklet describing these categories is available from NTIS. Within a subcategory, entries are listed alphanumerically by NTIS order number.

Four indexes are included to allow the user to cross reference NBS papers by personal author, keywords, title, and NTIS order/report number. Each index entry lists the corresponding title, NTIS order number and abstract number.

AVAILABILITY AND ORDERING INFORMATION

The highest quality and least expensive copies of those NBS publications which are published by the Government are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Publications cited with stock numbers (SN) should be purchased from this source by these numbers. The GPO will accept payment by check, money order, VISA, MasterCard, or deposit account. For availability and price, write to the GPO at the above address or telephone (202) 783-3258. Should an NBS publication be out of print at the GPO, its continued availability is assured by NTIS which sells publications in microfiche or paper copy which is reproduced from the microfiche.

If an entry has a price code, such as PC A04/MF A01, the publication may be ordered from NTIS in paper copy (PC) or microfiche (MF) or both if both codes are given. Order from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. A copy of the latest price code schedule is available from NTIS. NTIS will accept payment by check, money order, VISA, American Express, MasterCard, or deposit account. NTIS also is the sole source of Federal Information Processing Standards (FIPS), National Bureau of Standards Interagency Reports (NBSIRs), and Grant/Contract Reports (GCRs).

Sometimes, papers noted "Not Available NTIS" may be obtained directly from the author or from the external

publisher cited. Such papers published are not for sale by either the GPO or NTIS.

Two other sources for NBS publications are depository libraries (libraries designated to receive Government publications) and Department of Commerce District Offices. The depository libraries listed in Appendix A receive selected publication series of the National Bureau of Standards for general reference use (see inside back cover for a description of the various NBS publication series). While every Government publication cannot be sent to all depository libraries, certain depositories which have been designated Regional Depositories are required to receive and retain one copy of all Government publications made available either in printed or microfiche form. Contact the depository library in your area to obtain information on what publications are available and where.

Department of Commerce District Offices listed in Appendix B provide ready access at the local level to publications, statistical data and summaries, and surveys. Each District Office serves as an official sales agency of the Superintendent of Documents, U.S. Government Printing Office. A wide range of Government publications can be purchased from these offices. In addition, the reference library maintained by each District Office contains many review copies of Government and private publications, periodicals, directories, reports, and other reference materials.

NBS PUBLICATIONS ANNOUNCEMENTS

SAMPLE ENTRY

7.
Chemistry

7A. Chemical Engineering
400,129
PB83-165068 PC A03/MF A01
National Bureau of Standards, Boulder, CO, National Engineering Lab.
Membrane Separations in Chemical Processing
Thomas M. Flynn and J. Douglas Way. Dec. 82, 28 p.
NBSIR 82-1675
Contract F-000000

Keywords: *Membranes, *Energy conservation, Separations, Chemical industry. . .

Rapidly rising energy and operating costs have underscored the need for novel energy efficient separations processes. . .

NTIS Subject Category

NTIS Subcategory
Abstract number
NTIS order number Availability **Price Codes**
Corporate or performing organization

Report title
Personal authors Report date Page count
Report number(s)
Contract or grant number(s)

Keywords: * indicates keyword index entry

Abstract

1. AERONAUTICS

1A. Aerodynamics

400,001
PB84-221068 Not available NTIS
National Bureau of Standards, Washington, DC.
Wind Loading and Strength of Cladding Glass.
Final rept.,
D. A. Reed, and E. Simiu. Apr 84, 15p
See also PB83-214189.
Pub. in Jnl. of Struct. Eng. 110, n4 p715-729 Apr 84.

Keywords: *Glass, *Loads(Forces), *Aerodynamics, *Wind pressure, *Cladding, Buildings, Probability theory, Windows, Failure, Reprints.

A procedure for investigating glass cladding behavior under arbitrary loads, including fluctuating wind loads, was presented. The procedure accounts for the fact that internal stresses are nonlinear functions of the external loads, that initial glass strengths are random functions of position and direction, and that the glass

strength undergoes degradation under the action of external loads in accordance with basic fracture mechanics laws that reflect subcritical crack growth. Numerical examples were presented and corresponding probability distribution curves were calculated, indicating the probability of failure of a specified panel subjected to fluctuating wind loads and to 1-minute constant loads. These curves were used to illustrate a methodology for assessing current glass cladding design procedures. For the case considered in the paper it was found that procedures based on the transformation of the peak wind load averaged over 1-2 seconds into an equivalent 1-minute load appear to result in overly optimistic assessments of the probability of failure of glass cladding under wind loads. The work reported in the paper is part of an ongoing window cladding research program being conducted at the National Bureau of Standards.

400,002
PB84-221712 Not available NTIS
National Bureau of Standards, Washington, DC.
Probabilistic Design of Cladding Glass Subjected to Wind Loads.
Final rept.,
E. Simiu, and D. A. Reed. 1983, 22p
Pub. in Proceedings of International Conference on Application Statistics Probability Soil and Structural Engineering (4th), Florence, Italy, June 13-17, 1983, p1339-1360.

Keywords: *Glass, *Loads(Forces), *Aerodynamics, *Wind pressure, *Cladding, Buildings, Probability theory, Windows, Failure, Design criteria.

In the past decade significant advances have been made in the application of fracture mechanics concepts to the analysis of the strength of glass. To date, these advances have not been synthesized with current knowledge in the areas of extreme wind climatology and building aerodynamics. The objective of this paper is to describe a methodology based on such a synthesis that allows the development of risk-consistent design criteria for cladding glass applicable to buildings with known orientation for which the aerodynamic information is obtained in the wind tunnel. The paper is divided into four parts. The first part consists of introductory and background material, including definitions of basic terms and a brief description of the constituent elements of any procedure for the design of cladding glass. The second part presents a critique of current glass cladding design practice in the United States. The third and fourth parts describe, respectively, the proposed methodology and its fracture mechanics component.

Field 1—AERONAUTICS

Group 1B—Aeronautics

1B. Aeronautics

400,003
PB84-244649 Not available NTIS
National Bureau of Standards, Washington, DC.
Some Analyses of the FAA (Federal Aviation Administration) Post Crash Aircraft Fire Scenario.
Final rept.,
J. G. Quintiere. May 83, 13p
Sponsored in part by Federal Aviation Administration Technical Center, Atlantic City, NJ.
Pub. in Fire Technologies 19, n2 p77-89 May 83.

Keywords: *Aircraft fires, Aviation accidents, Aviation safety, Crash landing, Mathematical models, Reprints.

An attempt is made to develop mathematical predictions for various aspects of the dynamics of post crash aircraft fires. The basis of the analysis is the experimental simulation scenario under study by the FAA. The effects of wind are considered as well as the effect of interior and exterior fires. Suggestions are presented for estimating cabin door flow rates from measured temperatures.

400,004
PB85-145647 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Thermal Response of Aircraft Cabin Ceiling Materials during a Post-Crash, External Fuel-Spill, Fire Scenario.
L. Y. Cooper. Oct 84, 53p NBSIR-84/2912
Sponsored by Federal Aviation Administration, Washington, DC.

Keywords: *Aircraft fires, Fire tests, Aviation accidents, Aviation safety, Aviation fuels, Algorithms, Ceilings(Architecture), Materials, Fire safety, Fire resistant materials, Aircraft seats, *Aircraft crash fires, Exit, Emergency escape, Fire spread, Thermal response, Fuel spillage.

An algorithm is developed to predict the thermal response of aircraft ceiling materials during a post-crash fire scenario. The scenario involves an aircraft's emergency exit doorway which opens directly onto the flames of an external, fuel-spill fire which engulf a large portion of the fuselage. Data of near-ceiling temperatures acquired during a series of eight, full-scale, wide-body aircraft cabin, post-crash test simulations provide indirect validation of the algorithm. These tests involved cabins outfitted with single, mockup seats. Two other full-scale cabin tests involving fire spread through twenty-one seat arrays with different types of seat construction provide the input data required to exercise the algorithm in evaluations of fully outfitted cabins.

3.

ASTRONOMY AND ASTROPHYSICS

3B. Astrophysics

400,005
PB84-218445 Not available NTIS
National Bureau of Standards, Washington, DC.
Radio Searches for Additional Interstellar Molecules.
Final rept.,
J. M. Hollis, R. D. Suenram, F. J. Lovas, and L. E. Snyder. 1983, 7p
Pub. in Astronomy and Astrophysics 126, p393-399 1983.

Keywords: *Radio astronomy, *Interstellar matter, Molecular energy levels, Nitrogen oxide(N₂O), Sodium hydroxide, Sulfur dioxide, Molecular rotation, Acetic acid, Reprints, Sagittarius B2, Orion A, Formic acid/

(methyl-ester), Cyanic acid/(ethyl-ester), Formic acid/diamino.

The authors report 2-mm wavelength range observations which yield new interstellar molecular transitions of NH₂CHO, SO₂, H₂CCO, U150820.5 and U150850.0 toward Sgr B2 and SO₂, CH₂CHCN, HCOOCH₃, and U153513.0 toward Orion A. They conducted the first interstellar searches for HOCl, CH₃CH₂CCH, and CH₃SiH₃ but did not detect these species. During these observations limits were also obtained on 2-mm wave transitions of N₂O and NaOH toward several galactic sources of molecular emission.

400,006
PB84-220037 Not available NTIS
National Bureau of Standards, Washington, DC.
Computations and Estimates of Rate Coefficients for Hydrocarbon Reactions of Interest to the Atmospheres of the Outer Solar System.
Final rept.,
A. H. Laufer, E. P. Gardner, T. L. Kwok, and Y. L. Yung. 1983, 5p
Sponsored in part by National Oceanic and Atmospheric Administration Washington, DC.
Pub. in ICARUS 56, p560-567 1983.

Keywords: *Reaction kinetics, *Hydrocarbons, *Planetary atmospheres, Chemical reactions, Chemical bonds, Mathematical models, Three body problem, Reprints, Arrhenius parameters, Numerical solution.

The rate coefficients, including Arrhenius parameters, have been computed for a number of chemical reactions involving hydrocarbon species for which experimental data are not available and which are important in planetary atmospheric models. The techniques used to calculate the kinetic parameters include the Troe and semi-empirical Bond Energy-Bond Order (BEBO) or Bond Strength-Bond Length (BSBL) methods.

400,007
PB84-221308 Not available NTIS
National Bureau of Standards, Washington, DC.
Sigma Geminorum (K1 III +): Variability of the Ultraviolet Emission Lines Near Conjunction.
Final rept.,
T. R. Ayres, T. Simon, and J. L. Linsky. Apr 84, 5p
Grant NGL-06-003-057
Pub. in Astrophysical Jnl. 279, n3 p197-201 Apr 84.

Keywords: *Stars, Emission spectra, Ultraviolet spectra, Stellar spectra, Far ultraviolet radiation, Oxygen, Magnesium, Silicon, Carbon, Line spectra, Reprints, *Stellar chromospheres, Late stars, IUE.

The authors report far-ultraviolet IUE echelle spectra of the moderate-period RS CVn system sigma Geminorum (K1 III + unknown). Despite the location of the red giant primary of sigma Gem in a portion of the H-R diagram where cool stellar winds are common, the authors find no evidence for circumstellar absorption features or blueward asymmetries in the chromospheric O I (or Mg I and Mg II) emission cores. However, observations on two consecutive days indicate significant changes in the profiles of high-excitation species, such as Si IV and C IV, which likely were produced by the rotation off of the visible hemisphere of the primary of a large-scale magnetic active region identified in a previous photometric study.

400,008
PB84-238419 Not available NTIS
National Bureau of Standards, Washington, DC.
Redshifts of High-Temperature Emission Lines in the Far-Ultraviolet Spectra of Late-Type Stars.
Final rept.,
T. R. Ayres, R. E. Stencel, J. L. Linsky, T. Simon, and C. Jordan. 15 Nov 83, 14p
Grant NGL-06-003-057
Pub. in Astrophysical Jnl. 274, n3 p801-814, 15 Nov 83.

Keywords: *Stellar spectra, *Red shift, Ultraviolet spectra, Far ultraviolet radiation, Stellar atmospheres, Reprints, Stellar chromospheres, Late stars, Stellar winds, Stellar coronas, IUE.

High-dispersion IUE spectra of six late-type stars exhibit small but statistically significant differential redshifts of high-temperature emission lines, like Si IV and C IV, with respect to low-temperature lines like S I and O I. The authors discuss several possible explanations for the stellar redshifts, including a warm wind (100,000 K) in which apparent redshifts are produced in optically thick lines by an accelerating outflow, and

the downflowing component of a vertical circulation system for which the up-leg portion of the flow is too cool, too hot, or too tenuous to be visible in Si IV and C IV.

400,009
PB84-239292 Not available NTIS
National Bureau of Standards, Washington, DC.
Stellar Chromospheres and Coronae in the Ursa Major Cluster Stars.
Final rept.,
F. M. Walter, J. L. Linsky, T. Simon, L. Golub, and G. S. Vaiana. Jun 84, 11p
Grant NGL-06-003-057
Pub. in Astrophysical Jnl. 281, p815-825 Jun 84.

Keywords: Stellar atmospheres, Ultraviolet spectra, X rays, Stellar spectra, Dwarf stars, Reprints, *Stellar chromospheres, *Stellar coronas, Ultraviolet astronomy, Late stars, IUE.

The authors discuss IUE spectra of 16 proposed members of the Ursa Major Cluster and Einstein X-ray images of nine of these stars and one additional star. It is found that 12 of these stars (six in the Nucleus and six in the Stream) exhibit bright ultraviolet and/or X-ray emission indicating that they are bona fide members of the young Ursa Major Cluster, whereas four stars (one in the Nucleus and three in the Stream) exhibit weak emission and are probably old field stars that have space velocities similar to the Cluster.

400,010
PB84-239946 Not available NTIS
National Bureau of Standards, Washington, DC.
Outer Atmospheres of Cool Stars. XV. High Dispersion Ultraviolet Studies of Active Chromospheres G-K Dwarfs with IUE.
Final rept.,
T. R. Ayres, J. L. Linsky, T. Simon, C. Jordan, and A. Brown. 15 Nov 83, 10p
Grant NGL-06-003-057
See also PB84-138338.
Pub. in Astrophysical Jnl. 274, n3 p784-793, 15 Nov 83.

Keywords: *Stellar atmospheres, Ultraviolet spectra, Stars, Reprints, Stellar chromospheres, Stellar coronas, Late stars.

The authors have obtained IUE ultraviolet echelle spectra of three late-type active-chromosphere dwarf stars—chi Orionis (G0 V), xi Bootis A (G8 V) and epsilon Eridani (K2 V)—which they compare with previously published observations of the quiet chromosphere dwarfs alpha Centauri A (G2 V) and alpha Centauri B (K1 V).

400,011
PB84-239961 Not available NTIS
National Bureau of Standards, Washington, DC.
First Detection of Winds in Red Giants by Microwave Continuum Techniques.
Final rept.,
S. A. Drake, and J. L. Linsky. 15 Nov 83, 5p
Grant NGL-06-003-057
Pub. in Astrophysical Jnl. Letters 274, n3 pL77-L61, 15 Nov 83.

Keywords: Extraterrestrial radio waves, Reprints, *Red giant stars, *Stellar winds, Stellar chromospheres, Late stars, Mass loss, Microwave emission.

The authors have observed six nearby red giants at 4885 MHz (6 cm) with the Very Large Array in an attempt to detect continuum emission. Results are discussed.

400,012
PB84-242072 Not available NTIS
National Bureau of Standards, Washington, DC.
Microwave Emission from the Coronae of Late-Type Dwarf Stars.
Final rept.,
J. L. Linsky, and D. E. Gary. 15 Nov 83, 8p
Grant NGL-06-003-057
Pub. in Astrophysical Jnl. 274, n3 p776-783, 15 Nov 83.

Keywords: *Dwarf stars, Stellar magnetic fields, Extraterrestrial radio waves, Flare stars, Reprints, *Stellar coronas, *Microwave emission, Late stars.

The authors present VLA microwave observations of 14 late-type dwarf and subgiant stars and binary sys-

tems. This may provide the first direct evidence that the emission process is magnetic in character on dMe stars.

400,013
PB84-243849 Not available NTIS
 National Bureau of Standards, Washington, DC.
X-ray Sources in Molecular Clouds.
 Final rept.,
 S. Lepp, and R. McCray. 15 Jun 83, 8p
 Pub. in *Astrophysical Jnl.* 269, p560-567, 15 Jun 83.

Keywords: *Interstellar matter, Infrared spectra, Emission spectra, Models, Reprints, *Molecular clouds, *X ray sources, Infrared astronomy.

Models are calculated for the structure and infrared line emission from a dense interstellar gas cloud containing a compact X-ray source. For constant gas pressure models, the resulting structure consists of nested spherical shells containing, respectively, coronal gas at $T > 1,000,000$ K, an H II region with T about 10,000 K, an H I region with T about 8000 K, and finally an H(2) region with $T < 5000$ K. Scaling laws are given for the locations of the transitions. Approximately 10% of the X-ray luminosity absorbed in the H(2) region is converted into infrared emission lines that may be observable. Line ratios are predicted.

400,014
PB85-100261 Not available NTIS
 National Bureau of Standards, Washington, DC.
Outbursts of Dwarf Novae.
 Final rept.,
 J. Smak. 1984, 14p
 Pub. in *Jnl. of the Publications of the Astronomical Society of the Pacific* 96, n575 p5-18 1984.

Keywords: *Novae, *Dwarf stars, Reprints, Star accretion, Instability.

A review is given of the observational facts related to the outbursts of dwarf novae and of the relevant aspects of the theory of accretion disks. It now appears possible to explain the outbursts of dwarf novae in terms of a nonstationary accretion behavior.

400,015
PB85-100287 Not available NTIS
 National Bureau of Standards, Washington, DC.
Variability of Cool Stars at Optical and Ultraviolet Wavelengths.
 Final rept.,
 J. L. Linsky, P. L. Bornman, M. Rondo, V. Pazzani, and A. D. Andrews. 1982, 3p
 Pub. in *Proceedings of Third European IUE Conference, Madrid, Spain, May 10-13, 1982*, p165-167.

Keywords: *Stars, Light(Visible radiation), Ultraviolet radiation, Variability, *Flare stars, Stellar chromospheres, IUE.

Preliminary results of a collaborative observation program, involving ESS, NASA and SERC guest investigators with the International Ultraviolet Explorer, are presented. During thirteen eight-hour shifts, the flare star AU Mic was observed simultaneously with ground-based optical observations. In addition to one definite flaring event, remarkable changes of the BY Dra-type optical light curve and evidence of slow variability in the chromospheric and transition region (TR) line fluxes -- probably due to the rotational modulation of photospheric starspots and plages, respectively -- were found.

400,016
PB85-100303 Not available NTIS
 National Bureau of Standards, Washington, DC.
Second-Order Escape Probability Approximations in Radiative Transfer.
 Final rept.,
 D. G. Hummer, and R. B. Rybicki. 15 Dec 82, 10p
 Grant NSF-AST80-19874
 Pub. in *Astrophysical Jnl.* 263, n2 p925-934, 15 Dec 82.

Keywords: Stellar spectra, Approximation, Photons, Reprints, *Radiative transfer, Escape probability.

Second-order escape-probability approximations make some allowances for the transfer of radiation between the point where a photon is created and that where it escapes or is absorbed. An approximation of this kind has recently been formulated by Peutter et al. for planar atmospheres of finite thickness, in the form of a first-order differential equation relating the inte-

grated mean intensity to the source function. The authors give two alternative normalizations to the one proposed by these authors; the first of these enforces global conservation of photons in each transition, and the second gives reasonably accurate results for much less computational effort than the first.

400,017
PB85-100311 Not available NTIS
 National Bureau of Standards, Washington, DC.
Coordinated Einstein and IUE Observations of a 'Disparitions Brusques' Type Flare Event and Quiescent Emission from Proxima Centauri.
 Final rept.,
 B. M. Haisch, J. L. Linsky, P. L. Bornman, R. E. Stencel, and S. K. Antiochos. Apr 83, 11p
 Contract NAG5-82, Grant NGL-06-003-057
 Pub. in *Astrophysics Jnl.* 267, n1 p280-290 Apr 83.

Keywords: *Stars, Ultraviolet spectra, X rays, Reprints, *Flare stars, *Proxima Centauri star, Stellar chromospheres, Stellar coronas, IUE, HEAO 2.

The authors report on simultaneous Einstein and IUE observations of the dM5e flare star Proxima Centauri during a five hour period in August 1980.

400,018
PB85-100329 Not available NTIS
 National Bureau of Standards, Washington, DC.
OH/IR Stars: Late Stages of Evolution of Intermediate-Mass Stars.
 Final rept.,
 T. de Jong. Nov 83, 9p
 Pub. in *Astrophysical Jnl.* 274, p252-260 Nov 83.

Keywords: *Stellar evolution, *Radio astronomy, *Masers, Reprints, *Infrared stars, Hydroxyl radicals, Mass loss.

In this paper the author attempts to interpret a large body of radio and infrared data of OH/IR stars in terms of our present understanding of stellar evolution.

400,019
PB85-104669 Not available NTIS
 National Bureau of Standards, Washington, DC.
HEAO-1 Observations of X-ray Emission from Flares on dMe Stars.
 Final rept.,
 S. M. Kahn, J. L. Linsky, K. O. Mason, B. M. Haisch, and C. S. Bowyer. 1979, 1p
 Sponsored in part by National Aeronautics and Space Administration, Washington, DC.
 Pub. in *Astrophysical Jnl.* 234, n2 p107 1979.

Keywords: *X ray spectra, Stars, Reprints, *Stellar flares, X ray sources.

The authors report the detection of 2 X-ray flares from each of the nearby dMe stars, AT Mic and AD Leo, with the A2 experiment on board HEAO-1.

400,020
PB85-108603 Not available NTIS
 National Bureau of Standards, Washington, DC.
Extensive Galactic Search for Conformer II Glycine.
 Final rept.,
 L. E. Snyder, J. M. Hollis, R. D. Suenram, F. J. Lovas, and L. W. Brown. 1 May 83, 6p
 Pub. in *Astrophysical Jnl.* 268, p123-128, 1 May 83.

Keywords: *Interstellar matter, *Glycine, Reprints.

The authors have conducted the most extensive galactic search reported to date for conformer II glycine, a higher energy form of the simplest amino acid. The search utilized four glycine transitions at centimeter wavelengths and 21 at millimeter wavelengths to observe 18 galactic molecular sources and one comet. No conformer II glycine lines were detected and measurements of representative sources were used to compute upper limits on total column densities. Several unidentified lines were detected and are reported here with some suggested possible identifications.

400,021
PB85-111805 Not available NTIS
 National Bureau of Standards, Washington, DC.
New Interstellar Molecular Transitions in the 2-MM Range.
 Final rept.,
 J. M. Hollis, L. E. Snyder, D. H. Blake, F. J. Lovas, and R. D. Suenram. 1981, 30p
 Pub. in *Astrophysical Jnl.* 251, n2 p541-548 1981.

Keywords: *Interstellar matter, *Molecular energy levels, *Molecular rotation, *Rotational spectra, Methyl alcohol, Sulfur dioxide, Reprints, *Acetylene/methyl, Acetylene/cyano.

The authors derive a Sgr B2 kinetic temperature of about 47 K based on previously unreported observations of K-components of the 9K-8K transition of CH₃CCH. They searched for but did not detect the 14 sub (14,0)-13 sub (13,0), 14 sub (14,1)-13 sub (13,1), 15 sub (15,0)-14 sub (14,0) and 15 sub (15,1)-14 sub (14,1) transitions of H₂SO₄, the 25 sub (0,25)-24 sub (0,24) and 25 sub (1,25)-24 sub (1,24) transitions of HCOOCHO, the 4-3 transition of HCP, the 7-6 transition of OC(18 sup O), and the 2 sub (12)-1 sub (11) and 2 sub (02)-1 sub (01) transitions of HNO in several galactic molecular sources. They discuss the present evidence for the existence of interstellar HNO.

400,022
PB85-124360 Not available NTIS
 National Bureau of Standards, Washington, DC.
Accretion in Cataclysmic Binaries. 3. Helium Binaries.
 Final rept.,
 J. Smak. 1983, 5p
 Pub. in *Acta Astronomica* 33, n3-4 p333-337 1983.

Keywords: Helium, Reprints, *Accretion disks, White dwarf stars.

Models of the vertical structure of helium accretion disks show thermal instability in the temperature range corresponding to the helium ionization. The critical effective temperatures, $\log(T \text{ sub } e) = 4.1$ and 3.95 , are higher than in the case of hydrogen-rich disks. Of the two known helium cataclysmic binaries, AM CVn avoids the instability due to a high accretion rate, while GP Com - most likely - due to a very low accretion rate. Evidence is also presented to suggest that in GP Com the accretion pattern is modified by the magnetic field of the white dwarf.

400,023
PB85-129211 Not available NTIS
 National Bureau of Standards, Washington, DC.
Ratio of Mixing Length to Scale Height in Red Dwarfs.
 Final rept.,
 A. N. Cox, G. Shaviv, and S. W. Hodson. 1981, 1p
 Pub. in *Astrophysical Jnl.* 245, n1 p37 1981.

Keywords: *Dwarf stars, Helium 3, Mass, Luminosity, Reprints.

Previous completely convective theoretical models of low-mass stars, $M \text{ approx } = \text{ or } < 0.3 M_{\odot}$, predict a luminosity-mass relation which is below the observed one. The authors explain this disagreement by using the latest molecular opacities and by the consequent need to assume an I/H(p) ratio at $T < 9000$ K in the range 0.07-0.17, rather than the more conventional values of 1.0-2.0. When such a low surface layer I/H(p) ratio is assumed, we find significantly higher central temperatures (and hence luminosities) and quite large radiative cores, regardless of the deeper I/H(p) value and equation-of-state uncertainties. The low I/H(p) ratio is explained by the interaction of a magnetic field with convection. Several consequences of this result, including the interstellar abundance of 3He(+), are discussed.

Field 3—ASTRONOMY AND ASTROPHYSICS

Group 3B—Astrophysics

400,024

PB85-137461

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Feasibility of a $^{81}\text{Br}(\text{Nu}, e^-)^{81}\text{Kr}$ Solar Neutrino Experiment.

Final rept.,

G. S. Hurst, C. H. Chen, S. D. Kramer, B. T.

Cleveland, and R. Davis. 10 Sep 84, 4p

Contract DE-AC05-84OR21400

Pub. in Physical Review Letters 53, n11 p1116-1119, 10 Sep 84.

Keywords: Sun, Feasibility, Reprints, *Neutrino-electron interactions, *Solar neutrinos, Bromine 81, Krypton 79, Beryllium 7, Resonance ionization spectroscopy.

A solar neutrino experiment using the interaction of $^{81}\text{Br}(\text{nu}, e^-)^{81}\text{Kr}$ to study the ^{7}Be neutrino source in the interior of the sun is shown to be feasible. Resonance ionization spectroscopy was used to count less than 1000 atoms of 200,000-yr ^{81}Kr , making the bromine experiment possible. Except for the method of counting product atoms, the bromine experiment would be very similar to the successful chlorine detector $^{37}\text{Cl}(\text{nu}, e^-)^{37}\text{Ar}$, and thus it is a natural sequel to the only solar neutrino experiment to date.

400,025

PB85-141885

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Origin of Low-Velocity Absorption Components in the Magnesium II Resonance Lines of Hybrid-Chromosphere Stars.

Final rept.,

S. A. Drake, A. Brown, and J. L. Linsky. 15 Sep 84,

10p

Sponsored by National Aeronautics and Space Administration, Washington, DC.

Pub. in Astrophysical Jnl. 284, n2 p774-783, 15 Sep 84.

Keywords: *Interstellar matter, Ultraviolet spectra, Reprints, *Stellar chromospheres, *Stellar envelopes, Stellar winds, Late stars, IUE.

The authors argue that the low velocity absorption features seen in the Mg II resonance lines of seven confirmed and three probable hybrid-chromosphere stars are interstellar rather than circumstellar in origin. From a comparison of radial velocities based on all available spectra in the IUE archives with estimates of the interstellar velocity along each line of sight, the authors found a good correlation between the observed position of the low velocity component and the predicted interstellar feature. They also show that previous arguments in favor of the circumstellar origin of the low velocity absorption features are either incorrect or implausible. Their conclusion may modify previously proposed models of hybrid star winds which have assumed a priori that both Mg II absorption components are circumstellar.

400,026

PB85-142289

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Indications of Circumstellar Ring Systems from SiO and H₂O Maser Lines.

Final rept.,

D. Van Blerkom. 1978, 5p

Grant NSF-AST76-22032

Pub. in Astrophysical Jnl. 223, n3 p835-839, 1 Aug 78.

Keywords: *Masers, Water vapor, Silicon oxides, Emission spectra, Line spectra, Reprints, *Stellar envelopes, Radiative transfer.

Several sources of maser line emission show a distinctive line profile; symmetrically displaced satellite components which flank a central feature. VY CMa, in particular, exhibits this type of profile in both SiO and H₂O maser lines. It is argued that a rotating disk, viewed nearly edge-on, is a likely source of these lines. In order to account for changes in the SiO profiles in the space of two years, it is found that the disk must be broken into concentric rings. The sizes and rotational speeds of the rings imply a stellar mass of no greater than 4 M(\odot), and thus suggest that VY CMa is not a highly evolved star, but one that is just emerging from a cocoon of gas and dust. The model proposed has a ring system about the star and a more distant expanding region which is the remnant of the cocoon blown out by radiation pressure: SiO and H₂O emission originates in the rings, while OH derives from the expanding gas. Although this is an attractive picture in many

ways, there are a number of problems associated with it.

400,027

PB85-142578

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Models for the Active and Quiescent Regions on the RS CVn-Type System 2 Pegasi (HD 224085).

Final rept.,

J. L. Linsky, A. Brown, N. C. Marstad, M. Rodono,

and A. D. Andrews. Jul 84, 4p

Grant NAG5-82

Pub. in Proceedings of European IUE Conference (4th), Rome, Italy, May 15-18, 1984, ESA SP-218, p351-354 Jul 84.

Keywords: *Binary stars, Stellar atmospheres, Ultraviolet spectra, Emission spectra, Faculae, IUE.

IUE observations of the RS CVn binary system II Pegasi obtained during the period 1981 October 1-7 have been used by Marstad to deduce the presence of a compact bright active region covering less than 10% of the primary's visible hemisphere. These same observations have not been used to derive the emission measure distributions and to calculate transition region models of the quiescent and plage (active) regions of II Peg. Active region models have been calculated assuming area coverages of 10, 6, 3 and 1% of the visible hemisphere. These models are used to provide lower limits to the electron pressure in the quiescent and plage regions, which are compared with the available density diagnostics. The amount of mechanical energy deposition required to account for the observed radiative losses is very large.

400,028

PB85-142586

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

High-Resolution, Far-Ultraviolet Study of Beta Draconis (G2 Ib-II): Transition Region Structure and Energy Balance.

Final rept.,

A. Brown, C. Jordan, R. E. Stencel, J. L. Linsky, and

T. R. Ayres. 15 Aug 84, 14p

Grants NAG5-82, NGL-06-003-057

Sponsored in part by Grants NAG5-199 and NAS5-26409.

Pub. in Astrophysical Jnl. 283, p731-744, 15 Aug 84.

Keywords: *Stars, Giant stars, Ultraviolet spectra, Far ultraviolet radiation, Emission spectra, Resolution, Reprints, *Beta Draconis star, Stellar chromospheres, Stellar coronas, Late stars, Supergiant stars, IUE.

High resolution far-ultraviolet spectra of the star beta Draconis have been obtained with the International Ultraviolet Explorer satellite. The observed emission-line fluxes have been used to derive the mean emission measure distribution, which is used to construct models of the density and temperature variation with height as a function of the transition region pressure. The range of appropriate pressures is investigated from density-sensitive line ratios and through arguments concerning line opacities.

400,029

PB85-143345

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Coordinated IUE and Ground-Based Observations of Active Stars: Flare Events on YZ CM1, V 1005 Ori, and Leo and AR Lac.

Final rept.,

M. Rodono, G. Cutispoto, S. Catalano, J. L. Linsky,

and D. M. Gibson. 1984, 6p

Pub. in Proceedings of European IUE Conference (4th), Rome, Italy, May 15-18, 1984, p247-252.

Keywords: Binary stars, Variable stars, *Stellar flares, IUE.

The authors present a preliminary report on coordinated observations of stellar flare obtained with IUE and several ground-based facilities, as part of collaborative campaigns carried out in February 1983, October 1983 and March 1984. One of the principal aims of these observations was that of observing stellar flare simultaneously over a wide range of wavelengths in order to study the effect of the flare radiation at different atmospheric levels. The authors' observations include time-resolved IUE and optical spectroscopy, narrow and wide-band optical photometry, IR photometry, and microwave observations. Among the major results are the first detection of IR flux decrease, or negative flare, in coincidence with flux increase at all of the other wavelengths.

400,030

PB85-143352

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Coronal Models Tested with IUE and Einstein Observations.

Final rept.,

R. Hammer, and J. L. Linsky. 1984, 8p

Grants NGL-06-003-057, NAG5-82

Pub. in Proceedings of European IUE Conference (4th), Rome, Italy, May 15-18, 1984, p25-32.

Keywords: *Stellar atmospheres, *Stellar coronas, Stellar chromospheres, HEAO 2, IUE.

The authors review recent compilations of IUE and Einstein observations which show that the emissions from the various outer layers of cool stars are nonlinearly correlated. This result can be used to test theoretical corona models as well as hypotheses on the mechanism that determines the location of the transition region. In stars in which most of the X-ray emission originates in small coronal loops, it may be necessary that part of the emitting plasma is hotter than 20 million K or, alternatively, that the transition region is not only heated by thermal conduction, but also by downflows. The authors discuss observational evidence for both these effects. Finally, they consider methods for analyzing the geometrical structure of outer stellar atmospheres.

400,031

PB85-143360

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Rotational Modulation of Spots and Plages on RS CVn Stars.

Final rept.,

P. B. Byrne, J. G. Doyle, A. D. Andrews, C. J. Butler,

and N. Marstad. 1984, 7p

Pub. in Proceedings of European IUE Conference (4th), Rome, Italy, May 15-18, 1984, p343-349.

Keywords: *Binary stars, *Variable stars, Emission spectra, Rotation, Modulation, *Faculae, IUE.

Observations of three RS CVn stars made with the IUE satellite are presented. Emission line fluxes are found to vary in anti-phase with the stars' optical variations. The authors interpret these correlations in terms of large-scale spots in the stellar photospheres with overlying magnetic loops, giving rise to nonthermal heating of the layers above the spots. Evidence of nonthermal gas motions is also presented which appear to be associated with the most active regions of the stars.

400,032

PB85-143378

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

IUE Observations of BY Draconis.

Final rept.,

C. J. Butler, J. G. Doyle, A. D. Andrews, P. B. Byrne,

and J. L. Linsky. 1984, 4p

Pub. in Proceedings of European IUE Conference (4th), Rome, Italy, May 15-18, 1984, p243-246.

Keywords: Emission spectra, Magnesium, *BY Draconis star, Stellar flares, Faculae, IUE.

Phased IUE observations of BY Draconis show no significant modulation of the prominent SWP emission lines over one rotation period. However, a marginally significant anticorrelation of the Mg II flux, and the flux in the LWR 'continuum' with the V light curve is observed, and is interpreted as due to 'plage' type areas over the photospheric spots. Two SWP spectra show sporadic enhancements of the emission lines as has been seen in other IUE spectra of flares.

400,033

PB85-144434

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Hydrogen Dimer Structures in the Far-Infrared Spectra of Jupiter and Saturn.

Final rept.,

L. Frommhold, and G. Birnbaum. 15 Aug 84, 4p

Pub. in Astrophysical Jnl. 283, pL79-L82, 15 Aug 84.

Keywords: Far infrared radiation, Infrared spectra, Absorption spectra, Hydrogen, Helium, Ratios, Reprints, *Jupiter atmosphere, *Saturn atmosphere, *Dimers, Voyager project.

On the basis of a spectral line shape computation, the authors show that small structures recently discovered in the Voyager spectra near the hydrogen S(sub 0)(0)

and S(sub 0)(1) lines are due to bound-free transitions involving hydrogen dimers. This identification may stimulate laboratory observation, unavailable at this time, of a feature that may prove to be useful for a new helium/hydrogen ratio determination.

400,034
PB85-145183 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Io: Energy Constraints and Plume Volcanism.
 Final rept.,
 R. T. Reynolds, S. J. Peale, and P. Cassen. 1980, 6p
 Pub. in Icarus 44, n2 p234-239 1980.

Keywords: *Volcanism, Jupiter(Planet), Sulfur dioxide, Reprints, *Io.

Observational and theoretical considerations support a model of Io which features a surface layer of sulfur overlying an active silicate crust. Such a model would imply frequent contact between silicate magma intrusions and the sulfur layer. This contact would produce volcanic plumes driven by high temperature sulfur vapor. The model meets observational constraints for a wide range of possible conditions in contrast to the special conditions required for plume generation by SO₂. Characteristics of the two models are compared, and it is suggested that high spatial resolution infrared radiometry could identify the driving volatile.

400,035
PB85-147320 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO.
Eruptive Binaries, 11. Disk-Radius Variations in U Gem.
 Final rept.,
 J. Smak. 1984, 4p
 Pub. in Acta Astronomica, n1 p93-96 1984.

Keywords: *Novae, Reprints, *Accretion disks, *Dwarf novae.

New set of geometrical elements is determined from an improved analysis of eclipses of the hot spot. The radius of the disk, which expands during an outburst, shrinks exponentially from about $(r \text{ sub } d) = 0.39$ immediately after outburst to about $(r \text{ sub } d) = 0.29$ just before the next outburst. The expansion of the disk begins at the very onset of an outburst.

400,036
PB85-147338 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO.
Accretion in Cataclysmic Binaries. 4. Accretion Disks in Dwarf Novae.
 Final rept.,
 J. Smak. 1984, 29p
 See also PB85-124360.
 Pub. in Acta Astronomica 34, n2 p161-189 1984.

Keywords: *Novae, Reprints, *Accretion disks, *Dwarf novae.

Time-dependent disk models are constructed, including the effects of thermal instability due to the ionization of hydrogen. The results are very sensitive to the assumptions concerning the viscosity. It is argued that by comparing models based on different viscosity prescriptions with the observational data for dwarf novae it should be possible to get an insight into the nature of viscosity. In the first approximation it is found that models based essentially on the alpha-disk approach with alpha approximately = 0.2, but with lower viscosity at low temperatures, reproduce reasonably well the dwarf novae behavior.

400,037
PB85-147965 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO.
Better Determinations of Mass Loss Rates for Red Giants and Supergiants.
 Final rept.,
 S. A. Drake, and J. L. Linsky. 1984, 3p
 Pub. in Proceedings of the Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun (3rd), Cambridge, MA., October 1983, p350-352, 1984.

Keywords: *Giant stars, Radio astronomy, *Mass loss, *Red giant stars, *Supergiant stars, Late stars, Stellar chromospheres, Stellar winds, Stellar radiation.

Mass loss in the form of stellar winds is of great relevance to the study of stellar atmospheres, stellar structure and evolution, and the interstellar medium, and progress in these areas would greatly benefit from reliable estimates of mass loss rates (\dot{M}) for many

stars. Deutsch (1956) first showed that significant mass loss does occur for cool, luminous stars, but order of magnitude or more disagreements in the value of (\dot{M}) between different studies of the same star are fairly typical. Goldberg (1979) and Zuckerman (1980) have reviewed the optical and infrared techniques by which the vast majority of (\dot{M}) estimates have been obtained. In this paper, the authors discuss the 'new' methods which have become available in the last decade or so using other wavelength regions. The authors limit this study to giants and super-giants of spectral type G to mid M, and thus do not mention (\dot{M}) measurements in late M stars using molecular emission lines such as CO(J=2-1). They also exclude techniques that are only appropriate for binary systems of known orbital parameters.

400,038
PB85-147981 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO.
Radio Observations of Active Stars: Direct Evidence for Polarity Reversals.
 Final rept.,
 D. M. Gibson. 1984, 5p
 Pub. in Proceedings of the Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun (3rd), Cambridge, MA., October 1983, p197-201, 1984.

Keywords: Radio astronomy, *Stellar coronas, *Polarity reversal, Stellar radiation.

Radio astronomical measurements of source spectra and polarization can provide significant insight into the physical conditions in the emitting regions. Such observations of active stars can be particularly useful because they provide information on coronal conditions which is different from, but complementary to, that obtained by X-ray observations. Observations at other bands (UV, optical, IR) allow us to 'connect' the corona to the stellar surface and, in effect, provide additional boundary conditions for our interpretations. The author evaluated the homogeneous gyrosynchrotron model for stellar radio emission proposed by Owen et al. (1976) and found it difficult to reconcile with models for the coherent radio emission from the same stars. The author found the statistics of stellar radio polarization to be inconsistent with this model as well. Finally, the author suggests that a phenomenological model based on the 'leading-following spot' geometry seen in active regions on the Sun serves to explain most of the peculiarities observed in radio star spectra and polarizations and, in fact, provides an explanation for similar peculiarities seen in the rapidly varying coherent emission.

400,039
PB85-148138 Not available NTIS
 National Bureau of Standards, Boulder, CO.
RS CVn Binary Systems.
 Final rept.,
 J. L. Linsky. 1984, 15p
 Grant NGL-06-003-057
 Pub. in Proceedings of Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun (3rd), Cambridge, MA., October 1983, p244-258 1984.

Keywords: *Binary stars, Ultraviolet spectra, Stellar magnetic fields, Reviews, Stellar chromospheres, Stellar coronas, X ray sources.

The author attempts to place in context the vast amount of data obtained in the last few years as a result of X-ray, ultraviolet, optical, and microwave observations of RS CVn and similar spectroscopic binary systems. As this topic is now very broad, the author concentrates on the RS CVn systems and their long-period analogs, and restricts the scope by attempting to answer on the basis of the recent data and theory the following questions: (1) Are the original defining characteristics still valid and still adequate. (2) What is the evidence for discrete active regions. (3) Have we derived any meaningful physical properties telling us about magnetic fields in RS CVn systems. (5) Is there evidence for systematic trends in RS CVn systems with spectral type.

3C. Celestial Mechanics

400,040
PB84-223379 Not available NTIS
 National Bureau of Standards, Washington, DC.
Secular Accelerations in Gylden's Problem.
 Final rept.,
 A. Deprit. 1983, 22p
 Pub. in Celestial Mechanics 31, p1-22 1983.

Keywords: *Celestial mechanics, *Two body problem, *Acceleration(Physics), Moon, Orbits, Hamiltonian functions, Reprints, Gravitational constant.

In a two body problem, any variation in time of the Keplerian parameter μ (product of the constant of gravitation G by the reduced mass m) causes a mean secular acceleration in the mean anomaly, but leaves the mean argument of perigee stationary. All asymptotic estimates for mean marginal rates of variation in the osculating elements, that Vinti established in the case when G is inversely proportional to the time, are now extended to the most general type of Gylden systems, and made into exact relations. The role of a Gylden system in explaining the marginal acceleration in the moon's mean motion is clarified. Separable Gylden systems are classified from a physical standpoint by the integrals that they admit.

400,041
PB84-225200 Not available NTIS
 National Bureau of Standards, Washington, DC.
Elimination of the Nodes in Problems of N Bodies.
 Final rept.,
 A. Deprit. 1983, 15p
 Pub. in Celestial Mechanics 30, p181-195 1983.

Keywords: *Many body problem, Reprints, Reduction theorems, Quaternions, Transformations(Mathematics), Nodes.

In application of the Reduction Theorem to the general problem on $n(>3)$ bodies, a Mathieu canonical transformation is proposed whereby the new variables separate naturally into (1) a coordinate system on any reduced manifold of constant angular momentum, and (2) a quadruple made of a pair of ignorable longitudes together with their conjugate momenta. The reduction is built from a binary tree of kinetic frames. Explicit transformation formulas are obtained by induction from the top of the tree down to its root at the invariable frame; they are based on the unit quaternions which represent the finite rotations mapping one vector base onto another in the chain of kinetic frames. The development scheme lends itself to automatic processing by computer in a functional language.

4.

ATMOSPHERIC SCIENCES

4A. Atmospheric Physics

400,042
PB84-245901 Not available NTIS
 National Bureau of Standards, Washington, DC.
Data on Total and Spectral Solar Irradiance.
 Final rept.,
 A. T. Mecherikunnel, J. A. Gatlin, and J. C. Richmond. 1 May 83, 6p
 Pub. in Applied Optics 22, n9 p1354-1359, 1 May 83.

Keywords: *Solar constant, *Irradiance, *Solar radiation, Atmospheric attenuation, Solar energy, Reviews, Reprints, Atmospheric transmissivity.

This paper presents a brief survey of the data available on solar constant and extraterrestrial solar spectral irradiance. The spectral distribution of solar radiation at ground surface, computed from extraterrestrial solar spectral irradiance for several air mass values and for

Field 4—ATMOSPHERIC SCIENCES

Group 4A—Atmospheric Physics

four levels of atmospheric pollution, is also presented. The total irradiance at ground level is obtained by integration of the area under the spectral irradiance curves. It is significant that, as air mass increases or as turbidity increases, the amount of energy in the infrared relative to the total increases, and that the energy in the UV and visible decreases.

400,043
PB85-116218 Not available NTIS
California Univ., Riverside.

Evaluation of Kinetic and Mechanistic Data for Modeling of Photochemical Smog.
R. Atkinson, and A. C. Lloyd. c1984, 130p
Prepared in cooperation with Environmental Research and Technology, Inc., Newbury Park, CA.
Included in Jnl. of Physical and Chemical Reference Data, v13 n2 p315-444 1984.

Keywords: *Photochemistry, *Smog, *Mathematical models, *Air pollution, Nitrogen oxides, Sulfur dioxide, Butane, Toluene, Xylenes, Nitrogen dioxide, Nitric acid, *Atmospheric chemistry, *Chemical reaction mechanisms, Butane/dimethyl, Ethene, Propene, Butene, Peroxyacetyl nitrate.

This review is a critical evaluation of the rate constants, mechanisms, and products of selected atmospheric reactions of hydrocarbons, nitrogen oxides, and sulfur oxides in air. The evaluation considers eight hydrocarbons (n-butane, 2,3-dimethylbutane, ethene, propene, 1-butene, trans-2-butene, toluene, and m-xylene) for which smog chamber irradiations have been carried out under carefully controlled conditions and which have been the subject of computer modeling studies by more than one research group. The reactions involved are treated in the following categories: inorganic reactions in organic-NO_x-air irradiations; organic reactions of the formaldehyde-NO_x-air system; organic reactions of the acetaldehyde-NO_x-air system; organic reactions of the alkene-NO_x-air systems; organic reactions of the alkane-NO_x-air systems; organic reactions of selected carbonyl-NO_x-air systems; organic reactions of the aromatic-NO_x-air systems; combination reactions of peroxy radicals, and homogeneous gas phase SO₂ reactions. This report considers literature through early 1983.

400,044
PB85-129310 Not available NTIS
National Bureau of Standards, Washington, DC.

Induced Electric Currents in the Alaska Oil Pipeline Measured by Gradient Fluxgate and Squid Magnetometers.

Final rept.,
W. H. Campbell, and J. E. Zimmerman. 1980, 7p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Geoscience and Remote Sensing 18, n3 p244-250 Jul 80.

Keywords: *Geomagnetism, Pipelines, Electric currents, Measurement, Magnetometers, Magnetic disturbances, Magnetic measurement, Measuring instruments, Auroras, Reprints, SQUID devices.

Fluxgate magnetometers in a gradient alignment and a gradient cryogenic SQUID magnetometer were used to determine the current induced in the Alaska oil pipeline during a period of geomagnetic disturbance. The measurements compared favorably to each other and to the nearby current determinations using a shunt connected directly to the pipe.

400,045
PB85-129336 Not available NTIS
National Bureau of Standards, Washington, DC.

Comments on 'Natural Tritiated Moisture Levels in Air Vary with Atmospheric Pressure'.

Final rept.,
W. B. Mann. 1984, 1p
Pub. in International Jnl. of Applied Radiation and Isotopes 35, n2 p144 1984.

Keywords: *Tritium, *Atmospheric composition, *Atmospheric pressure, Natural radioactivity, Experimental data, Measurement, Reprints.

Dr. B.M. Coursey has drawn my attention to the comments of H.G. Ostlund and A.S. Mason on the paper entitled 'Natural tritiated moisture levels in air vary with atmospheric pressure', by G.G.J. Boswell and M. Ghannadi-Marageh. Ostlund and Mason draw attention in particular to the unnaturally high levels of tritium and to possible underestimates of the experimental uncertainties. This latter point is supported by the large spread of results at two of the pressures, 1020 and

1022mbar, shown in Fig. 1 of Boswell and Ghannadi-Marageh's paper. To credit such spreads to delayed effects due to changes in atmospheric pressure could be more persuasive if the experimental data correlating the changes of activity concentration with lags in changes in atmospheric pressure over periods of about '1 to 2 days' were given for pressures of both 1020 and 1022mbar. If these large spreads are, however, due to random experimental uncertainties, the few outliers at 1030mbar, only three out of a total of 81 results, cannot be considered to be excessive.

400,046
PB85-145423 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Measurements of Sky Luminance, Sky Illuminance, and Horizontal Solar Radiation.

Final rept.,
S. Treado, and G. Gillette. 1983, 6p
Pub. in Jnl. of the Illuminating Engineering Society 12, n3 p130-135 Apr 83.

Keywords: *Sky, *Luminance, *Illuminance, *Daylighting, District of Columbia, Solar radiation, Measurement, Reprints.

Initial findings are presented of a sky measurement program currently underway at the National Bureau of Standards. Correlations are discussed relating horizontal illuminance to horizontal solar radiation, and zenith luminance to solar altitude angles for a North American climate (Washington, D.C.). These are simplified empirical equations to a complex phenomenon, but should be acceptable for most practical daylighting applications where accuracy is needed only within + or - 15%. Measurements were made only in the Washington, D.C. area. Similar efforts need to be made for other North American localities to validate these relationships.

400,047
PB85-145563 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

High Precision Atmospheric Ozone Measurements Using Wavelengths between 290 and 305 nm.

Final rept.,
H. J. Kostkowski, R. D. Saunders, A. E. S. Green, J. F. Ward, and C. H. Popenoe. 30 Jun 84, 12p
Pub. in Jnl. of Geophysical Research 89, nD4 p5215-5226, 30 Jun 84.

Keywords: *Atmospheric composition, *Ozone, Atmospheric attenuation, Atmospheric radiation, Ultraviolet radiation, Solar radiation, Measurement, Spectroradiometers, Radiometry, Reprints.

It is shown theoretically that many errors are significantly less when determining atmospheric ozone thicknesses from measurements of solar terrestrial spectral irradiance in the wavelength region between 290 and 305 nm as compared to the 305- to 340-nm region employed by the Dobson spectrophotometer. In order to test this conclusion experimentally, an elaborate set of state-of-the-art measurements have been made in the shorter wavelength region in Gainesville, Florida, between June 13 and June 18, 1980. Details of these measurements, including an extensive error analysis, are presented and indicate that such short-wavelength measurements, particularly between 295 and 305 nm, can be used to detect long-term changes of atmospheric ozone with an uncertainty not exceeding 1%. Observing conditions restricted the Gainesville measurements to zenith angles of less than 35 degrees. Further investigations are required to determine the shortest wavelength that can be used at significantly greater zenith angles.

4B. Meteorology

400,048
PB84-220771 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.

Center for Building Technology. Fastest-Mile Wind Speeds in Hurricane Alicia.

Final rept.,
R. D. Marshall. Jun 84, 71p NBS/TN-1197
Also available from Supt. of Docs as SN003-003-02592-5.

Keywords: *Hurricanes, *Wind velocity, Velocity measurement, Boundary layer, Building codes, Structural engineering, Mexico Gulf, Texas Gulf Coast(United States), Hurricane Alicia, Galveston(Texas), Houston(Texas).

Surface wind speeds recorded during the passage of Hurricane Alicia through the Galveston-Houston area on August 18, 1983, are used to estimate the fastest-mile wind speeds at 10 m above ground in open terrain. The paper describes the relationships between wind speeds for various averaging times and the boundary-layer representations used in the transformation to fastest-mile speeds. These speeds are compared with wind speeds recommended for the design of buildings and other permanent structures. Errors inherent in the original wind speed records and in the transformations are estimated.

400,049
PB84-245745 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.

Center for Building Technology. NBS (National Bureau of Standards) Daylight Availability Database.

S. Treado, G. Gillette, W. Remmert, and J. Bean. Jul 84, 55p NBSIR-84/2859

Sponsored in part by Naval Civil Engineering Lab., Port Hueneme, CA., National Fenestration Council, Topeka, KS., Naval Facilities Engineering Command, Alexandria, VA., Directorate of Civil Engineering (Air Force), Washington, DC., and Office of Chief Engineers (Army), Washington, DC.

Keywords: *Daylight, *Irradiance, *Luminance, *Sky brightness, *Atmospheric temperature, *Buildings, Histograms, Availability, *Energy requirements.

This report presents an annual database containing hourly measurements of solar radiation, illumination, sky luminance, and ambient air temperature. The measurements were made at the National Bureau of Standards, Gaithersburg, Maryland. Both instantaneous hourly and integrated average hourly measurements are included, as are daily, monthly and annual average and totals. For each measured quantity, a histogram of the distribution of the data is presented for the year. The data measurement, collection, and analysis system is described. This type of information is useful for determining energy requirements of buildings.

5.

BEHAVIORAL AND SOCIAL SCIENCES

5A. Administration and Management

400,050
PB84-217058 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.

Recommended Practice for Measuring Simple and Discounted Payback for Investments in Buildings and Building Systems.

Final rept.,
H. E. Marshall. Mar 84, 66p NBSIR-84-2850

Keywords: *Benefit cost analysis, *Buildings, Return on investment, Economic analysis, Cost effectiveness, Life cycle costs.

This report describes how to calculate simple and discounted payback measures of economic performance of buildings and building systems. Formulas for calculating payback, applications for evaluating and selecting projects, and limitations in the use of payback analysis are discussed. The simple payback method measures the time between the date of initial project investment and the date when cumulative future earnings or savings on that investment, net of cumulative future costs, just pay off the investment. The discounted payback method measures the time between the date of initial project investment and the date when the present value of future earnings or savings, net of the present value of future costs, just equals the initial in-

vestment. This recommended practice will assist the private and public building communities in making cost-effective decisions in the design, operation, maintenance, and retrofit of buildings.

400,051
PB84-217470 PC A10/MF A01
National Bureau of Standards (NML), Washington, DC. Center for Radiation Research.
Center for Radiation Research (of the National Bureau of Standards) Technical Activities for 1983, R. S. Caswell. Apr 84, 214p NBSIR-84/2848

Keywords: *Research projects, *Radiation, Plasma radiation, Atomic spectroscopy, Nuclear radiation, Radioactivity, X rays, Far ultraviolet radiation, Spectroradiometers, Radiometry, Radiation measuring instruments, Synchrotron radiation, Sources, National Bureau of Standards, Center for Radiation Research.

This report summarizes research projects, measurement method development, testing and data evaluation activities, carried out during Fiscal Year 1983 in the NBS Center for Radiation Research. These activities fall in the areas of radiation measurements, atomic and plasma radiation, nuclear radiation, radiation physics, radiometric physics, and radiation sources and instrumentation.

400,052
PB84-217553 PC A05/MF A01
National Bureau of Standards, Washington, DC. Office of Product Standards Policy.
NVLAP (National Voluntary Laboratory Accreditation Program) Annual Report and Directory of Accredited Laboratories (7th). Rept. for 1 Jan-31 Dec 83, H. W. Berger. May 84, 77p NBS/SP-677
See also PB84-109875. Library of Congress catalog card no. 84-601041.

Keywords: *Laboratories, *Acceptability, Test facilities, Standards.

This annual report of the National Voluntary Laboratory Accreditation Program (NVLAP) is prepared in accordance with NVLAP Procedures (Title 15 CFR Parts 7a, 7b, and 7c). Part I summarizes significant activities, including program changes, accreditation actions and ongoing discussions concerning laboratory accreditation on national and international levels. Part II is a directory of laboratories currently accredited on behalf of the Secretary of Commerce.

400,053
PB84-218031 PC A20/MF A01
National Bureau of Standards, Washington, DC. Information Resources and Services Div.
Publications of the National Bureau of Standards, 1983 Catalog. Rept. for Jan-Dec 83, R. J. Morehouse. May 84, 457p NBS/SP-305-SUPPL-15
See also PB82-242462. Also available from Supt. of Docs as SN003-003-02585-2. Library of Congress catalog card no. 48-47112.

Keywords: *Standards, *Bibliographies, *Catalogs(Publications), Abstracts, Indexes(Documentation), Authors, *Standard reference materials.

The 15th Supplement to Special Publication 305 lists the 1983 papers which reflect the results of National Bureau of Standards programs. Also included are those NBS papers published prior to 1983 but not reported in previous supplements of SP305. In addition to bibliographic data, key words, and abstracts for each publication and/or paper, the catalog provides an author and key word index. Errata pages for SP305, Supplement 14 (secs. 7, 8.1, and 8.2) follow Appendix B.

400,054
PB84-221894 Not available NTIS
National Bureau of Standards, Washington, DC.
Using Standards to Select Equipment. Final rept., L. K. Eliason. Apr 84, 4p
Sponsored in part by National Inst. of Justice, Washington, DC.
Pub. in Police Chief LI, n4 p36-39 Apr 84.

Keywords: *Equipment specifications, *Police, Law enforcement, Standards, Consumers, Technology assessment, Procurement, Cost effectiveness, Reprints.

One of the goals of the Technology Assessment Program of the National Institute of Justice (NIJ) is to assist the law enforcement community by developing a listing of police equipment that has been tested in accordance with NIJ performance standards and passed the tests. To achieve this goal, the standard must be developed, independent testing laboratories must be accredited and the tests conducted. In this article, the author gives the necessary NIJ background material, details each step in the development of a typical performance standard, discusses the conception and growth of the Technology Assessment Program and describes how the products of the program can best be utilized by the client, in this case, the police community.

400,055
PB84-223221 Not available NTIS
National Bureau of Standards, Washington, DC.
Critical Issues in Materials and Mechanical Engineering. Final rept., J. T. Fong, R. C. Dobbyn, L. Mordfin, and B. M. Johnson. 1981, 286p
Pub. in Proceedings of Pressure Vessels Piping Conference, Centennial Celebration, American Society of Mechanical Engineers, San Francisco, CA., Aug 12-15, 1980, Paper in Critical Issues in Materials and Mechanical Engineering PVP-47, 286p 1981.

Keywords: Curve fitting, Mathematical models, Reliability, Nondestructive tests, Fatigue(Materials), Safety, Standards, Boiler codes, Pressure vessels, Pipes(Tubes), Pumps, Valves, Welding, *Materials science, Failure analysis, Fracture mechanics.

This book resulted from a three-year-effort by more than one hundred contributors under the leadership of the Materials and Fabrication Committee, Am. Soc. of Mech. Engrs. Beginning in April 1978 when the idea of planning a critical issue symposium was first conceived, a total of twelve issues were identified through a series of pre-symposium meetings and reviews. The twelve issues are: (1) The role of engineering judgment and the computer in the management of material property data. (2) Curve-fitting vs. modeling for formulating design rules. (3) New material property data: Terminal vs. incremental tests. (4) Variability of data: Standards for applications. (5) On-line monitoring of critical components to improve reliability. (6) Upgrading welders' skill and education level: How and why. (7) Reliability of nondestructive evaluation. (8) Characterization of the subjective component of inservice data. (9) Should there be a methodology for failure analysis. (10) Accelerated development of a more rational basis for nonlinear fracture mechanics. (11) Safety factors in fatigue design: Arbitrary or rational. (12) The ASME Code and Product Liability: Should compliance create a rebuttable presumption of proper design.

400,056
PB84-226943 PC A04/MF A01
TITAN Systems, Inc., McLean, VA.
Toward an Improved FIPS Cost-Benefit Methodology. Phase 2. Descriptive Models - General Purpose Application Software Development and Maintenance. Final rept., M. L. Chipman, M. Fiorello, M. Snead, P. Kay, and P. Powell. Jun 84, 60p NBS/SP-500/116
Contract NB80-SBCA-0405
Prepared in cooperation with Aurora Associates, Inc., Washington, DC. Also available from Supt. of Docs as SN003-003-02591-7. Library of Congress catalog card no. 84-601071.

Keywords: *Benefit cost analysis, Maintenance, Computer programming, *Software engineering, *Federal information processing standards, *Cost benefit analysis.

This report presents a functional-flow descriptive model that can be used to categorize the application software (ASOF) development and maintenance activities of Federal data processing facilities. ASOF-related activities may be conceptually represented in descriptive model form by combining one or more of the basic model tasks. The comprehensive framework for ASOF development and maintenance provided by the descriptive model can be used in the identification of impacts from standards and guidelines and in the preparation of cost-benefit impact assessments. The framework provides both macro and micro levels of detail in order to link the descriptive models to additional data processing issues.

400,057
PB84-239755 PC A04/MF A01
National Bureau of Standards, Washington, DC. Office of Product Standards Policy.
Standards Committee Activities of the National Bureau of Standards - 1983 Highlights. Special pub., K. G. Newell, Jr. Apr 84, 57p NBS/SP-675
Also available from Supt. of Docs as SN003-003-02572-1. Library of Congress catalog card no. 84-601028. See also PB83-207209.

Keywords: *Management analysis, *Participative management, *Standards, Professional personnel, Group dynamics, National government, *National Bureau of Standards, *Committees.

This report summarizes NBS standards committee activities and accomplishments during calendar year 1983. It profiles NBS staff participation on outside standards committees and highlights significant technical and individual contributions made by NBS staff.

400,058
PB85-106151 PC A24/MF A01
Toth (R.B.) Associates, McLean, VA.
Standards Activities of Organizations in the United States. Final rept., R. B. Toth. Aug 84, 575p NBS/SP-681
Supersedes PB-249 542. Also available from Supt. of Docs. as SN003-02602-6. Library of Congress catalog card no. 84-601084.

Keywords: *Directories, *Organizations, *Management engineering, *Standardization, Standards, State government, National government, Technology, Social welfare, Criteria, United States, Private associations, Federal agencies.

This directory is a guide to mandatory and voluntary standards activities in the United States at Federal and state levels and by nongovernment (trade associations, technical and other professional societies). It excludes proprietary (company standards) and local levels of government (i.e., county and municipal). It supersedes the 1975 edition (NBS SP 417), 'Directory of United States Standardization Activities' and, for the first time, includes standards distributors, libraries, and information centers, and union lists of standards repositories by regional areas. It also lists organizations that no longer develop standards or have become defunct since the previous directory was issued. Over 750 current descriptive commentaries are formatted, with subject headings to facilitate access to specific information. The main sections cover nongovernment; Federal Government; state procurement offices; sources of standards documents and information; a subject index and related listings covering acronyms and initials, defunct bodies, and those organizations with name changes. Organizations have been included if they develop standards or contribute to the standardization process, whether voluntary or mandatory, or are sources of standards documents or information. An introductory section provides general information on Federal (including military) standards activities, a list of 20 major nongovernment standards developers, some historical notes, and an overview of U.S. (national) standardization activities.

400,059
PB85-111821 Not available NTIS
National Bureau of Standards, Washington, DC.
Concepts of Model Confidence. Final rept., S. I. Gass, and L. S. Joel. 1981, 6p
See also PB81-158164.
Pub. in Computers and Operations Research 8, n4 p341-346 1981.

Keywords: *Confidence limits, *Decision making, *Models, Validating, Criteria, Mathematical models, Meeting, Verifying.

This report discusses the concept of confidence in results obtained from decision-aiding models. Model confidence is viewed not as an attribute of a model, but of the model user. We argue that confidence in a model is a result of the accumulation of information, the sum total of which leads to a judgmental statement by the decision-maker. We offer an approach to the analysis of such information by defining seven criteria against which the information can be interpreted. For each criterion, a minimal level of 'information satisfac-

Field 5—BEHAVIORAL AND SOCIAL SCIENCES

Group 5A—Administration and Management

tion' is assumed that represents the decision-maker's threshold value. The meeting of all the criteria values informs the decision-maker that the model results can be used with an acceptable level of confidence.

400,060

PB85-121390 PC A11/MF A01
Marley Organization, Inc., Ridgefield, CT.
Principal Aspects of U.S. Laboratory Accreditation Systems - Revised 1984.
Final rept.,
C. W. Hyer. Oct 84, 247p NBS/GCR-84/472
Contract NB82-NAAM-7728
See also PB80-199086.

Keywords: *Laboratories, *Research management, Project management, National government, State government, Local government, Trade associations, Research projects, Criteria, Standards, *Accreditation.

The purpose of this report is to identify United States laboratory accreditation systems and to summarize the principal aspects of these systems. Previous reports were published in 1979 and 1980 under the same title. The latest adds forty-one systems not previously reported and contains 109 systems. The most significant addition to the report over and above previous editions is the information on 'Fields of Testing' and 'Products Covered' for each system. The report places the systems in four separate categories: (1) Federal Government Systems; (2) State Government Systems; (3) Local Government Systems; (4) Professional/Trade Organization Systems.

400,061

PB85-129591 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 89, Number 4, July-August 1984.
Aug 84, 46p
See also PB85-129609 through PB85-129625 and PB85-115426. Library of Congress catalog card no. 63-37059.

Keywords: *Research, Thermal expansion, Resistance thermometers, Radiotherapy, Hydrogen, Liquid helium, Iodine 125.

Contents:

- Exposure Standardization of Iodine-125 Seeds Used for Brachytherapy;
- Stability of Small Industrial Platinum Resistance Thermometers;
- Thermal Expansion of Liquid Normal Hydrogen Between 18.8 and 22.2 K.

400,062

PB85-143295 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Innovation in Residential Construction.
Final rept.,
F. T. Ventre. 1979, 10p
Sponsored by Massachusetts Inst. of Tech., Cambridge.
Pub. in Technology Review 82, n2 p50-59 1979.

Keywords: *Buildings, *Construction industry, Management, Strategy, Regulations, Analyzing, Policies, Government policies, Reprints, *Technology innovation.

Conventional indirect measures of technological change in industry are shown to mislead analysts of the building industry. The result is a continuing popular and academic misreading of the industry. The diffusion of 14 innovations in the industry are measured empirically rather than inferentially and differences in diffusion rates are related to the industry's 'management' of those innovations. A joint public-private strategy for managing future innovations is suggested. A more detailed, technical version of this paper will appear in Volume 10 of Policy Sciences. The current version is intended for policy makers in industry and government.

5B. Documentation and Information Technology

400,063

FIPS PUB 10-3 PC A04/MF A01
National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.
Countries, Dependencies, Areas of Special Sovereignty, and Their Principal Administrative Divisions. Category: Data Standards and Guidelines. Subcategory: Representations and Codes.
Federal information processing standards (Final), S. S. Shaw, and J. L. Walkowicz. 9 Feb 84, 70p
Supersedes FIPS PUB 10-2. Errata sheet inserted. Three ring binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Coding, *Countries, Standards, Data, Information processing, *Federal information processing standards, *Geographic areas, Geocoding.

The Standard sets forth a list of the basic geopolitical entities in the world, together with the principal divisions that comprise each entity. The generic name of each division type is given. The Standard also provides a four-character alphanumeric identifier for each division listed. The two-character alphabetic portion of this identifier serves as the country code of a basic entity. This code is identical to that published in Federal Information Processing Standard (FIPS) 10-2, Countries, Dependencies, and Areas of Special Sovereignty. The remainder of the identifier, primarily numerical, differentiates the principal divisions in each basic entity. This Standard supersedes FIPS 10-2 in its entirety.

400,064

FIPS PUB 104 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Guideline for Implementation of ANSI (American National Standards Institute) Codes for the Representation of Names of Countries, Dependencies, and Areas of Special Sovereignty. Category: Data Standards and Guidelines. Subcategory: Representations and Codes.
Federal information processing standards (Final), R. G. Saltman. 19 Sep 83, 32p
Three ring vinyl FIPS binder also available, North American Continent price \$6.25; others write for quote.

Keywords: *Standards, *Nomenclature, Mnemonics, Symbolic codes, Foreign countries, United States.

This Guideline implements ANSI Z39.27, Structure for the Representation of Names of Countries of the World for Information Interchange, of the American National Standards Institute (ANSI). ANSI Z39.27 adopts, with qualifications, the entities, names, and codes prescribed by ISO 3166, Codes for the Representation of Names of Countries, a standard of the International Organization for Standardization (ISO). The qualifications provide for complete coverage of the land areas of the world without overlap or duplication, and for entity names that, to the maximum extent possible, are approved or accepted by the United States Board on Geographic Names. Both two and three-character alphabetic codes are provided for each entity adopted from ISO 3166. The two-character codes are provided for general use and are recommended by ISO for international interchange. The three-character codes are available for special applications when their use would provide a particular advantage.

400,065

FIPS PUB 55-1 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Guideline: Codes for Named Populated Places, Primary County Divisions, and Other Locational Entities of the United States. Category: Data Standards and Guidelines. Subcategory: Representations and Codes.
Federal information processing standards (Final), H. Tom, and R. G. Saltman. 30 Dec 83, 35p
See also FIPS PUB 55 DC. Supersedes FIPS PUB 55. Three ring vinyl FIPS binder also available, North American Continent price \$6.25, all others write for quote.

Keywords: *Geography, *Guidelines, *Coding, Municipalities, Counties, States(United States), Information systems, Census, Magnetic tapes, Standards, Data processing, Data files, *Federal information processing standards, Geocoding.

This Guideline provides a two-character State code and five-character numeric place code to uniquely

identify each listed entity. An exhaustive list is carried of incorporated places, census designated places (CDP's), primary county divisions (such as townships, New England towns, and census county divisions), recognized Indian reservations and Alaska Native villages, and counties. The listing also includes unincorporated places, military bases, National parks, airports, and ground transportation points. A two-character class code distinguishes over seventy entity types. Each entity is identified by the county or counties in which it is located. All exhaustive categories and military bases are identified by Congressional District and, in most cases, by metropolitan statistical area. Incorporated places, CDP's, and Indian and Alaska Native areas, are cross-referenced to U.S. Bureau of the Census files. ZIP codes are provided for all Post Offices. Areas of the United States covered are the fifty States, the District of Columbia, and all outlying territories with significant self-administration. Data files are available on magnetic tape, microfiche, or hard copy. Documentation is provided separately from the data files.

400,066

PB84-154566 PC A02/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Scientific Littoral Data Management Study Summary Report,
R. E. Schofer, and F. F. Goodyear. Dec 83, 16p
NBSIR-83-2806
Prepared in cooperation with Fisk Systems, Bethesda, MD. Sponsored in part by Army Engineer Waterways Experiment Station, Vicksburg, MS.

Keywords: *Information systems, *Littoral zone, Index terms, Cataloging, Systems management, Computer programming, Data banks.

The report describes a review of management procedures for scientific littoral data, and lists recommendations for their improvement. Recommendations include both good general management practice and specific detailed actions. Indexing and cataloging of data are recommended in order to obtain broader data utilization and to remove the dependence of institutional memory on specific individuals. Development of a methodology for identifying and releasing obsolete data is detailed. A list is provided of data catalog files, which were created to describe unautomated data, and of the computer programs which were developed to build and manipulate these catalog files.

400,067

PB84-202670 PC A19/MF A01
National Bureau of Standards, Washington, DC. Technical Information and Publications Div.
Publications of the National Bureau of Standards, 1982 Catalog.
Special pub. Jan-Dec 82,
R. J. Morehouse. Jun 83, 445p NBS/SP-305-SUPPL-14
Also available from Supt. of Docs as SN003-003-02501-1. Library of Congress catalog card no. 48-47112. See also PB82-242462.

Keywords: *Bibliographies, *Research, *Indexes(Documentation), Catalogs(Publications), Periodicals, Abstracts, Authors, National government, Subject index terms, Physics, Mathematics, Chemistry, Engineering, Computers, *Scientific research, Keywords, National Bureau of Standards.

The 14th Supplement to Special Publication 305 lists the 1982 papers which reflect the results of the National Bureau of Standards programs. Also included are those NBS papers published prior to 1982 but not reported in previous supplements of SP305. In addition to bibliographic data, key words, and abstracts for each publication and/or paper, the catalog provides an author and key word index.

400,068

PB84-203439 PC A16/MF A01
National Bureau of Standards, Washington, DC.
Directory of International and Regional Organizations Conducting Standards-Related Activities.
Final rept.,
M. A. Breitenberg. Apr 83, 370p NBS/SP-649
Library of Congress catalog card no. 83-600511.

Keywords: *Directories, *Standardization, Foreign countries, Organizations, International relations.

This directory contains information on 272 international and regional organizations which conduct standardization, certification, laboratory accreditation, or other standards-related activities. This volume describes their work in these areas, as well as the scope of each organization, national affiliations of members, U.S. participants, restrictions on membership, as well as the availability of any standards in English. This volume summarizes an effort by the National Bureau of Standards to obtain information relevant to monitoring U.S. participation in the many international organizations active in standardization. It is designed to serve the needs to Federal agencies and standards writers for information on international and regional organizations involved in standardization and related activities. It may also be useful to manufacturers, engineers, purchasing agents, and others.

400,069

PB84-217900 PC A05/MF A01
National Bureau of Standards, Washington, DC.
Computer Science and Technology: Report on Approaches to Database Translation.
Final rept.,
L. Gallagher, and S. Salazar. May 84, 89p NBS/SP-500/115
Also available from Supt. of Docs as SN003-003-02583-6. Library of Congress catalog card no. 84-601055.

Keywords: Models, *Data base management, Data structures, File maintenance, Data tagging.

Transporting a database from a source to a target environment has often been an expensive and complex project. In large part this is due to the lack of standards for data models and database interchange forms. This report describes approaches to database translation, discusses candidate interchange forms, and recommends a method for representing the data structures of newly proposed network and relational data models in a form suitable for database interchange. Methods for representing other commonly used database structures in terms of the proposed standard structures show that automated database translation is feasible for most currently installed data models.

400,070

PB84-246073 Not available NTIS
National Bureau of Standards, Washington, DC.
Robot: An Entry in the Encyclopedia Americana.
Final rept.,
J. S. Albus. 1983, 12p
Pub. in Encyclopedia Americana 23, p582-583 1983.

Keywords: *Robots, *Artificial intelligence, Automata theory, Utilization, Encyclopedias, Reviews, Reprints, Robotics.

A robot is defined. A short history of automata and a review of the literature dealing with robots is given. Common industrial robot applications are listed, and a brief outline of some of the leading research topics in robotics is presented.

400,071

PB85-111771 Not available NTIS
National Bureau of Standards, Washington, DC.
Summary of Current NBS (National Bureau of Standards) Protocol Specifications.
Final rept.,
J. F. Heafner, and R. P. Blanc. 1981, 6p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) National Telecommunications Conference, New Orleans, LA., November 29-December 3, 1981, F8.2/1-6 V3.

Keywords: *Specifications, *Federal Information Processing Standards, FIPS, *National Bureau of Standards, Protocols.

This paper summarizes network protocols developed by the National Bureau of Standards (NBS) which will soon be proposed as Federal Information Processing Standards (FIPS). These protocol specifications are based on the work of the International Organization for Standardization (ISO). The protocols summarized here include internetwork, transport, session, data presentation and file transfer which correspond to layers 3 - 7 of the ISO Reference Model for Open Systems Interconnection.

400,072

PB85-119501 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD. Information Resources and Services Div.
Abstract and Index Collection - National Bureau of Standards Library (Second Edition),
D. Cunningham. Aug 84, 48p NBSIR-84/2933

Keywords: *Abstracts, *Indexes(Documentation), Collection, Descriptions, *National Bureau of Standards.

An alphabetical arrangement of abstracts and indexes available at the National Bureau of Standards (NBS) Library is listed by most current title of the publication. Other information includes description of the abstract or index, library holdings, principal sources, publisher or association, corresponding data base and the classification number. A general subject and former title index follow the main text of the report.

400,073

PB85-123453 Not available NTIS
National Bureau of Standards, Washington, DC.
Introducing and Implementing On-Line Bibliographic Retrieval Services in a Scientific Research and Development Organization.

Final rept.,
M. J. Ruhl, and E. J. Yeates. 1976, 4p
Pub. in Jnl. of Chemical Information and Computer Sciences 16, n3 p147-150 1976.

Keywords: *Information systems, *Research and development, Implementation, Reprints, *On-line retrieval.

The paper describes the experience of the National Bureau of Standards Library in implementing on-line bibliographic retrieval services. Methods are given to orient and aid users in availing themselves of the services. Results are presented, based on appraisal of the services by users: value to users; most-used data bases; problems requiring search revision; reasons for unsatisfactory results; purposes for requests and use of search results; impact on subsequent library use; and future searching requirements. The paper concludes with a brief discussion of implications on-line capability on library financing as a whole and on the library role in the community.

400,074

PB85-145597 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Planning, Budgeting and Personnel Management in a Scientific Library of the Federal Government.
Final rept.,
M. A. Bond. 1984, 16p
Pub. in Sci. Technol. Libraries 4, n3/4 p45-60 1984.

Keywords: National government, Executives, Libraries, Planning, Budgeting, Cycles, Personnel management, Reprints, *Library management, *Scientific library, Federal agencies.

Planning, budgeting, and personnel management as practiced in a sci-tech library of an Executive Agency in the Federal government are discussed. Examples of particular planning accomplishments are provided, a budget cycle is detailed, and some of the dynamics of the personnel process are reviewed.

5C. Economics

400,075

PB84-218379 PC A04/MF A01
National Bureau of Standards, Washington, DC. Office of Product Standards Policy.
GATT (General Agreement on Tariffs and Trade) Standards Code Activities of the National Bureau of Standards 1983.

Final rept.,
J. R. Overman. May 84, 52p NBS-SP-678
Also available from Supt. of Docs as SN003-003-02586-1. Library of Congress catalog card no. 84-601051.

Keywords: *Standards, *International trade, Commerce, Technical assistance, Standardization, Regulations.

This report describes the GATT Standards Code activities performed by the Standards Code and Information program, National Bureau of Standards (NBS), for calendar year 1983. NBS responsibilities include oper-

ating the U.S. GATT inquiry point for information on standards and certification activities; notifying the GATT Secretariat of proposed U.S. Federal Government standards-based rules that may significantly affect trade; assisting U.S. industry with trade-related standards problems; and responding to inquiries on foreign and U.S. proposed regulations.

400,076

PB85-122471 PC A08/MF A01
Ecosometrics, Inc., Bethesda, MD.
Technologies in the Service Sector. Volume 1. Economic and Technological Trends.
Final rept.,
A. M. Lago, and E. E. Hamilton. 1 Oct 84, 166p RR-174-VOL-1, NBS/GCR-84/474/1
Contract NB83-SBCA-2084
See also Volume 2, PB85-122489.
Also available in set of 3 reports, PC E99, PB85-122463.

Keywords: *Economic analysis, *Technology, *United States, Forecasting, Productivity, Measurement, Barriers, Trends, Service sector.

In Volume I, the economic structure and trends in the U.S. service sector are reviewed as a basis for identifying and characterizing technology flows into this sector. The sources, transfer channels and utilization patterns are described as a basis for developing forecasts of the impacts of technology on the various components of the service sector. Characterization and forecasts of technology trends are used to assess technical and economic barriers to technology-driven productivity growth, including measurement- and standards-related barriers.

400,077

PB85-122489 PC A06/MF A01
Ecosometrics, Inc., Bethesda, MD.
Technologies in the Service Sector. Volume 2. A Case Study of Videotex/Teletext.
Final rept.,
A. M. Lago, and E. E. Hamilton. 1 Oct 84, 114p RR-174-VOL-2, NBS/GCR-84/474/2
Contract NB83-SBCA-2084
See also Volume 1, PB85-122471, and Volume 3, PB85-122497.
Also available in set of 3 reports PC E99, PB85-122463.

Keywords: *Economic analysis, *Technology, *United States, Trends, Barriers, Communications, Forecasting, *Videotex/Teletext.

In Volume II, (Videotex/Teletext), the economic structure and trends in the U.S. service sector are reviewed as a basis for identifying and characterizing technology flows into this sector. The sources, transfer channels and utilization patterns are described as a basis for developing forecasts of the impacts of technology on the various components of the service sector. Characterization and forecasts of technology trends are used to assess technical and economic barriers to technology-driven productivity growth, including measurement- and standards-related barriers. Two case studies, Videotex/Teletext (Volume II) and Payment Technologies in Banking (Volume III), provide more detailed analyses of two of the more dynamic subsectors.

400,078

PB85-122497 PC A06/MF A01
Ecosometrics, Inc., Bethesda, MD.
Technologies in the Service Sector. Volume 3. A Case Study of Payment Technologies in Banking.
Final rept.,
A. M. Lago, and E. E. Hamilton. 1 Oct 84, 117p RR-174-VOL-3, NBS/GCR-84/474/3
Contract NB83-SBCA-2084
See also Volume 2, PB85-122489.
Also available in set of 3 reports PC E99, PB85-122463.

Keywords: *Economic analysis, *Technology, *Payments, *United States, Barriers, Productivity, Trends, Forecasting, Communications, *Banking, Service sector.

In Volume III, (Payment Technologies in Banking), the economic structure and trends in the U.S. service sector are reviewed as a basis for identifying and characterizing technology flows into this sector. The sources, transfer channels and utilization patterns are described as a basis for developing forecasts of the

Field 5—BEHAVIORAL AND SOCIAL SCIENCES

Group 5C—Economics

impacts of technology on the various components of the service sector.

400,079
PB85-145167 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Role of Government in Supporting Measurement Standards for High-Technology Industries.
Final rept.,
G. Tasse. 1982, 10p
Pub. in Research Policy 11, n5 p311-320 Oct 82.

Keywords: *Industries, *Government policies, Economic development, Investments, Standards, Measurement, Optical materials, Reprints, *Industrial growth, Technology utilization, Technology innovation.

The role of voluntary standards in industrial growth is discussed by characterizing standards as a public good and identifying the consequent determinants of underinvestment by the private sector. Underinvestment results from the nature of both the standard itself and the underlying technology. The focus is on measurement technologies which require capital-intensive research facilities, specialized equipment and labor, and consensus building among buyers as well as sellers in order to implement them. Standards and the underlying measurement technologies which have been instrumental in the emergence of the optical fiber industry are discussed as an example. Finally, some implications are drawn for industrial growth policy.

5D. History, Law, and Political Science

400,080
PB85-121465 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Data Requirements for the Seismic Review of LNG (Liquefied Natural Gas) Facilities,
W. D. Kovacs, E. V. Leyendecker, J. S. Leiss, and L. A. Lister. Jun 84, 52p NBSIR-84/2833
Sponsored in part by Federal Energy Regulatory Commission, Washington, DC.

Keywords: *Liquefied natural gas, *Facilities, *Earthquake resistant structures, Reviewing, Data, Site surveys, Information, Requirements, Safety, Standards, *Certification, Applicants, Federal energy regulatory commission.

This report describes data needed by the Federal Energy Regulatory Commission for the seismic review of Liquefied Natural Gas (LNG) facilities and is intended to expedite the certification process of the Federal Energy Regulatory Commission. It uses a format familiar to those industry representatives and their consultants who work on siting other safety-related structures. Available state and Federal regulations were reviewed for format and type of information required to develop a source document which can be used to establish a consistent format and content for applications in their submittal of the necessary geological-structural-seismic information required to analyze sites for LNG facilities. Design criteria and levels of safety to be used in analyzing sites were not considered.

400,081
PB85-137644 PC A08/MF A01
National Bureau of Standards, Gaithersburg, MD.
Uniform Laws and Regulations as Adopted by the National Conference on Weights and Measures (69th), 1984.
Oct 84, 154p NBS/HB-130/1985
Supersedes PB85-126606. Also available from Supt. of Docs as SN003-003-02619-1.

Keywords: *Law(Jurisprudence), *Regulations, State government, Weight measurement, States(United States), Standardization, Packaging, Units of measurement, Measuring instruments, Commercial laws, Handbooks, Marking, Labels, Sales management, Commodities, Guidelines, Prices, Publicity, Consumer affairs, National Bureau of Standards, Open dating, *Weights and measures.

This Handbook, revised annually, compiles the Uniform Laws and Regulations developed by the Committee on Laws and Regulations of the National Conference on Weights and Measures (NCWM). The compilation itself was approved by the NCWM in 1979, and this edition includes amendments adopted by the Con-

ference at its annual meeting in 1984. The title of the Handbook and the titles of the Laws and Regulations compiled in it were changed at the 1983 annual meeting of the NCWM. The NCWM recommends adoption and promulgation by the States of these Uniform Laws and Regulations as updated in this Handbook.

5F. Humanities

400,082
PB85-145324 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Is Invention an Art. Since It is Fun, Should Inventors be Paid.
Final rept.,
J. Rabinow. 1980, 4p
Pub. in Industrial Research/Development 22, n12 p88-91 1980.

Keywords: *Arts, Creativity, Inventions, Culture(Social sciences), Reprints.

Invention is an art form because it has the attributes of all arts: (1) It is the product of a person's mind. (2) It is the combination of prior knowledge, combined in new ways. (3) It requires a sophisticated audience well versed in the art to appreciate the product. (4) It produces an emotional reaction in the mind of a beholder so cultured. The talk relates anecdotes from my experiences and touches upon the fact that much of the present management of our technology does not appreciate the art.

5I. Personnel Selection, Training, and Evaluation

400,083
PB85-100410 PC A06/MF A01
National Bureau of Standards (NEL), Washington, DC. Building Equipment Div.
Interim Design Guidelines for Automated Offices,
A. I. Rubin. Aug 84, 117p NBSIR-84/2908
Sponsored in part by Public Buildings Service, Washington, DC.

Keywords: *Office management, *Automation, Design criteria, Organization theory, Office equipment, Environmental engineering.

This report presents interim guidelines for the design of offices using automated technologies. The introduction of automated systems into offices has changed the office setting as a place to work. Architects and other design professionals have responded to this technology by formulating a variety of design strategies. This report identifies design issues which merit consideration in automated offices, tentative criteria for environments and systems based on an overview of all resources used to develop this document, and typical approaches used accomplish design goals. Technological, ergonomic and organizational factors are considered from the standpoint of design implications.

400,084
PB85-105740 PC A02/MF A01
National Bureau of Standards, Washington, DC.
Benefits Perceived by U.S. Industry from Participating in International Standards Activities.
Final rept.,
P. W. Cooke. Sep 84, 24p NBSIR-84/2886

Keywords: *International organizations, *Standardization, *Industries, *Benefit cost analysis, Exports, International trade, Recommendations.

This report describes the results of a limited study to assess the extent to which U.S. industry profits by virtue of participation in the committee activities of international standardization organizations. The substantial trade benefits that can accrue are identified and evaluated in terms of the needs of the firms surveyed and the potential opportunities for new or increased foreign trade. Recommendations are given for industry to become more aware of the cost-effectiveness of participation and to extend the potential benefits to other firms and industries.

5J. Psychology (Individual and Group Behavior)

400,085
PB84-244680 Not available NTIS
National Bureau of Standards, Washington, DC.
Human Behavior and Fires: An Introduction.
Final rept.,
R. L. Paulson. May 84, 13p
Pub. in Fire Technology 20, n2 p15-27 May 84.

Keywords: *Human behavior, *Fires, Fire safety, Evacuating(Transporting), Smoke, Buildings, Design criteria, Warning systems, Decision making, Reprints.

From a selected list of references, the author traces the developments in the research into human behavior in fire situations. This paper includes research approaches, people and design as related to the evacuation process, panic, behavioral tendencies, and decision-making, citing references from the author's paper: Human Behavior and Fire Emergencies: An Annotated Bibliography, NBSIR 81-2438.

5K. Sociology

400,086
PB84-165778 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Multi-Year Affirmative Action Program for Women and Minorities for Fiscal Years 1982 through 1986 Washington, DC. and Boulder, Colorado. Executive Summary.
Final rept.,
L. K. Despeaux. Dec 83, 29p NBSIR-83-2798

Keywords: *National government, *Discrimination, *Females, Civil service, Government employees, Executives, Minority groups, Objectives, Civil rights, Equal opportunity.

The NBS multi-year affirmative action program has been designed to assist the Bureau in meeting the goal established by Congress in the Civil Service Reform Act of 1978--i.e., to provide... a federal workforce reflective of the nation's diversity. Women and minorities are underrepresented in scientific occupations at NBS. Although women and minorities are employed in most all administrative, technician, clerical, and blue collar occupations, they are generally underrepresented or absent from higher grades. The affirmative action program has been designed to improve or correct these problems by using three strategies.

400,087
PB85-124329 Not available NTIS
National Bureau of Standards, Washington, DC.
Comment on 'The Standardization of Time' by Zerubavel.
Final rept.,
I. R. Bartky. May 84, 6p
Pub. in American Jnl. of Sociology 89, n6 p1420-1425 May 84.

Keywords: *Time, *Standardization, History, Reprints, Daylight saving time, Time zones, Standard time.

E. Zerubavel's recent article, 'The Standardization of Time: A Sociohistorical Perspective,' describes the establishment of American time zones and the use of time zones worldwide. Unfortunately a number of conclusions regarding these systems and their adoption processes are based upon technical misunderstandings and errors of fact. This comment on Zerubavel's article identifies some of the technical errors and shows consequentially why the conclusions are untenable.

400,088
PB85-127512 PC A05/MF A01
Washington Univ., Seattle. Dept. of Psychology.
Post Fire Interviews: Development and Field Validation of the Behavioral Sequence Interview Technique.
Final rept.,
J. P. Keating, and E. F. Loftus. Oct 84, 92p NBS/GCR-84/477
Grant NB80-NADA-1053

Keywords: *Interview, *Human behavior, Fire safety, Fire prevention, Recording, Buildings, Evacuation.

This report describes the development and field-validation of a research interview instrument which is used for recording how people behave/act after the outbreak of a residential fire. In the first phase of the interview, the witness is invited to recount his story of the fire, free from interference or questions. During the second phase, the witness and interviewer cooperatively generate a comprehensive account of the witness' actions, the reasons for each action, and the situational cue during the fire using a standardized format. During its development, the behavioral sequence technique was used successfully to interview 357 respondents in Seattle and New York City. Responses were coded, quantified and analyzed using a modification of the Breux technique for developing a graphical representation of response sequences. Statistics regarding the sample of fires and of interviewees are presented.

400,089
PB85-144848 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Surveillance Receiver/Recorders.
Final rept.,
J. F. Shafer, and H. E. Taggart. Jun 84, 17p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in NIJ (National Inst. of Justice) Report-0222.00, 17p Jun 84.

Keywords: *Surveillance, *Recording instruments, Receivers, Law enforcement, Audio surveillance.

The standard establishes performance requirements and methods of test for one type of receiving and recording system used for audio surveillance by the law enforcement community. The document lists the principal terms and definitions needed, as well as the most critical items of required test equipment. The standard addresses typical frequency-modulated receivers and tape recorders that use a 4.76 cm/s (1 7/8 in/s) Philips-type cassette. Characteristics measured include receiver sensitivity and selectivity, squelch sensitivity, audio distortion and response, tape speed tolerance and memory retention.

peptide bonds of crosslinked peptides of phenylalanine. The actions of the enzymes on these particular compounds were discussed in detail.

400,091
PB85-120814 Not available NTIS
National Bureau of Standards, Washington, DC.
Sensitivity of Trends in Geometric Mean Blood Levels to Random Measurement Errors.
Final rept.,
I. H. Billick, D. R. Shier, and C. H. Spiegelman. 1982, 16p
Pub. in Jnl. of Science of the Total Environment 24, n3 p233-248 Aug 82.

Keywords: *Blood chemical analysis, *Lead(Metal), Poisoning, Sensitivity, Models.

A statistical model is investigated that expresses observations, such as blood lead levels, as an additive function of true levels and random measurement errors. Both empirical results (obtained by a series of simulation experiments) and theoretical results indicate how the various statistics such as means, standard deviations, geometric means and geometric standard deviations of the observations vary in response to measurement errors. In particular, it is shown that the geometric mean of blood lead levels varies inversely with laboratory precision.

400,092
PB85-145555 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Physicochemical Bench-Scale Caries Model.
Final rept.,
L. C. Chow, and W. E. Brown. Jun 84, 6p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of Dental Research 63, n6 p868-873 Jun 84.

Keywords: *Biochemistry, *Membranes, Diffusion, Dental materials, Reprints, *Caries mechanism, Fluorapatite, Hydroxyapatite.

A diffusion cell comprising two compartments separated by a commercial membrane of known ion permeability was used as an experimental model to study factors which may affect caries formation. One compartment (the 'lesion') contained an excess of hydroxyapatite or fluorapatite crystals, and its solution was kept near saturation by stirring. An unsaturated acidic calcium phosphate solution flowed continuously through the other compartment (the 'Plaque-saliva'), thus providing the driving force for dissolution of the crystals as modified by the permeability of the membrane and/or the presence of fluoride. Calcium, phosphate, fluoride, and chloride concentrations, pH, and membrane potential were measured at steady state.

6B. Bioengineering

400,093
PB85-111789 Not available NTIS
National Bureau of Standards, Washington, DC.
Monte Carlo Simulation of Sub-Micrometer Linewidth Measurements in the Scanning Electron Microscope.
Final rept.,
G. G. Hembree, S. W. Jensen, and J. F. Marchiando. 1981, 4p
Pub. in Proceedings of Annual Conference Microbeam Analysis Society (16th), July 13-17, 1981, p123-126.

Keywords: *Electron microscopes, Simulation, *Backscattered electron images, *Linewidth measurements.

Monte Carlo calculations are made to simulate experimental SEM line scans across submicrometer structures. Calculations are performed for a specimen consisting of submicrometer metal lines on a silicon substrate. The response of a split annular PN junction diode backscatter electron detector is modeled by simulating the solid angle of collection as well as the linear energy response of the detector. The influence on the simulated backscattered electron signal due to parameters such as electron beam voltage, electron beam voltage, electron beam size, metal line composition, and metal line thickness is investigated. The significance of these parameters as they affect the accurate measurement of sub-micrometer linewidths is also considered.

400,094
PB85-119980 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD. Polymers Div.
Characterization of Porosity in Porous Polymer Implant Materials.
Annual rept. Apr-Sep 83,
R. E. Dehl. Sep 84, 32p NBSIR-84/2883
See also PB83-172023. Sponsored in part by National Center for Devices and Radiological Health, Rockville, MD.

Keywords: *Porosity, *Polymers, Evaluation, Methodology, Characteristics, Measurements, Polyethylene, Medical equipment, Carbon, Composite materials, *Biomaterials, *Implants.

The investigation of the methods of characterizing the porosity of two porous polymeric implant materials have been concluded with the work discussed in this report. The two materials, a porous polyethylene (PPE) and a porous composite of polytetrafluoroethylene and carbon (PTFE-C) have been further investigated by the method of quantitative microscopy. The mean pore volume fractions of 30 samples each of PPE and PTFE-C were found to be 0.48 and 0.69, respectively, and are in good agreement with other measurements of this quantity. The mean intercept length for PPE was found to be 76 micrometers, and for PTFE-C, 67 micrometers. Both values are somewhat larger than the average interconnecting pore 'diameters' as measured by mercury porosimetry. The reproducibility of mercury porosimetry data has been tested by examining 16 samples of PTFE-C in thin sheet form and 6 samples of laminated blocks. The mean and standard deviation of four parameters derived from the mercury intrusion curves were calculated. A high correlation was found between the specific pore volume and the position of the mercury intrusion curve along the pressure axis. A number of random errors pertaining to mercury porosimetry were discovered and are discussed in this report.

400,095
PB85-141984 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
High-Power Automatic Network Analyzer for Measuring the Power Absorbed by Biological Samples in a TEM (Transverse Electromagnetic) Cell.
Final rept.,
J. R. Juroshek, and C. A. Hoer. Aug 84, 7p
Sponsored by National Inst. for Occupational Safety and Health, Cincinnati, OH.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques MTT-32, n8 p818-824 Aug 84.

Keywords: *Network analyzers, *Bioinstrumentation, Power measurement, Radiofrequency power, Reprints, TEM cells.

A device for measuring the radio frequency (rf) power absorbed by biological samples while they are being irradiated in a transverse electromagnetic (TEM) cell is described. The report discusses the design, calibration, and performance of this automated measurement system. The power absorption analyzer is based on a six-port type of automatic network analyzer, and operates at an incident power to the TEM cell of 1 to 1000 W, and a frequency range of 100 to 1000 MHz. Experiments show that an absorbed power of 0.02% to 0.05% of the incident power can be measured. Measurements of the power absorbed by a 1% saline solution were made using the power absorption analyzer and by an independent calorimetric measurement. The two measurement techniques show excellent agreement.

400,096
PB85-147924 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Calibration of Flat 60-Hz Electric Field Probes.
Final rept.,
M. Misakian. 1984, 4p
Sponsored by Department of Energy, Washington, DC.
Pub. in Bioelectromagnetics 5, n4 p447-450 1984.

Keywords: *Probes, Calibrating, Electric fields, Reprints.

The influence of nearby ground planes, perturbation of surface charge distributions, and fringing fields on the electric field between parallel plates are characterized

6. BIOLOGICAL AND MEDICAL SCIENCES

6A. Biochemistry

400,090
PB85-107332 Not available NTIS
National Bureau of Standards, Washington, DC.
Enzymatic Digestibility of Peptides Crosslinked by Ionizing Radiation.
Final rept.,
M. Dizdaroglu, E. Gajewski, and M. G. Simic. 1984, 13p
Pub. in International Jnl. of Radiation Biology 45, n3 p283-295 1984.

Keywords: *Enzymes, *Peptides, *Ionizing radiation, *Digestion(Decomposition), Crosslinking, Reprints.

Digestibility by proteolytic enzymes of peptides crosslinked by ionization radiation was investigated. Small peptides of alanine and phenylalanine were chosen as model compounds and aminopeptidases and carboxypeptidases were used as proteolytic enzymes. Peptides exposed to gamma-radiation in aqueous solution were analyzed by high-performance liquid chromatography before and after hydrolysis by aminopeptidase M, Leucine aminopeptidase, carboxypeptidase A and carboxypeptidase Y. The results obtained clearly demonstrate the different actions of these enzymes on crosslinked aliphatic and aromatic peptides. Peptide bonds of crosslinked dipeptides of alanine were completely resistant to enzymatic hydrolysis whereas the enzymes except for carboxypeptidase Y cleaved all

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Group 6B—Bioengineering

to define a parallel plate system that can be used to calibrate flat 60-Hz electric field probes.

6E. Clinical Medicine

400,097
PB84-216894 PC A04/MF A01
National Bureau of Standards (NML), Washington, DC.
Evaluation by an ID/MS (Isotope Dilution/Mass Spectrometric) Method of the AACC (American Association for Clinical Chemistry) Reference Method for Serum Glucose.

Final rept.,
R. Schaffer, J. Mandel, T. Sun, A. Cohen, and H. S. Hertz. Oct 82, 58p NBS/SP-260-80
Also available from Supt. of Docs as SN003-003-02443-1. Library of Congress catalog card no. 82-600618. Prepared in cooperation with Centers for Disease Control, Washington, DC.

Keywords: *Glucose, *Blood analysis, *Standards, Clinical chemistry, Chemical analysis, Performance evaluation, Statistical analysis, Laboratories, *Standard reference materials, *Isotope dilution mass spectrometry.

A study group of the Committee on Standards of the American Association for Clinical Chemistry was organized in 1972 for the purpose of establishing a reference method for serum glucose determinations. This required the study group to (a) consider the limits for bias and imprecision it judged would be acceptable in a glucose reference method for clinical chemistry, (b) identify the potential (i.e., candidate) reference method, from such evidence as low susceptibility to possible sources of interference and amenability to precise performance, (c) obtain several serum pools whose glucose levels are determined by an essentially bias-free, highly precise (i.e., definitive) method, and (d) use the serum pools in a statistically designed, multilaboratory study to evaluate the candidate method as the reference method. Cali et al. (1) employed that approach in attempting to establish the reference method for total calcium, and it was subsequently used for the serum sodium (2), potassium (3), chloride (4), and lithium (5) reference methods.

400,098
PB84-216993 Not available NTIS
National Bureau of Standards, Washington, DC.
Study of Biological Samples Obtained from Victims of MGM Grand Hotel Fire.

Final rept.,
M. Birky, D. Malek, and M. Paabo. Dec 83, 7p
Pub. in Jnl. of Analytical Toxicology 7, p265-271 Nov-Dec 83.

Keywords: *Blood chemical analysis, Death, Fire, Soot, Respiratory system, Inhalation, Reprints, *Carboxyhemoglobin.

Eighty blood samples and 17 respiratory-tract tissue samples containing fluid taken from victims of the MGM Grand Hotel fire were studied to assist in the determination of the cause of death. The blood and tissue-fluid samples were analyzed for carboxyhemoglobin, oxyhemoglobin, methemoglobin, and total hemoglobin. Outgassing studies were done on the tissue samples using gas chromatography/mass spectroscopy, and heavy metal analysis on inhaled soot was done by x-ray fluorescence. The carboxyhemoglobin values obtained on the samples were significantly higher than those reported by Clark County. However, the percentage of the victims with a carboxyhemoglobin saturation level of 50% or less is higher than that found in the Maryland fire fatality study, suggesting that other toxic factors may have contributed to the lethal nature of the fire.

400,099
PB84-217231 Not available NTIS
National Bureau of Standards, Washington, DC.
Cements Containing Syringic Acid Esters - o-Ethoxybenzoic Acid and Zinc Oxide.

Final rept.,
G. M. Brauer, and J. W. Stansbury. Feb 84, 4p
Pub. in Jnl. of Dental Research, v63 n2 p137-140 Feb 84.

Keywords: *Dental materials, *Adhesives, Esters, Zinc oxides, Physical properties, Reprints, *Syringic acids, *Benzoic acid/ethoxy, Syringic acid/(hexyl-ester), Syringic acid/(ethylhexyl-ester).

Fissure caries is reduced when syringic acid is incorporated into a cariogenic diet of rats. It was therefore of interest to synthesize n-hexyl and 2-ethylhexyl syringate and to evaluate the properties of cements with these compounds as ingredients. Liquids containing the esters dissolved in o-ethoxybenzoic acid (EBA)-when mixed with powders made up from zinc oxide, aluminum oxide, and hydrogenated rosin-hardened in from four to nine min. Properties of the cements were determined, when possible, according to ANSI/ADA specification tests. Depending on the powder-liquid ratio employed, we obtained compositions with varying physical properties desirable for different dental applications.

400,100
PB84-217587 PC A04/MF A01
National Bureau of Standards (NML), Washington, DC.
Polymers Div.
Properties and Interactions of Oral Structures and Restorative Materials. Annual Report for Period October 1, 1982 through September 30, 1983.
J. A. Tesk, G. M. Brauer, J. M. Antonucci, W. Wu, and J. E. McKinney. May 84, 59p NBSIR-84/2843
See also PB83-147546. Sponsored in part by National Inst. of Dental Research, Bethesda, MD.

Keywords: *Dental materials, *Adhesives, Solubility, Composite materials, Infrared spectroscopy, Polymerization, Synthesis(Chemistry), Physical properties, Wear resistance, Ceramics, Biomaterials.

High strength, eugenol-free cements based on esters of vanillic acid show good biocompatibility in some tests, do not inhibit polymerization and have low solubility. Additional potential applications include pulp capping, endodontic sealing and intermediate restoratives. Hydrophobic resin formulations have lower water sorption than Bis Phenol Glycidyl Methacrylate (BIS-GMA) and reduce microleakage. Flexible backbone dimer and trimer acids produce hydrophobic materials with potential for use as cavity liners, endodontic sealers and impression materials. A 75% ethanol-25% water solution softens composites more than other ratios; resins with solubility parameters more different from this solution than BIS-GMA are under development. The newer resins are fluoromethacrylates and urethaneacrylates. A cumulative failure plot, based on Weibull statistics was shown capable of representing data obtained from a four point bending composite beam (porcelain-fused-to-metal). Castabilities of six nickel based alloys were shown to be represented by a simple, two term equation with constants characteristic of each alloy.

400,101
PB84-223965 Not available NTIS
National Bureau of Standards, Washington, DC.
Measurement Assurance Studies of High-Energy Electron and Photon Dosimetry in Radiation-Therapy Applications.

Final rept.,
M. Ehrlich, and C. G. Soares. 1981, 8p
Pub. in Proceedings of Intercomparison Procedures in Dosimetry of High-Energy X-ray Electron Beams, Vienna, Austria, April 2-6, 1979, IAEA-TECDOC-249, p75-88 1981.

Keywords: *Radiology, *Dosimetry, Cobalt 60, Radiation dosage, Bremsstrahlung, Gamma rays, X rays, Thermoluminescent dosimeters.

This is a brief review of surveys on the dosimetry of radiation-therapy beams by the National Bureau of Standards (NBS). Covered are the NBS ferrous-sulfate (Fricke) dosimetry service, a recently completed survey carried out with thermoluminescence dosimeters (TLD) on the dosimetry in cobalt-60 teletherapy beams, and plans for a TLD survey of dosimetry in high-energy bremsstrahlung beams.

400,102
PB84-227297 Not available NTIS
National Bureau of Standards, Washington, DC.
Subsurface Damage Layer of In vivo Worn Dental Composite Restorations.

Final rept.,
W. Wu, E. E. Toth, J. F. Moffa, and J. A. Ellison. May 84, 6p
Sponsored in part by American Dental Association Health Foundation, Chicago, IL., and National Inst. of Dental Research, Bethesda, MD.
Pub. in Jnl. of Dental Research 63, n5 p675-680 May 84.

Keywords: *In vivo analysis, *Dental materials, Surfaces, Wear tests, Solubility, Reprints.

Dental composite restorations have been examined using a silver staining method to elucidate in vivo wear mechanisms. Emphasis was placed on examination of material immediately beneath the wearing surfaces. Several in vitro tests were also investigated for their ability to generate in vivo-like surface defects. For all the clinically worn composite restorations, a porous layer has been observed beneath those surfaces exposed to the oral environment. A laboratory test using certain substances to simulate the oral environmental effects can reproduce this porous layer. These results suggest that the in vivo wear process of dental composites is one accelerated by environmental softening of the composites.

400,103
PB84-239318 Not available NTIS
National Bureau of Standards, Washington, DC.
Approach to Remineralization via Sallva.

Final rept.,
L. C. Chow, and W. E. Brown. 1982, 6p
Sponsored in part by American Dental Association Health Foundation, Chicago, IL.
Pub. in Proceedings of Annual Conference on Foods, Nutrition and Dental Health (3rd), Chicago, IL., October 10-12, 1979, p217-222 1982.

Keywords: *Calcium phosphates, *Dental materials, In vitro analysis, In vivo analysis, Enamel, Concentration(Composition), Calcium, Phosphates, *Remineralization, Apatite/hydroxy.

From much evidence published previously, the authors can be certain that remineralization of teeth can and does occur to a very significant extent both in vitro and in vivo. Remineralization has the potential of being a very promising means of caries prevention. Several difficulties, however, block application of remineralization in practice. One such difficulty is the volume factor. Most remineralizing solutions that have been tried have low concentrations of calcium and phosphate. Typically, the calcium concentration is less than three mM. As tooth mineral contains about 40% calcium and has a density of 3, the calcium concentration in terms of molarity is about 30. Therefore, the calcium concentration in enamel is 10,000 x that of the calcifying solution. Furthermore, as only a fraction of the calcium in the solution can precipitate, one would need approximately 10 to the 5th power unit volumes of calcifying solution to produce one unit volume of the mineral. This is not a serious problem in in vitro experiments because a liter of such calcifying solution could precipitate 30 mg of the calcium phosphate, which is probably more than any given tooth specimen requires. However, to do this in the mouth is much more difficult. It may require rather elaborate devices and tedious procedures to place a large volume of the calcifying solution on the portion of the tooth where calcification must occur.

400,104
PB84-239896 Not available NTIS
National Bureau of Standards, Washington, DC.
Candidate Reference Method for Determination of Bilirubin in Serum. Test for Transferability.

Final rept.,
B. W. Perry, B. T. Doumas, D. D. Bayse, T. Butler, and A. Cohen. 1983, 5p
Sponsored in part by American Association for Clinical Chemistry, Washington, DC. Study Group on Bilirubin.
Pub. in Clinical Chemistry 29, n2 p297-301 1983.

Keywords: *Bile pigments, *Standards, *Blood analysis, Solutions, Blood serum, Laboratories, Comparison, Chemical analysis, Reprints.

Each of 10 laboratories, using portions of a single crystalline bilirubin preparation, prepared bilirubin standards in solutions of bovine serum albumin. The standards were prepared on two days. The standards and two control sera were analyzed by a modified Jendrasik-Grof method, in duplicate, on the same day the standards were prepared. The mean molar absorptivity of the alkaline azobilirubin at 598 nm was 75080 L/mol²/cm⁻¹ with a standard deviation of 760. Mean values for the two controls were 41.4 and 113.5 mg/L, with standard deviations of 0.9 and 1.4 mg/L, respectively.

400,105
PB84-242460 Not available NTIS
 National Bureau of Standards, Washington, DC.
Recently Developed Concepts in Adhesive Bonding of Composites to Dentin and Enamel.
 Final rept.,
 R. L. Bowen, E. N. Cobb, and L. E. Setz. May 84, 3p
 Sponsored in part by American Dental Association Health Foundation, Chicago, IL.
 Pub. in Buffalo Dent. Rev. 1, n1 p10-12 May 84.

Keywords: *Adhesive bonding, *Dentin, *Composite materials, *Enamels, Polymerization, Methacrylic acid, Surfaces, Reprints, Free radicals.

Strong in-vitro bonding between composites and dentin can now be obtained. Described are results of tests using variations from the method developed recently. To accomplish the strong bonding, it is currently concluded that two necessary features of the treatment are (1) the dissolution of the smeared surface layer and precipitation of insoluble reaction products, forming a strong, probably microporous, structure; and (2) the initiation of free radical polymerization of the methacrylate layers by redox interactions among the components complexed with this altered surface structure.

400,106
PB85-100212 Not available NTIS
 National Bureau of Standards, Washington, DC.
U.S. National Bureau of Standards/Atomic Industrial Forum Radioactivity Measurements Assurance Program.
 Final rept.,
 D. B. Golas, and J. M. Calhoun. 1983, 6p
 Pub. in International Jnl. of Nuclear Medicine and Biology 10, n2/3 p163-168 1983.

Keywords: *Radioactivity, *Industrial plants, *Radiochemistry, Standards, Drugs, Samples, Reprints, *Standard reference materials, Nuclear medicine, NRC.

Beginning in the early 1970's, the U.S. National Bureau of Standards (NBS) and the Atomic Industrial Forum (AIF), representing several of the major bulk suppliers of radiochemicals and producers of radiopharmaceuticals, have cooperated in a measurements assurance program in the field of nuclear medicine. Approximately 10 different samples (Standard Reference Materials) of known but undisclosed value ('blinds') are distributed to each participating company each year. Participants then report their measured value to NBS and a report is issued showing how well their measurements agree with those of NBS. Consequences of this program are (i) each company's measurements are in better agreement with those of other participating companies, (ii) measurement uncertainties have been reduced, (iii) traceability to NBS demonstrates a participant's measuring abilities when submitting New Drug Applications to the U.S. Food and Drug Administration (FDA), and (iv) evidence of compliance with requirements of the U.S. Nuclear Regulatory Commission (NRC), the U.S. Pharmacopeia and other Federal and State agencies is provided.

400,107
PB85-102143 Not available NTIS
 National Bureau of Standards, Washington, DC.
Programme of the United States Bureau of Standards in Dosimetry Standards for Neutron Radiation Therapy.
 Final rept.,
 L. J. Goodman, J. J. Coyne, and R. S. Caswell. 1984, 11p
 Pub. in Proceedings in Advances in Dosimetry for Fast Neutrons and Heavy Charged Particles for Therapy Applications, Vienna, Austria, June 14-18, 1982, IAEA-AG-371/8, p217-227 1984.

Keywords: *Radiotherapy, *Dosimetry, *Standards, Gamma rays, Neutrons, Calibration.

This report discusses two aspects of the neutron dosimetry program at the United States National Bureau of Standards (NBS), namely the plans and progress towards establishing dosimetry standards for neutron radiation therapy, and an investigation of the neutron and gamma-ray tissue kerma rates from a 252Cf source. Neutron radiation therapy is being clinically tested at a number of centers in the world. To maximize the chances of success of this radiation therapy modality, good physical dosimetry is needed. To facilitate exchange of therapy experience between institu-

tions, the United States dosimetry standards base must be accurate and consistent with the international standards system. The purpose of the NBS program is to improve the accuracy and consistency of measurements of absorbed dose for neutron radiation therapy by providing national dosimetry standards and improved data on neutron interactions with tissue and tissue-equivalent materials. A longer-term goal is to develop a calibration facility at NBS where neutron dosimeters can be calibrated and their energy dependence studied.

400,108
PB85-107449 Not available NTIS
 National Bureau of Standards, Washington, DC.
Parallel Beam Microradiography of Dental Hard Tissue Using Synchrotron Radiation and X-Ray Image Magnification.
 Final rept.,
 S. Takagi, L. C. Chow, W. E. Brown, R. C. Dobbyn, and M. Kuriyama. 1984, 3p
 Grant PHS-DE-05030-05A2
 Pub. in Nuclear Instruments and Methods in Physics Research 222, p256-258 1984.

Keywords: *Radiography, *Dentistry, Reprints.

A novel technique utilizing a highly parallel beam of monochromatic synchrotron radiation combined with x-ray image magnification has been used to obtain microradiographs of caries lesions in relatively thick tooth sections. Preliminary results reveal structural features not previously reported. This technique holds the promise of allowing one to follow the structural changes accompanying the formation, destruction and chemical repair of mineralized tissue in real time.

400,109
PB85-129609
 (Order as PB85-129591, PC A03/MF A01)
 National Bureau of Standards, Gaithersburg, MD.
Exposure Standardization of Iodine-125 Seeds Used for Brachytherapy.
 T. P. Loftus. 1 May 84, 9p
 Included in Jnl. of Research of the National Bureau of Standards, v89 n4 p295-303 Jul-Aug 84.

Keywords: *Calibration, *Radiotherapy, Exposure, Standards, X rays, *Iodine 125, Ionizing radiation.

A method for calibrating iodine-125 seeds in terms of exposure has been established. The standard free-air ionization chamber, used for measuring soft x rays, was chosen for the measurements. Arrays of four to six seeds were used to enhance the ionization-current-to-background-current ratio. Seeds from an array were measured individually in a re-entrant chamber. The quotient of the exposure rate for the array by the sum of the ionization currents in the re-entrant chamber is the calibration factor for the re-entrant chamber. Calibration factors were established for three types of iodine-125 seeds. The overall uncertainty for the seed exposure calibrations is less than 6%.

400,110
PB85-140333 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Ultrasonic Tissue Characterization Seminar: An Assessment.
 Final rept.,
 M. Linzer. 1976, 4p
 Pub. in Jnl. of Clinical Ultrasound 4, n2 p97-100 Apr 76.

Keywords: *Diagnosis, *Tissues(Biology), *Ultrasonics, Characteristics, Reprints.

A review and assessment of the impact of the 1975 Ultrasonic Tissue Characterization Seminar is presented.

400,111
PB85-143477 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Amplitude Analysis of Pancreatic B-Scans: A Clinical Evaluation of Cystic Fibrosis.
 Final rept.,
 T. A. Shawker, S. I. Parks, M. Linzer, B. Jones, and L. A. Lester. 1980, 12p
 Pub. in Ultrason. Imaging 2, n1 p55-66 Jan 80.

Keywords: *Cystic fibrosis, *Pancreas, *Ultrasonic frequencies, Respiratory diseases, Reprints.

Ultrasonic B-scan images of the pancreatic parenchyma in normal and cystic fibrotic patients were numerically analyzed. Images of both the maximum and mini-

mum echoes from the tissue were generated by a recently-developed digital ultrasound system. Complete segregation of the two groups was achieved by averaging the echo amplitude over a selected region in the image. The dependence of the numerical values on the B-scan imaging mode, transducer properties, dynamic range compression curve, and operator scanning technique is discussed in depth.

400,112
PB85-143618 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Ultrasonic Tissue Characterization.
 Final rept.,
 M. Linzer, and S. J. Norton. 1982, 27p
 See also PB-296 356.
 Pub. in Annual Review of Biophysics and Bioengineering 11, p303-329 1982.

Keywords: *Ultrasonic tests, *Tissues(Biology), Acoustic properties, Reprints, Noninvasive tests.

A critical review of ultrasonic tissue characterization techniques is presented.

6F. Environmental Biology

400,113
PB84-217793 PC A03/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 ElectroSystems Div.
Electrical Parameters in 60-Hz Biological Exposure Systems and Their Measurement: A Primer.
 Final rept.,
 M. Misakian. Apr 84, 47p NBS/TN-1191
 Also available from Supt. of Docs as SN003-003-02581-0. Sponsored in part by Department of Energy, Washington, DC. Div. of Electric Energy Systems.

Keywords: *Biological effects, *Coronas, Transmission lines, Exposure, Measurement, Electric fields, Magnetic fields, Simulation, Surveys, Air pollution effects.

The report presents material which is intended to provide assistance in the measurement of a number of electrical parameters that are of importance during bioeffects research involving 60-Hz electric and magnetic fields. The parameters that are considered are the electric field strength E, the magnetic induction or flux density B, field uniformity, harmonic content, phase relations between field components, and corona. Descriptions of the fields and methods for their laboratory generation are surveyed. The text is purposely elementary with references provided to aid the interested reader in obtaining a fuller understanding of many of the topics. It is shown that using relatively simple instrumentation, it is possible to characterize reasonably well the electric and magnetic fields used in animal exposure studies.

6H. Food

400,114
PB84-177823 PC A05/MF A01
 National Bureau of Standards, Washington, DC.
 National Engineering Lab.
Role of Color in Lighting for Meat and Poultry Inspection.
 B. L. Collins, and J. A. Worthey. Mar 84, 89p NBSIR-84-2829
 Sponsored in part by Department of Agriculture, Washington, DC.

Keywords: *Food inspection, *Food analysis, *Meat, *Poultry, *Colors(Materials), *Chromaticity, Illuminescence, Inspection, Spectroradiometers, Reflectance, Light(Visible radiation), Luminous intensity.

The role of color in lighting for meat and poultry inspection is discussed. A review of literature relevant to the problem of quality of illumination is presented, along with literature specific to agricultural and veterinary problems. A psychophysical study of the accuracy of detecting and identifying selected defects in meat and poultry was conducted under five light sources: incandescent, cool white fluorescent, cool white deluxe, high pressure sodium (HPS), and low pressure sodium (LPS). The results indicated that more errors were made under the latter two sources, and that the in-

Field 6—BIOLOGICAL AND MEDICAL SCIENCES

Group 6H—Food

spection task was rated as more difficult under these sources. In addition, spectroradiometric measurements were made of defective and adjacent 'normal' tissue to document the kinds of spectral reflectance that exist in four species: chicken, cattle, turkey, and swine. These measurements indicated that differences in spectral reflectance characterized much of the tissue studied. Based on these data, recommendations are made to avoid the use of light sources with poor color rendering qualities in the inspection task.

400,115
PB85-145282 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Radiation Chemistry of Water-Soluble Food Components.
Final rept.,
M. G. Simic. 1983, 73p
Pub. in Chapter 9, Preservation of Food by Ionizing Radiations, p1-73 1983.

Keywords: *Food analysis, *Radiation chemistry, *Solubility, Reaction kinetics, Proteins, Amino acids, Carbohydrates, Vitamins, Peptides, Preservation, Reprints, State of the art, Chemical reaction mechanisms, Free radicals.

Radiation chemistry of water-soluble food components has been reviewed and deals with state of art in radiation preservation of food. It covers kinetics and mechanisms of water free radical (e(-1)(sub aq), OH, H) reactions with (a) amino acids, peptides, proteins, (b) acids, esters and lipids, (c) carbohydrates, (d) vitamins.

6L. Medical and Hospital Equipment

400,116
PB84-165083 PC A07/MF A01
National Bureau of Standards, Washington, DC.
Information on Polymeric Materials Used in Orthopedic Devices,
J. M. Crissman, and G. B. McKenna. Jan 84, 134p
NBSIR-84-2820-FDA
Sponsored in part by Food and Drug Administration, Silver Spring, MD. Bureau of Medical Devices.

Keywords: *Orthopedic equipment, *Plastics, *Implantation, Mechanical properties, Acrylic resins, Poly-methyl methacrylate, Specifications, Polyethylene, Wear, Bones.

This report provides information on the two polymeric materials most commonly used in the fabrication of orthopedic implants. The work was done as part of Task 80-01 NBS-FDA/BMD Interagency Agreement. The two materials described are ultra high molecular weight polyethylene UHMWPE and polymethylmethacrylate (PMMA) bone cement. The report contains information on such subjects as specifications (ASTM), raw materials characterization, processing, morphology, mechanical properties, and wear.

400,117
PB84-166685 PC A07/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
User's Manual for the Fire Safety Evaluation System Cost Minimizer Computer Program,
R. E. Chapman, and W. G. Hall. Dec 83, 133p
NBSIR-83-2797
Sponsored in part by Department of Health and Human Services, Washington, DC.

Keywords: *Fire safety, *Hospitals, Manuals, Safety engineering, Building codes, Economic analysis, *Nonlinear programming, Health care facilities, Nursing homes.

The Fire Safety Evaluation System Cost Minimizer (FSESCM) computer program integrates engineering and economic considerations with a linear programming algorithm which permits the least-cost means of upgrading health care facilities to compliance with the Life Safety Code to be identified. This report is designed as a reference document for a nonprogramming FSESCM user. A description of the philosophy and methodology behind FSESCM is given first, followed by a discussion of the data requirements, the various options available to the user, as well as some of the limitations of the program. A detailed example in which all inputs to the FSESCM computer program are described is then given. The output associated with

the example is then analyzed rigorously. The report concludes with a set of guidelines for making efficient use of the FSESCM computer program.

400,118
PB85-142313 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Anodic Polarization Behavior of Unfired and Moderately Fired Nickel-Chromium Alloys.
Final rept.,
H. Weber, and A. C. Fraker. 1980, 5p
Pub. in Deutsche Zahnärztliche Zeitschrift 35, n10 p942-946 1980.

Keywords: *Dental materials, *Nickel chromium alloys, Anodic polarization, Reprints.

Due to the rapid increasing costs of gold alloys, attempts have been underway to develop other alloys which are suitable for dental crown and bridge work. This study deals with the effects of fire cycling on the anodic polarization behavior of three commercial nickel-chromium dental casting alloys. Measurements were made in modified Fusayama's solution at 37C.

6M. Microbiology:

400,119
PB85-117992 Not available NTIS
National Bureau of Standards, Washington, DC.
Volatilization of Mercury By Thiobacillus-Ferrooxidans.
Final rept.,
G. J. Olson, W. P. Iverson, and F. E. Brinckman. 1981, 4p
Pub. in Current Microbiology 5, n2 p115-118 1981.

Keywords: *Mercury(Metal), *Thiobacillus, *Vaporizing, Microorganisms, Bacteria, Gas chromatography, Metals, Reprints, *Thiobacillus ferrooxidans, Heavy metals.

Thiobacillus ferrooxidans and an acidophilic iron-oxidizing bacterium resembling T. ferrooxidans became significantly more tolerant to mercury stress after culturing in media of increasing mercury (II) concentrations. When mercuric chloride was added to the growth medium and the headspace above the cultures was analyzed by a gas chromatography-atomic absorption system, the resistant organisms were found to volatilize elemental mercury (Hg). Mercury was not similarly volatilized from phenylmercuric acetate or methylmercuric chloride. T. ferrooxidans may be an important factor in the natural mercury cycle since the environments where T. ferrooxidans is found typically contain elevated levels of heavy metals, including mercury.

400,120
PB85-134070 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Sulfate-Reducing and Methanogenic Bacteria from Deep Aquifers in Montana.
Final rept.,
G. J. Olson, W. S. Dockins, G. A. McFeters, and W. P. Iverson. 1981, 14p
Pub. in Geomicrobiol. Jnl. 2, n4 p327-340 1981.

Keywords: *Ground water, *Hydrogen sulfide, *Water pollution, Aquifers, Sulfate reducing bacteria, Bacteria, Detection, Water wells, Montana, Reprints.

Thermophilic sulfate reducing and methanogenic bacteria were detected in waters of the Madison Limestone, a deep aquifer underlying a large portion of the Northern Great Plains. Some sulfate reducing bacteria were isolated and tentatively identified as Desulfotomaculum nigrificans. These organisms are probably responsible for the hydrogen sulfide which occurs in the ground water. Microscopic counts of microorganisms in certain formation waters were about 1000/ml. Attempts to detect other aerobic and anaerobic bacteria were unsuccessful.

6Q. Protective Equipment

400,121
PB85-142610 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Crash Helmets.
Final rept.,
N. J. Calvano. Jun 84, 9p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in National Inst. of Justice Standard-0105.01, 9p Jun 84.

Keywords: *Helmets, *Motor vehicles, *Standards, Requirements, Tests, Impact strength, Visibility, Penetration.

This standard establishes requirements and methods of test for helmets to be worn by drivers and passengers of surface vehicles. This standard is a revision of and supersedes NILECJ-STD-0105.00 dated June 1975. This revision of the standard changes the impact attenuation requirements, deletes the requirement for wet testing of helmets, modifies the requirement and test method for peripheral vision limits, and clarifies test methods and test equipment requirements.

6R. Radiobiology

400,122
PB85-120640 Not available NTIS
National Bureau of Standards, Washington, DC.
NBS (National Bureau of Standards) Standard Reference Neutron Fields for Personnel Dosimetry Calibration.
Final rept.,
R. B. Schwartz, and J. A. Grundl. 1978, 19p
Sponsored in part by International Atomic Energy Administration, Washington, DC.
Pub. in Proc. Natl. and Int. Standardization of Radiation Dosimetry, Atlanta, Georgia, December 5-9 1977, p367-375.

Keywords: *Neutron sources, *Dosimetry, *Calibrating, Thermal column, Dosimeters, *Personnel dosimetry, *Neutron dosimetry, Californium 252.

The National Bureau of Standards (NBS) has established and characterized several neutron fields for dosimeter calibration. Two of these fields are continuous neutron spectra: the spontaneous fission neutron distribution from (252)Cf, and a thermal Maxwellian beam. The other three neutron fields are monoenergetic reactor beams with energies of 2, 24, and 144 keV.

400,123
PB85-137479 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Gamma Ray Response of 'Opti-chromic' Dosimeters.
Final rept.,
B. B. Radak, and W. L. McLaughlin. 1984, 3p
Pub. in Radiation Physics and Chemistry 23, n6 p673-675 1984.

Keywords: *Dosimeters, Fiber optics, Food irradiation, Gamma rays, Performance, Cobalt 60, Reprints, *Gamma dosimetry, Methane/triphenyl, Radiochromic dyes.

Commercially available 'Opti-chromic' dosimetry systems, consisting of radiochromic dye solutions in plastic tubing, were tested in terms of their response to (60)Co gamma radiation at various doses, dose rates, and temperatures, representative of those that might be encountered in typical radiation processing environments. Results of the tests are presented.

400, 124

PB85-141448

Not Available NTIS

National Bureau of Standards, Gaithersburg, MD.

Improvement of Radiochromic Film Dosimeter Precision by Individual Dosimeter Characterization.Final rept.,
R. M. Uribe, W. J. Chappas, and W. L. McLaughlin.
1984, 3pPub. in *International Jnl. of Applied Radiation and Isotopes* 35, n10 p995-997 1984.

Keywords: *Dosimeters, Radiation dosage, Precision, Gamma rays, Reprints, *Radiochromic dyes, Gamma dosimetry.

Dosimeters supplied in large batches generally have intrinsic non-uniform response characteristics that can be improved by a technique of individual dosimeter characterization. Pre-use irradiation of radiochromic dye film dosimeters provides a simple method for reducing the standard deviation and error in making absorbed dose assessments. Through a simple pre-use uniform irradiation of a selection of dosimeters to a dose of 1.0 kGy, variability in the dosimeters' optical absorbances at a given wavelength and film-to-film variation in thickness are automatically included in an interpretation of subsequent unknown doses in the range 1-20 kGy. This technique reduces by about a factor of four the nominal error associated with routine radiochromic dye film measurements.

6T. Toxicology

400, 125

PB84-140227

PC A04/MF A01

National Bureau of Standards, Washington, DC. National Engineering Lab.

Acute Inhalation Toxicological Evaluation of Combustion Products from Fire Retarded and Non-Fire Retarded Flexible Polyurethane Foam and Polyester.Final rept.,
B. C. Levin, M. Paabo, M. L. Fultz, C. Bailey, and W. Yin. Nov 83, 71p NBSIR-83-2791
Sponsored in part by Consumer Product Safety Commission, Bethesda, MD.

Keywords: *Polyurethane resins, *Polyester resins, *Combustion products, *Toxicology, Fire resistant plastics, Plastics, Foam, Hydrogen cyanide, X ray fluorescence, Exposure, Laboratory animals, Decomposition, Gas analysis, Ignition, Air pollution, Chemical analysis, Carbon dioxide, Carbon monoxide, Lethal dosage.

The acute inhalation toxicity of the combustion products from selected upholstered furniture filling materials with and without fire retardants was evaluated by the toxicity test method developed by the National Bureau of Standards. The five materials that were evaluated consisted of two different formulations of flexible polyurethane foam (each formulation was supplied in both a fire retarded and non-fire retarded form) and a polyester fiberfill (not fire retarded). Atmospheric concentrations of carbon monoxide, carbon dioxide, oxygen, and hydrogen cyanide in the exposure chamber were monitored throughout the thermal decomposition of the materials. The LC50 (30 minute and 14 day) values did not distinguish any of the materials as being significantly more toxic than the others. Extensive weight loss and post-exposure deaths occurred after exposure to the combustion products from all the materials.

400, 126

PB84-244284

Not available NTIS

National Bureau of Standards, Washington, DC.

Evaluation of the Pulmonary Toxicity of Plasticized Polyvinyl Chloride Thermal Decomposition Products in Guinea Pigs by Repeated CO₂ Challenges.Final rept.,
K. L. Wong, M. F. Stock, and Y. C. Alarie. 1983, 13p
Pub. in *Toxicology and Applied Pharmacology* 70, p236-248 1983.

Keywords: *Toxicity, *Polyvinyl chloride, *Plastics, *Thermal decomposition, *Air pollution, Laboratory animals, Reprints, Guinea pigs.

Evaluation of the Pulmonary Toxicity of Plasticized Polyvinyl Chloride Thermal Decomposition Products in Guinea Pigs by Repeated CO₂ Challenges. Wong, K.

L., Stock, M. F., and Alarie, Y. C. (1983). *Toxicol. Appl. Pharmacol.* 70, 236-248. Male guinea pigs were exposed to thermal decomposition products of plasticized polyvinyl chloride (PVC-A) at different concentrations up to levels inducing acute lethality. Several groups exposed at sublethal levels were then evaluated for pulmonary performance for a period of 57 days following exposure. Pulmonary performance was evaluated by challenging each animal with a mixture containing 10% CO₂, 20% O₂, and 70% N₂. In control animals, this mixture induced an increase in both tidal volume and respiratory frequency. This hyperventilatory response was greatly depressed during the first 3 days following exposure and gradually returned to normal during the following weeks with the exception of the highest exposure group which still showed a diminished response 57 days after exposure. The pulmonary toxicity induced by thermal decomposition products of PVC-A is probably related to the very large amount of HCl released during thermal decomposition. The CO₂ response test, a noninvasive and noninvasive method to evaluate pulmonary performance in guinea pigs, is easily performed and appears to be a very promising type of pulmonary function test for toxicological evaluations.

400, 127

PB84-244292

Not available NTIS

National Bureau of Standards, Washington, DC.

Toxicity of Smoke during Chair Smoldering Tests and Small Scale Tests Using the Same Materials.Final rept.,
Y. Alarie, M. F. Stock, M. Matlak-Schper, and M. M. Birky. 1983, 8p
Pub. in *Fund. Appl. Toxicol.* 3, p619-626 1983.

Keywords: *Toxicology, *Fire tests, *Materials tests, *Chairs, *Air pollution, Furniture, Polyester fibers, Cotton fabrics, Laboratory animals, Carbon monoxide, Hydrogen cyanide, Decomposition, Pyrolysis, Reprints, *Smoldering, *Indoor air pollution, *Air pollution effects (Animals).

Toxicological evaluation of smoke produced during smoldering chair tests was undertaken by exposing mice to smoke emitted prior to, as well as following, flaming ignition of the chairs. By exposing several groups of mice, using undiluted smoke from the room containing the chairs, as well as various dilutions of the smoke, different levels of acute lethality were obtained. From these experiments, chairs constructed with polyurethane foam were found to create higher toxic atmospheres than chairs constructed with polyester or cotton fiber cushions. The same materials (polyurethane foam, polyester and cotton fibers) were also thermally decomposed in a small scale system and mice were exposed to the smoke to evaluate acute toxicity. Again polyurethane foam was found to produce smoke more toxic than smoke produced by polyester and cotton fibers. Sensory irritation monitored in mice during the smoldering tests indicated that an intense level of irritation was present long before large amounts of smoke were generated and long before flaming ignition occurred. The phenomenon of eye, nose and throat irritation would therefore be the first effect impeding escape attempts of individuals in a fire situation. Sensory irritation was followed by asphyxiation as evolution of carbon monoxide or hydrogen cyanide, or both, occurred. The same pattern of responses was observed with smoke generated with the small scale decomposition system.

400, 128

PB85-141422

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

National Bureau of Standards Toxicity Test Method.Final rept.,
B. C. Levin. Oct 84, 19p
Pub. in *Proceedings of a Conference on Fire Safety Aspects of Products of Combustion/Hazard Assessment and Fire Testing*, Baltimore, MD., Mar 20-23, 1983, p88-106 Oct 84.

Keywords: *Toxicity, *Standards, *Combustion products, *Air pollution, Experimental design, Assessment, Ignition, In vivo analysis, Fire resistant materials.

The National Bureau of Standards is developing a small-scale test method to assess the acute inhalation toxicity of combustion products under specified laboratory conditions. This presentation on March 22, 1983 to the Spring Conference of the Fire Retardant Chemicals Association describes the current test method, its uses and limitations, and the future plans of the National Bureau of Standards to overcome these limita-

tions. Aspects of the test method that were discussed in detail were the temperatures of combustion (25°C above and below the autoignition temperature), the current combustion system and two radiant-energy combustion systems, the achievement of the test method's objective, and the reproducibility of results as determined by an interlaboratory evaluation of the test by seven laboratories.

7.**CHEMISTRY****7A. Chemical Engineering**

400, 129

PB83-165068

PC A03/MF A01

National Bureau of Standards, Boulder, CO. National Engineering Lab.

Membrane Separations in Chemical Processing,

Thomas M. Flynn, and J. Douglas Way. Dec 82, 28p

NBSIR-82-1675

See also PB82-264276.

Keywords: *Membranes, *Energy conservation, Separations, Chemical industry, Technology, Operating costs.

Rapidly rising energy and operating costs have underscored the need for novel energy efficient separations processes, such as membrane processes, which avoid the energy consuming phase change step of many conventional separations (e.g., distillation, absorption, stripping). It is well known that membrane separation is the most energy efficient separation technique thermodynamically possible, since it does not rely upon vaporization and condensation to effect fractionation. Recent developments in solid polymer, hollow fiber and liquid membranes give excellent promise for industrial application. Hence, because of recent technological developments of these new membranes, and because of its great energy savings potential, research is being conducted on the fundamentals determining separation rates, separation factors, and selectivity of new types of solid and liquid membranes with potential application to the chemical process industry.

400, 130

PB85-141380

Not available NTIS

National Bureau of Standards, Boulder, CO.

Prediction of Transport Properties: Application of Basic Theory.Final rept.,
H. J. M. Hanley. 1983, 9p
Contract DE-A101-76PR06010
Pub. in *Rev. Portuguese Chem.* 25, p27-35 1983.

Keywords: *Transport properties, Viscosity, Computerized simulation, Mixtures, Reprints, *Basic theory, Enskog theory.

The transport prediction procedure of Ely and Hanley is discussed in this paper as an example of how theory can contribute to practical usable methods required by industry. The procedure is outlined and one particular failure of the original approach is isolated, i.e., that the procedure failed to predict correctly the viscosity of a mixture whose components differ substantially in size. A companion computer simulation molecular dynamic study is discussed, the results of which give insight into the problem of the real system. A correction based on the Enskog theory as introduced and suggested by Ely is proposed. The modified prediction procedure is shown to give excellent results.

Field 7—CHEMISTRY

Group 7A—Chemical Engineering

400,131
PB85-151652 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Cryogenic Processes.
Final rept.,
T. M. Flynn. 1984, 12p
Pub. in Perry's Chemical Engineer's Handbook, 6th Edition, Section 12, p12-47--12-58 1984.

Keywords: *Chemical engineering, *Cryogenics, Distillation, Heat transfer, Adsorption, Low temperature tests, Reprints.

Cryogenic processes are described as the traditional unit operations of chemical engineering, taking place in an extreme environment (at temperatures below 200K). This paper discusses distillation, adsorption, and heat transfer at low temperatures.

400,132
PB85-151751 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Snapshot of the NBS (National Bureau of Standards) Center for Chemical Engineering.
Final rept.,
J. Hord. 1983, 9p
Pub. in Proceedings of the National Conference of Standards Laboratories 1983 Workshop and Symposium, Boulder, CO., July 18-21, 1983, pl-3.1-1-3.9.

Keywords: *Chemical engineering, Standards, Thermophysical properties, Fluids, Solids, Standards.

The Center for Chemical Engineering was formed two years ago by the National Bureau of Standards to meet the changing needs of the U.S. chemical process industry. The goal of the Center is to provide U.S. industry with measurement and data bases that enable improved innovation, design, and control of chemical processes, assure equity in domestic and international trade, and strengthen the competitiveness of U.S. industry in the world market. This paper provides an overview of selected research efforts within the Center and of its test and calibration services and research products. Emphasis is placed on chemical process metrology, thermophysical properties of fluids and solids, and chemical engineering science.

7B. Inorganic Chemistry

400,133
PB85-164952 PC A08/MF A01
National Bureau of Standards (NML), Gaithersburg, MD.
Technical Activities 1984, Center for Analytical Chemistry.
Final rept.,
R. A. Velapoldi, H. S. Hertz, and J. K. Taylor. Dec 84, 156p NBSIR-84/2979

Keywords: *Chemical analysis, *Standards, *Research projects, Inorganic compounds, Organic compounds, Particles, Gases.

This report summarizes the technical activities of the Center for Analytical Chemistry at the National Bureau of Standards. It emphasizes activities over the Fiscal Year 1984 in the Inorganic Analytical Research Division, the Organic Analytical Research Division, and the Gas and Particulate Science Division. In addition, it describes certain special activities in the Center including quality assurance and voluntary standardization coordination.

7C. Organic Chemistry

400,134
PB84-222124 Not available NTIS
National Bureau of Standards, Washington, DC.
Synthesis and Characterization of Polymeric C18 Stationary Phases for Liquid Chromatography.
Final rept.,
L. C. Sander, and S. A. Wise. 1984, 7p
Pub. in Analytical Chemistry 56, n3 p504-510 1984.

Keywords: *Aromatic polycyclic hydrocarbons, *Synthesis(Chemistry), Chromatographic analysis, Reprints.

The synthesis of monomeric, polymeric, and 'oligomeric' C18 alkyl phases is described for a series of

wide pore (300 Å) silica substrates. Chromatographic properties of the phases are compared by use of polycyclic aromatic hydrocarbon (PAH) probes. A three-component test mixture was used to evaluate the relative polymeric nature of a given phase. On the basis of the elution order of the components of this mixture, the phase type could be classified rapidly and the selectivity toward more complex PAH mixtures could be predicted. Selectivity was observed to be related to surface coverage values while absolute retention was found to be more closely related to the total carbon contained within the column. Although in past work intentional polymerization has usually been avoided in the preparations of alkyl-bonded phases, the unique selectivity of polymeric phases makes them an excellent complement to monomeric phases.

400,135
PB85-102226 Not available NTIS
National Bureau of Standards, Washington, DC.
O-Iminy Esters of N,N-Bis(2-chloroethyl)phosphorodiamidic Acid. Synthesis, X-Ray Structure Determination, and Anticancer Evaluation.
Final rept.,
S. M. Ludeman, V. L. Himes, K. L. Shao, G. Zon, and A. D. Mighell. 1983, 3p
Grants PHS-CA-21345, PHS-DE-05030
Pub. in Jnl. of Medicinal Chemistry 26, n12 p1788-1790 1983.

Keywords: *Antineoplastic agents, *Synthesis(Chemistry), Nitrogen organic compounds, Drugs, Enzymes, X ray analysis, Crystal structure, Laboratory animals, Reprints, *Phosphorodiamidic acid/(iminy-ester)-N-N-bis(chloroethyl).

Nine representatives of the title series of compounds ((ClCH₂CH₂)₂NP(O)(NH₂)ON=CCR') were synthesized as potential anticancer prodrugs, based on the possibility of enzymatic reduction of the N-O bond to release the known cytotoxic agent phosphoramidate mustard (1, (ClCH₂CH₂)₂NP(O)(NH₂)OH). The dimethyl derivative (2, R = R' = CH₃) exhibited a statistically significant albeit low-level of anti-L1210 activity in mice. A single crystal X-ray study of 2 revealed, inter alia, an unusual hydrogen bonding 'ladder' and an isosteric relationship for the N-CH₂-CH₂-Cl and O-N=C-CH₃ moieties.

7D. Physical Chemistry

400,136
NB82-30551/7 PC A02/MF A01
National Bureau of Standards, Washington, DC. National Measurement Lab.
Thermoelectric Refrigeration for Temperatures Below 100 K: A Study of Titanium Sesquioxide.
R. Redebaugh, D. Linenberger, and E. Spellicy. May 82, 14p NAS 1.26:166343, NBSIR-82-1665, NASA-CR-166343
Contract NBS-A-6-3249B(DDA)

Keywords: *Electrical resistivity, *Refrigerating, *Specific heat, *Thermal conductivity, *Titanium oxides, Cryogenics, Figure of merit, Thermoelectric cooling, Thermophysical properties, Vanadium.

Previous measurements of the specific heat of V-doped Ti₂O₃ at low temperatures were explained by a model which also suggested the material would have a high thermoelectric figure-of-merit. The sample preparation, experimental apparatus, and the results of measurements on the thermal conductivity, thermoelectric power, and electrical resistivity of a single crystal Ti₂O₃ - 4% V sample are described. The results are used to derive the thermoelectric figure-of-merit between 5 and 300 K. The figure-of-merit is much smaller than expected and of little practical value because of the very high phonon thermal conductivity.

400,137
NB83-24800/5 PC A05/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Transport Properties of Oxygen.
H. M. Roder. Apr 83, 86p NAS 1.61:1102, NBSIR-82-1672, NASA-RP-1102
NASA ORDER C-32369-C

Keywords: *Oxygen, *Thermal conductivity, *Thermal diffusivity, *Viscosity, Equations of state, Prandtl number, Tables (Data).

Tables of viscosity, thermal conductivity, and thermal diffusivity of oxygen as a function of temperature and pressure from the triple point to 320 K and at pressures to 100 MPa are presented. Auxiliary tables in engineering units are also given. Viscosity and thermal conductivity are calculated from published correlations. Density and specific heat at constant pressure, required to calculate thermal diffusivity, are obtained from an equation of state. The Prandtl number can be obtained quite easily from the values tabulated.

400,138
PB84-122704 PC A09/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Hydrogen Sulfide Provisional Thermophysical Properties from 188 to 700 K at Pressures to 75 MPa.
R. D. Goodwin. Oct 83, 177p NBSIR-83-1694
Sponsored in part by Gas Research Inst., Chicago, IL. Portions of this document are not fully legible.

Keywords: *Hydrogen sulfide, *Thermophysical properties, Pressure, Physical properties, Equations of state, Vapor pressure, Density(Mass/volume), Computer programs, Tables(Data), Compressibility, Enthalpy, Entropy, Specific heat, Joule-Thompson effect, Virial coefficients.

Thermophysical properties of hydrogen sulfide are derived from physical properties data by using our nonanalytic equation of state, and are tabulated along isobars at integral temperatures. Results include vapor pressures, orthobaric densities, the second virial coefficient, the equation of state, the ideal gas state functions, compressibility factors, densities, derivatives of the P(rho,T) surface, heats of vaporization, internal energies, enthalpies, entropies, specific heats, fugacity coefficients, speeds of sound, and the Joule-Thomson inversion. Thermofunctions by another author are compared with present results.

400,139
PB84-140508 PC A11/MF A01
National Bureau of Standards, Washington, DC.
Characterization of the Chesapeake Bay: A Systematic Analysis of Toxic Trace Elements.
H. M. Kingston, R. R. Greeberg, E. S. Beary, B. R. Hardas, and J. R. Moody. Nov 83, 227p NBSIR-83-2698
Sponsored in part by Environmental Protection Agency, Washington, DC.

Keywords: *Water pollution, *Trace elements, *Water analysis, Concentration(Composition), Chemical analysis, Neutron activation analysis, Sampling, Separation, *Chesapeake Bay, *Toxic substances, *Water pollution detection, Graphite furnace atomic spectroscopy.

As part of a multidisciplinary study of the Chesapeake Bay, the National Bureau of Standards (NBS) was asked to develop the techniques and procedures necessary to measure the trace and toxic element concentrations within the water column through the entire length of the Chesapeake Bay. The Inorganic Analytical Research Division of the Center for Analytical Chemistry at NBS has completed the analysis for selected elements (Cd, Ce, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sc, Sn, Th, U, and Zn), including some elements at concentrations consistently below one picogram per milliliter (part per trillion).

400,140
PB84-155332 PC A08/MF A01
Washington Univ., St. Louis, MO. Thermodynamics Research Lab.
Definition of Recommended Values of Certain Thermodynamic Properties for the Ketones.
Final rept.,
B. D. Smith, and O. Muthu. Jan 84, 170p NBSIR-84-2811
Contract NB80-NADA-1047
Sponsored in part by National Science Foundation, Washington, DC.

Keywords: *Thermodynamic properties, *Ketones, Vapor pressure, Density(Mass/volume), Equations of state, Melting point, Boiling point, Critical point, Heat vaporization, Virial coefficients.

Experimental data for the vapor pressure, liquid density, second virial coefficient, and certain compound constants for the ketones were retrieved in a comprehensive sweep of the literature. The vapor pressure

and liquid density data were subjected to an intensive selection-deletion process to identify the best available experimental data points for each compound. Those data were carefully correlated with reliable equations in order to put the selected data into a form convenient for use in computer data banks. The second virial coefficient data were not subjected to such an intensive evaluation process; that predictive correlation equation which provided the best overall representation of the literature data sets for each compound was chosen for use in the data bank. Values of the compound constants were selected subject to the requirement that those constants related to the vapor pressure and liquid density be consistent with the selected correlations for those properties. Whenever possible, the parameters for the best available equations of state are provided. The correlation equations can be used to provide tabulations of vapor pressure, saturated liquid density, second virial co-efficients, heat of vaporization, and saturated vapor volume to the extent permitted by the available good experimental data.

400,141
PB84-165349 PC A09/MF A01
 National Bureau of Standards, Washington, DC. National Measurement Lab.
NBS (National Bureau of Standards) Standard Reference Materials Catalog 1984-85,
 C. H. Hudson. Feb 84, 184p NBS-SP-260
 Also available from Supt. of Docs. as SN003-003-02558-5. Supersedes PB82-138140.

Keywords: *Catalogs(Publications), Standards, Chemical properties, Physical properties, Engineering standards, *Standard reference materials.

The National Bureau of Standards issues over 1000 different materials through its Standard Reference Materials Program. These materials are primarily Standard Reference Materials (SRM's) certified for their chemical composition, chemical property, or physical property, but also include Research Materials (RM's) and Special Reference Materials (GM's). All SRM's, RM's, and GM's bear distinguishing names and numbers by which they are permanently identified. Thus, each SRM, RM, or GM bearing a given description is identical (within the required or intended limits) to every other sample bearing the same designation--with the exception of individually certified items, which are further identified by serial number. The first materials issued by NBS were called Standard Samples and consisted of a group of ores, irons, and steels certified for their chemical composition. Since the mid-1960's these materials have been issued as Standard Reference Materials, and cover a wide range of chemical and physical properties and an equally wide range of measurement interests.

400,142
PB84-183599 PC A04/MF A01
 National Bureau of Standards, Washington, DC.
Characterization of Organometallic Polymers by Chromatographic Methods and Nuclear Magnetic Resonance. Part 2.
 Rept. for 1 Oct 82-30 Sep 83,
 E. J. Parks, W. F. Manders, R. B. Johannesen, and
 F. E. Brinckman. Feb 84, 56p NBSIR-83-2802
 Sponsored in part by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.

Keywords: *Chromatographic analysis, *Polymers, *Nuclear magnetic resonance, *Metal containing organic compounds, *Chemical analysis, *Coatings, Spectrochemical analysis, Tin organic compounds, Samples, Isotopic labeling, Molecular weight, *Chemical reaction mechanisms, Slow release chemicals.

Continuing research into the analytical methodology for characterization of organometallic polymers (OMPs) has produced improved methods of characterization by size exclusion chromatography (SEC) and Fourier transform nuclear magnetic resonance (FTNMR). Molecular weight (MW) and MW dispersion (MWD), as well as the amount of tin associated with fractions of various MW can now be reliably determined by SEC coupled with various detectors: differential refractive index (delta RI), ultra-violet (UV), and graphite furnace atomic absorption (GFAA) spectroscopy. Configurational sequencing in terms of both tacticity and sequencing of monomer units can be determined by FTNMR, as well as certain tin-containing impurities. Removal of tributyltin groups to produce a metal-free copolymer allows much more informative FTNMR spectra to be obtained. All of the polymers examined are approximately 80 percent racemic (r) and

20 percent meso (m) in tacticity (i.e., predominantly syndiotactic). The growing chain end in the copolymer adds either of the monomer units approximately in proportion to its instantaneous concentration in the mixture (i.e., at random).

400,143
PB84-217009 Not available NTIS
 National Bureau of Standards, Washington, DC.
Theory of Collision-Induced Translation-Rotation Spectra; H₂-He.
 Final rept.,
 G. Birnbaum, S. Chu, A. Dalgarno, L. Frommhold, and E. Wright. Feb 84, 10p
 Pub. in Physical Review (Section) A: General Physics, v29 n2 p595-604 Feb 84.

Keywords: *Hydrogen, *Helium, *Molecular rotation, Absorption spectra, Dipole moments, Reprints, Ab initio calculations, Numerical solution.

An adiabatic quantal theory of spectral line shapes in collision-induced absorption and emission is presented which incorporates the induced translation-rotation and translational-vibration spectra. The generalization to account for the anisotropy of the scattering potential is given. Calculations are carried out of the collision-induced absorption spectra of He in collisions with H₂ using ab initio electric dipole functions and realistic potentials. The anisotropy of the interaction potential is small and is not included in the calculations. The predicted spectra are in satisfactory agreement with experimental data though some deviations occur which may be significant. The rotational lines shapes have exponential wings and are not Lorentzian. The connection of the quantal and classical theories is written out explicitly for the isotropic overlap induction.

400,144
PB84-217140 Not available NTIS
 National Bureau of Standards, Washington, DC.
Collision-Induced Far-Infrared Absorption Band of Gaseous Methane in the Region 30-900/cm.
 Final rept.,
 G. Birnbaum, L. Frommhold, L. Nencini, and H. Sutter. 9 Sep 83, 5p
 Pub. in Chemical Physics Letters, v100 n3 p292-296, 9 Sep 83.

Keywords: *Methane, *Infrared spectroscopy, *Molecular rotation, Dipole moments, Line width, Reprints, Dimers.

The collision-induced rotational band of CH₄ has been measured at 195K from about 30 to 900/cm. These results have been analyzed with a quantum mechanical line shape which show that this spectrum can be understood on the basis of octupole and hexadecapole induced dipoles. However, this analysis has revealed the role of bound and predissociating dimers in the spectrum.

400,145
PB84-217157 Not available NTIS
 National Bureau of Standards, Washington, DC.
Collision-Induced Dipoles of Rare Gas Mixtures.
 Final rept.,
 G. Birnbaum, M. Krauss, and L. Frommhold. 15 Mar 84, 6p
 Pub. in Jnl. of Chemical Physics, v80 n6 p2669-2674, 15 Mar 84.

Keywords: *Rare gases, *Dipole moments, Mixtures, Absorption spectra, Hartree-Fock approximation, Helium, Argon, Neon, Krypton, Reprints, Ab initio calculations, Numerical solution.

New ab initio calculations of the collision-induced dipole moment of the rare gas systems He-Ar, Ne-Kr and Ar-Kr are obtained on the basis of a molecular Hartree-Fock treatment. With these and recent potential functions the spectral moments and line shapes of collision-induced absorption spectra are computed. Agreement with existing measurements is observed for the first time for the systems Ne-Ar and Ne-Kr.

400,146
PB84-217181 Not available NTIS
 National Bureau of Standards, Washington, DC.
Coexistence and Spinodal Curves in Directionally Bonded Liquids Using the Four-Cluster Approximation.
 Final rept.,
 E. Bodegom, and P. H. E. Meijer. Feb 84, 8p
 Sponsored in part by Office of Naval Research, Arlington, VA.
 Pub. in Jnl. of Chemical Physics, v80 n4 p1617-1624 Feb 84.

Keywords: *Phase diagrams, *Binary systems(Materials), *Liquid phases, Chemical bonds, Clustering, Anisotropy, Reprints.

The authors derive the phase diagrams and spinodals of binary liquid systems with anisotropic interactions, such as hydrogen-bonded molecules. The work is based on the four-particle cluster variation method, using a different potential for different contact points. It is shown that the introduction of a cluster larger than previously used by Barker and Fock, leads to a considerable improvement in the shape of the phase diagram and avoids some of the difficulties encountered in their calculation. Phase diagrams are displayed for various choices of the parameters: the number of contact points, the interaction potential, and the order of the approximation.

400,147
PB84-217199 Not available NTIS
 National Bureau of Standards, Washington, DC.
Long Term Behavior of Phase Separation. Computations with the Non-Homogeneous, Time Dependent Cluster Variation Method.
 Final rept.,
 E. Bodegom, and P. H. E. Meijer. 1983, 24p
 Sponsored in part by Office of Naval Research, Arlington, VA.
 Pub. in Physica 122A, p13-36 1983.

Keywords: Reprints, *Path probability method, *Cluster variation method, *Spinodal decomposition, *Phase separation, Numerical solution.

Time-dependent computations on the phase separation between two kinds of molecules are performed by means of the Path Probability Method (PPM). The PPM is solved in both the mean field and pair approximations. This is the first application of the PPM to an inhomogeneous, non-stationary system and it is found that the resulting differential equations are relatively easy to solve using a stiff integration technique. The PPM allows for a realistic kinetic process using an activation process for the migration of the particles through substitutional vacancies. The complete process of phase separation is closely analogous with calculations performed by de Fontaine and Langlois using completely different theories.

400,148
PB84-217223 Not available NTIS
 National Bureau of Standards, Washington, DC.
Surface Penning Ionization Study of the CO/Ni(III) System.
 Final rept.,
 F. Bozso, J. T. Yates, Jr., J. Arias, H. Metiu, and R. M. Martin. 15 Mar 83, 14p
 Sponsored in part by National Science Foundation, Washington, DC.
 Pub. in Jnl. of Physical Chemistry, v78 n6 pt2 p4256-4269, 15 Mar 83.

Keywords: *Surface chemistry, *Ionization, *Nickel, *Cobalt, *Electronic spectra, Metastable state, Excitation, Reprints, *Surface Penning ionization spectroscopy.

Metastable He(2 singlet S) and Ne(triplet P sup 2,0) beams were used to probe the electronic properties of Ni(111) and CO/Ni(111) surfaces. The metastable atoms collide with the surface and transfer their electronic excitation energy, causing electron ejection. With the Ni(111) surface the metastable is first resonantly ionized, and the ion is subsequently Auger neutralized, giving an electron energy spectrum which is similar to the corresponding low kinetic energy ion neutralization spectrum (INS). Differences between the metastable quenching spectrum and the INS spectrum were observed, and are discussed in terms of the differences in the mechanisms and the ion kinetic energies. With a CO/Ni(111) surface the CO eliminates

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direct interaction of the metastable atom with the metal, and the surface Penning ionization electron spectrum (SPIES) is obtained.

400,149

PB84-217272

Not available NTIS

National Bureau of Standards, Washington, DC.

Velocity Correlations in Supercooled and Nucleated Liquid Rubidium.

Final rept.,

A. C. Brown, and R. D. Mountain. 1 Feb 84, 9p

Pub. in Jnl. of Chemical Physics, v80 n3 p1263-1271, 1 Feb 84.

Keywords: *Rubidium, *Transport properties, *Liquids, *Supercooling, *Momentum transfer, *Nucleation, *Velocity, *Reprints, *Molecular dynamics.

The momentum transport is studied for supercooled liquid rubidium, via molecular dynamics. The transport is investigated on a microscopic scale by measuring the contribution to the two point velocity correlation function for various separations of the two points. The correlation functions are measured in both the normal and supercooled liquid and the solid phase. It is found that momentum is transported by two different mechanisms; by correlated oscillations associated with the maximum of $g(r)$, and by strongly diffusive modes associated with the minimum of $g(r)$. The amplitude of the diffusive or liquid like mode increases upon nucleation, and remains large at low temperatures in the solid phase.

400,150

PB84-217306

Not available NTIS

National Bureau of Standards, Washington, DC.

Counting of Resonance Structures for Large Benzenoid Polynuclear Hydrocarbons.

Final rept.,

R. L. Brown. 1983, 7p

Sponsored in part by Gas Research Inst., Chicago, IL, and Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Jnl. of Computer Chemistry, v4 n4 p556-562 1983.

Keywords: *Aromatic polycyclic hydrocarbons, *Computer programs, *Reprints, *Resonance structures, *Benzenoids, *Numerical solution.

A method is presented for counting the number of resonance structures for large benzenoid polynuclear hydrocarbons. Structure counts for even systems are made and compared with those of the odd systems resulting from the removal of one of the pi-centers from various points in the even structure. A computer program for performing the calculations is also given.

400,151

PB84-217314

Not available NTIS

National Bureau of Standards, Washington, DC.

Thermodynamics of Hydroxyapatite Surfaces.

Final rept.,

W. E. Brown, L. C. Chow, and M. Mathew. 1983, 9p

Sponsored in part by American Dental Association Health Foundation, Chicago, IL.

Pub. in Croatica Chemica Acta, v56 n4 p779-787 1983.

Keywords: *Thermodynamics, *Mathematical models, *Crystals, *Surface chemistry, *Dental materials, *Chemical equilibrium, *Electrochemistry, *Phase diagrams, *Reprints, *Hydroxylapatite.

A new model for equilibria at the interface of a sparingly soluble crystal is reviewed. It provides that several kinds of equilibria are present and each type is characterized by (1) a set of species that are transported across the phase boundary, (2) a set of chemical reactions which describe this transport process, and (3) a set of thermodynamic expressions which define equilibrium. Three types are envisaged: 1. Stoichiometric equilibrium provides the thermodynamic communication between the lattice and the bulk solution, occurs at a kink site, preserves the composition of the solid phase, defines a solubility product, leads to an isotherm in the phase diagram, and is unaffected by Galvani potentials. The equilibrium is defined by a single equation. 2. Gibbsian equilibrium in which the chemical potential of each component is stated to be equal across the phase boundary, but does not define an actual chemical process. There is one such equation for each component in the system. 3. Electrochemical equilibrium provides thermodynamic communication between ions in the bulk phase and those in the outer layer of the crystal, is non-stoichiometric, is profoundly affected by Galvani potentials, does not lead to a solu-

bility product constant nor to an isotherm, and requires one more equilibrium condition than there are components in the system. Equilibrium between the lattice and the surface is limited to reactions via the aqueous phase, one of which is stoichiometric and the other nonstoichiometric. This model provides a clarity of description of interfacial events heretofore unattainable.

400,152

PB84-217801

PC A03/MF A01

National Bureau of Standards (NEL), Washington, DC. Center for Chemical Engineering.

Interpolation Formulas for Viscosity of Six Gases: Air, Nitrogen, Carbon Dioxide, Helium, Argon, and Oxygen.

Final rept.,

F. E. Jones. Feb 84, 30p NBS/TN-1186

Also available from Supt. of Docs as SN003-003-02568-8.

Keywords: *Viscosity, *Air, *Nitrogen, *Carbon dioxide, *Helium, *Argon, *Oxygen, *Numerical solution.

Equations for the calculation of viscosity for dry air, nitrogen, carbon dioxide, helium, argon, and oxygen have been developed as interpolation formulas fitted to experimental data. The approximate ranges of strict application of the equations are the ranges of temperature ($20\text{C} < \text{or} = t < \text{or} = 50\text{C}$) and pressure ($0.04 < \text{or} = p < \text{or} = 4 \text{ MPa}$; $0.4 < \text{or} = p < \text{or} = 40 \text{ atm}$) for the experimental data. The estimates of relative residual standard deviation for the fits (0.05% for air, 0.03% for nitrogen, 0.02% for carbon dioxide, 0.02% for helium, 0.03% for argon, and 0.03% for oxygen) are in close agreement with estimates of precision for the experimental data.

400,153

PB84-217850

PC A05/MF A01

National Bureau of Standards (NEL), Washington, DC. Center for Chemical Engineering.

Thermodynamic Surface for the Critical Region of Ethylene.

Final rept.,

J. M. H. L. Sengers, G. A. Olchoway, B. Kamgar-Parsi,

and J. V. Sengers. May 84, 100p NBS/TN-1189

Also available from Supt. of Docs as SN003-003-02588-7. Prepared in cooperation with Maryland Univ., College Park. Inst. for Physical Science and Technology.

Keywords: *Thermodynamic properties, *Surface chemistry, *Ethylene, *Tables(Data), *Critical point, *Enthalpy, *Density(Mass/volume), *Fluids, *Temperature, *Equations of state, *Specific heat, *Impurity, *Pressure, *Speed of sound, *Supercritical extraction.

Tables are presented of thermodynamic properties of ethylene in the range 279-300K in temperature, 5.75 - 10.5 mol/cu dm in density, which range includes the critical point. The tables presented here are based on the critical-point scaling laws and incorporate the critical anomalies as presently known from renormalization-group theory. The tables complement the formulation of the equation of state of fluid ethylene by McCarty and Jacobsen (NBS Tech. Note 1045, 1981) which does not claim accuracy near the critical point. The predictions of the present formulation are compared with four sets of recent PVT data, and with speed-of-sound and enthalpy data. Tables are presented of pressure, energy, enthalpy, entropy, specific heats and speed of sound as function of temperature along finely-spaced isochores. The computer program required for table generation is included. Even if the surface were perfect, the reliability of densities calculated at experimental pressures and temperatures of limited accuracy declines rapidly as the critical point is approached. Contour plots in P-T space are presented of regions to be avoided in custody transfer for given uncertainties in pressure, temperature and sample composition.

400,154

PB84-217983

Not available NTIS

National Bureau of Standards, Washington, DC.

Intensities dans la Pentrade - (ν_{11}), ν_{12} + ν_{12} , $2 \nu_{10}$ + ν_{12} , ν_{9} (et) ν_{3} + ν_{8} + ν_{10} (de) (12)C₂H.

Final rept.,

A. S. Pine, M. Dang-Nhu, A. Fayt, M. de

Vleeschouwer, and C. Lambeau. 1983, 8p

Pub. in Canadian Jnl. of Physics 61, p514-521 1983.

Keywords: *Infrared spectroscopy, *Ethylene, *Intensity, *Doppler effects, *Reprints, *Laser spectroscopy.

Analysis of the intensities of an interacting polyad of bands is complicated by basis function mixing. Fortunately it is usually possible to find lines belonging principally to one band or to subsets of the polyad to begin an iterative procedure to derive intensity parameters. Five bands of ethylene in the micrometers region have been investigated for line intensities by this method, using 148 selected measurements of about 6800 Doppler-limited transitions recorded with a difference-frequency laser spectrometer. Finally two band strengths and two Herman-Wallis parameters have been determined with statistical significance, permitting the observed intensities of the pentad to be calculated with 1%.

400,155

PB84-217991

Not available NTIS

National Bureau of Standards, Washington, DC.

Turbidity Very Near the Critical Point of Methanol-Cyclohexane Mixtures.

Final rept.,

R. B. Kopelman, R. W. Gammon, and M. R.

Moldover. Apr 84, 18p

Sponsored in part by National Aeronautics and Space Administration, Washington, DC.

Pub. in Physical Review A 29, n4 p2048-2053 Apr 84.

Keywords: *Critical point, *Methyl alcohol, *Cyclohexane, *Turbidity, *Mixtures, *Light scattering, *Phase transformations, *Reprints.

The authors have measured the turbidity of a critical mixture of methanol and cyclohexane extremely close to the consolute point. A carefully controlled temperature history was used to mix the sample and to minimize the effects of critical wetting layers.

400,156

PB84-218007

Not available NTIS

National Bureau of Standards, Washington, DC.

Adsorption of H₂O on Clean and Oxygen-Dosed Silver Single Crystal Surfaces.

Final rept.,

M. Klaua, and T. E. Madey. 1984, 9p

Sponsored in part by Department of Energy, Washington, DC.

Pub. in Surface Science 136, p142-150 1984.

Keywords: *Water, *Silver, *Surface chemistry, *Crystal structure, *Adsorption, *Chemical bonds, *Electron diffraction analysis, *Reprints, *Electron stimulated desorption ion angular distribution method, *Low energy electron diffraction, *Thermal desorption.

The adsorption of H₂O on the surface of a single-crystal sphere of silver with exposed (111), (100) and (112) facets has been examined using ESDIAD (electron stimulated desorption ion angular distribution), LEED (low energy electron diffraction) and TDS (thermal desorption spectroscopy). The purpose of the study was (a) to examine the influence of substrate geometry for adsorption of H₂O on a metal surface for which the adsorbate-substrate interaction is weak, and (b) to study the influence of a surface impurity, oxygen, on the surface chemistry and local bonding structure of H₂O on Ag.

400,157

PB84-218015

Not available NTIS

National Bureau of Standards, Washington, DC.

Optimal Regimes of Facilitated Transport.

Final rept.,

L. L. Kemena, and R. D. Noble. 1983, 16p

Pub. in Jnl. of Membrane Science 15, p259-274 1983.

Keywords: *Transport properties, *Membranes, *Reprints.

An optimization of facilitated transport in liquid membranes is accomplished to determine the maximum facilitation factor and corresponding dimensionless equilibrium constant for a given inverse Damkohler number epsilon and a parameter alpha which is directly proportional to the initial carrier concentration. The existence of the maximum is demonstrated. The optimal facilitation factor increases with decreasing alpha and is strongly dependent on alpha. The results can be used to select optimal operating conditions, and/or carriers, or to compare actual to optimal results.

400,158
PB84-218338 PC A11/MF A01
 National Bureau of Standards, Washington, DC.
Compilation of Elemental Concentration Data for NBS (National Bureau of Standards) Biological, Geological, and Environmental Standard Reference Materials, 1982.
 Final rept.,
 E. S. Gladney, C. E. Burns, D. R. Perrin, I. Roelandts, and T. E. Gills. Mar 84, 235p NBS/SP-260/88
 Also available from Supt. of Docs as SN003-003-02565-8. Library of Congress catalog card no. 84-601009. Prepared in cooperation with Los Alamos National Lab., N.M., and Liege Univ. (Belgium).

Keywords: *Chemical analysis, *Geological surveys, *Environmental surveys, *Standards, Tables(Data), Concentration(Composition), *Standard reference materials, *Biological processes.

Concentration data on 88 constituents in 75 NBS Standard Reference Materials have been collected from over 850 journal articles and technical reports. These data are summarized into mean values with uncertainties expressed as +/- one standard deviation and compared with available certification data from NBS. Data are presented on the analytical procedures employed and all raw data are given in the Appendices.

400,159
PB84-218395 Not available NTIS
 National Bureau of Standards, Washington, DC.
Matrix-Isolation Study of the Decomposition of CF₃NNCF₃ by Photons and by Excited Rare-Gas Atom Bombardment at Energies Between 4.9 and 16.8 eV.
 Final rept.,
 M. E. Jacox. 1984, 10p
 Pub. in Chemical Physics 83, p171-180 1984.

Keywords: *Decomposition reactions, *Infrared spectroscopy, Excitation, Photolysis, Chemical reactions, Fluorine organic compounds, Reprints, *Matrix isolation techniques, *Ethylamine/hexafluoro-bis, Atom molecule interactions, Argon atoms, Neon atoms.

When dilute solid solutions of CF₃NNCF₃ in argon at 14 K are irradiated by the full light of a medium pressure mercury arc, no net photolysis occurs, suggesting that the primary photodecomposition products, CF₃N₂ + CF₃, undergo cage recombination. On 122-nm photolysis, cage recombination leads instead to the appearance of prominent infrared absorptions of C₂F₆, suggesting an initial photodecomposition process to form 2CF₃ + N₂. Prominent infrared absorptions of CF₄ and CF₂ were shown to result from the photodecomposition of C₂F₆. Argon resonance radiation does not penetrate solid Ar:CF₃NNCF₃ deposits, but when photolysis is conducted concurrently with deposition a high yield of CF₃ is isolated in the argon matrix. Circumvention of the cage effect in this system is attributed to the large amount of excess energy with which the photofragments are formed and to a very short lifetime for the excited electronic state of CF₃NNCF₃ before dissociation. Even higher yields of CF₃ are formed when the Ar:CF₃NNCF₃ sample is codeposited with a beam of argon atoms excited in a microwave discharge. The effects of concentration and experimental configuration on the product yield are discussed. When the sample is codeposited with a beam of excited neon atoms (16.6-16.8 eV), the most prominent product absorption is that of CF₃(+1), with relatively weak absorptions of CF₃, suggesting that at this energy the primary photodecomposition process leads to the formation of CF₃ + CF₃(+1) + N₂ + e.

400,160
PB84-218403 Not available NTIS
 National Bureau of Standards, Washington, DC.
Reaction of F Atoms with Methyl Nitrite. Infrared Spectroscopic Evidence for the Stabilization of FON in an Argon Matrix.
 Final rept.,
 M. E. Jacox. 24 Nov 83, 6p
 Sponsored in part by Office of Naval Research, Arlington, VA.
 Pub. in Jnl. of Physical Chemistry, v87 n24 p4940-4945, 24 Nov 83.

Keywords: *Infrared spectroscopy, *Formaldehyde, Stability, Chemical reactions, Exothermic reactions, Chemical bonds, Reprints, *Nitrite/methyl, *Atom molecule interactions, *Fluorine atoms, *Matrix isolation techniques.

When the products of the reaction between F atoms formed in a microwave discharge and methyl or methyl-d₃ nitrite are frozen in a large excess of argon at 14 K, prominent absorptions of FNO appear in the infrared spectrum of the solid deposit, demonstrating that NO abstraction occurs. Two absorptions previously attributed to FON are also very prominent, supporting the identification of that isomer, but the assignment of the NO-stretching fundamental was not confirmed. The appearance of infrared absorptions of isolated and hydrogen-bonded HF indicates that the more exothermic reaction channel involving H-atom abstraction also occurs. The absorptions of H₂CO and NO, products of the decomposition of CH₂ONO, are prominent, with indirect evidence that a small concentration of CH₂ONO may have been stabilized. Factors influencing the relative contributions of the two observed F-atom reaction channels are considered.

400,161
PB84-218452 Not available NTIS
 National Bureau of Standards, Washington, DC.
Photoelectron Branching Ratios and Asymmetry Parameters for the Two Outermost Molecular Orbitals of Hydrogen Cyanide.
 Final rept.,
 D. M. P. Holland, A. C. Parr, and J. L. Dehmer. 1984, 10p
 Sponsored in part by Office of Naval Research, Arlington, VA., Department of Energy, Washington, DC. and North Atlantic Treaty Organization, Brussels (Belgium).
 Pub. in Jnl. of Physics B: Atomic and Molecular Physics 17, p1343-1352 1984.

Keywords: *Hydrogen cyanide, *Molecular orbitals, *Photoelectrons, Nitrogen, Carbon monoxide, Ethylene, Ionization potentials, Reprints.

Triply differential photoelectron spectroscopy has been performed on hydrogen cyanide in the photon energy range 14.5 to 24 eV, using synchrotron radiation. Photoelectron branching ratios and asymmetry parameters are presented for the two outermost molecular orbitals. The vibrationally resolved branching ratio $X \text{ sup } 2 \text{ II } (\text{nu sup } 3 = 1) / (\text{nu sup } 3 = 0)$ exhibits strong non-Franck-Condon behavior from threshold to approximately 19 eV. The results are discussed in relation to similar studies on the isoelectronic molecules, N₂, CO and C₂H₂. The evidence suggests that the prominent non-Franck-Condon feature observed in the HCN(+1) X sup 2 II channel may arise, at least in part, from a shape resonantly enhanced autoionizing state converging to a higher ionization potential.

400,162
PB84-218718 Not available NTIS
 National Bureau of Standards, Washington, DC.
Effect of Anisotropy on the Optical-Absorption Spectrum of Polyacetylene.
 Final rept.,
 A. J. Glick, and G. W. Bryant. 15 Oct 83, 6p
 Pub. in Physical Review B: Solid State, v28 n8 p4295-4300, 15 Oct 83.

Keywords: *Mathematical models, *Anisotropy, *Absorption spectra, Dielectric properties, Reprints, *Polyacetylene, *Maxwell Garnett theory.

The authors explore two different models for (CH)_x films. In one model they assume all the chains are parallel to one another, but not to the film surface. Light propagation in such a medium can be treated exactly. The second model is based on an extension of Maxwell-Garnett theory, describing anisotropic randomly-oriented ellipsoids (the fibrils). The latter model ignores the details of light propagation by replacing the random medium with an effective uniform isotropic medium. Using the conductivity derived previously for individual dimerized chains they find that both models give structure below the interband threshold which resembles the midgap absorption observed experimentally. Thus anisotropy can be at least partially responsible for the absorption structure usually attributed to solitons.

400,163
PB84-218759 Not available NTIS
 National Bureau of Standards, Washington, DC.
Microwave and Millimeter-Wave Spectra of Hypochlorous Acid.
 Final rept.,
 H. E. G. Singbeil, W. D. Anderson, R. W. Davis, M. C. L. Gerry, and E. A. Cohen. 1984, 40p
 Pub. in Jnl. of Molecular Spectroscopy 103, p446-485 1984.

Keywords: *Microwave spectra, Isotopes, Stark effect, Dipole moments, Molecular rotation, Hyperfine structure, Reprints, *Hydrochlorous acid.

To permit atmospheric monitoring of the molecule, the microwave spectra of two isotopic species of hypochlorous acid, HOCl, have been measured in the frequency range 8-650 GHz. Three b-type branches and an a-type Q branch have all been measured for the first time; improved measurements have been made for the a-type R branches. The analysis has included combination differences of earlier high-resolution infrared spectra to give accurate values for all rotational constants, five quartic and five higher degree centrifugal distortion constants, as well as the chlorine nuclear quadrupole and spin-rotation coupling constants. From the Stark effect, accurate values have also been obtained for both components of the molecular dipole moment. A table of transition frequencies of potential use in atmospheric monitoring is presented.

400,164
PB84-218767 Not available NTIS
 National Bureau of Standards, Washington, DC.
Vibrational Excitation in Molecule-Surface Collisions Due to Temporary Negative Molecular Ion Formation.
 Final rept.,
 J. W. Gadzuk. 15 Dec 83, 8p
 Pub. in Jnl. of Chemical Physics, v79 n12 p6341-6348, 15 Dec 83.

Keywords: *Molecular vibration, *Surface chemistry, *Diatomic molecules, Excitation, Nitrogen, Nitrogen oxides(NO), Inelastic scattering, Electron scattering, Reprints.

Inelastic electron scattering from gaseous and physisorbed diatomic molecules results in greatly enhanced vibrational overtone excitation if the incident electron has the appropriate energy to form a shape-resonance-induced temporary negative molecular ion. It is proposed here that due to the image potential lowering of the electron affinity level of a diatomic molecule in interaction with a metal surface, somewhere outside the surface an incident molecule would find its affinity level degenerate with or lower than the substrate Fermi level at which point a substrate electron could hop onto the molecule, in analogy with gas phase harpooning processes. A negative molecular ion is thus formed which remains until the molecular ion reflects from the surface and the affinity level rises above the Fermi level, thus permitting reverse electron hopping back into the metal. The lifetime of the molecular ion can be controlled by varying both the kinetic energy of the incident molecule and also the substrate work function. In analogy with the electron scattering events, greatly enhanced vibrational excitation of overtones is expected in the molecules of the scattered beam. Induced fluorescence probing of the vibrational state distribution should then yield fundamental information pertaining to the dynamics of charge transfer reactions and nonadiabatic effects in molecule-surface interactions. A theory of this phenomenon is here presented together with the numerical consequences for a model system designed to simulate N₂ or NO scattering from standard surface science metal surfaces.

400,165
PB84-218775 Not available NTIS
 National Bureau of Standards, Washington, DC.
Separation of Dipeptide Diastereoisomers by High-Resolution Gas Chromatography.
 Final rept.,
 M. Dizdaroğlu, and M. G. Simic. 1982, 6p
 Pub. in Jnl. of Chromatography 244, p293-298 1982.

Keywords: *Molecular structure, *Gas chromatography, *Isomers, *Peptides, Separation, Mass spectroscopy, Reprints.

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

Separation of trimethylsilylated diastereoisomers of dipeptides was achieved by high-resolution gas chromatography on a fused silica capillary column coated with an achiral (conventional) stationary phase. L,L- and D, D-isomers were separated from L,D- and D,L-isomers with excellent resolution. The nominal structure of the separated isomers was confirmed by gas chromatography-mass spectrometry.

400,166

PB84-218783 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermal Degradation of Polyisobutylene Studied Using Factor-Jump Thermogravimetry.
Final rept.,
B. Dickens. 1983, 12p
Pub. in Jnl. of Thermal Analysis 27, p379-390 1983.

Keywords: *Polyisobutylene, *Thermal degradation, *Activation energy, Reaction kinetics, Polymerization, Reprints, *Chemical reaction mechanisms.

The overall activation energy of the thermal degradation of polyisobutylene has been measured using factor-jump thermogravimetry to be $206 \pm$ or -1 kJ/mole over the range 365 to 405 degree in N₂ at 800 mm Hg pressure and flowing at 4 mm/s over the sample. This equation presupposes a degradation mechanism of random initiation, unzipping, and bimolecular termination. Substitution of reasonable values for the heat of polymerization, ΔH , in the definition $\Delta H = E(p) - E(d)$ suggests that the activation energy of the polymerization reaction at 375 degrees is approximately 30 kJ/mole.

400,167

PB84-218791 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermal Degradation Study of Isotactic Polypropylene Using Factor-Jump Thermogravimetry.
Final rept.,
B. Dickens. 1982, 15p
Pub. in Jnl. of Polymer Science 20, p1169-1183 1982.

Keywords: *Thermal degradation, *Polypropylene, Reaction kinetics, Activation energy, Thermogravimetry, Molecular weight, Reprints, *Chemical reaction mechanisms.

The degradation of isotactic polypropylene in the range 390-465C was studied using factor-jump thermogravimetry. The degradations were carried out in vacuum and at pressures of 5 and 800 mm Hg of N₂, flowing at 100-400 standard mL/s. At 800 mm Hg this corresponds to linear rates of 1-4 mm/s. In vacuum bubbling in the sample caused problems in measuring the rate of weight loss. Initiation was considered to be backbone scission beta to allyl groups formed in the termination reaction. For initiation by random scission of the polymer backbone, as in the early stages of thermal degradation, an overall activation energy of 72 kcal/mol is proposed. The difference between vacuum and in-N₂ activation energies is ascribed to the latent heat contributions of molecules which do not evaporate as soon as they are formed. At these imposed rates of weight loss the average molecular weights of the volatiles in vacuum and in 8 and 800 mm Hg N₂ are in the ratios 1-1/2-1/9.

400,168

PB84-218817 Not available NTIS
National Bureau of Standards, Washington, DC.
Isoconversional Method for Determination of Energy of Activation at Constant Heating Rates. Corrections for the Doyle Approximation.
Final rept.,
J. H. Flynn. 1983, 15p
Pub. in Jnl. of Thermal Analysis 27, p95-102 1983.

Keywords: *Activation energy, *Thermal analysis, *Isothermal treatment, Temperature, Reprints, *Doyle equation, Numerical solution.

The isothermal method for the determination of energies of activation from the reciprocal temperature at which a fraction of conversion was reached in experiments at differing constant heating rates is reviewed and amplified. The error introduced the calculation of activation energy by the use of a linear approximation of the logarithm of the temperature integral is discussed. Methods for the correction of this error are developed and a table of correction factors are given.

400,169

PB84-218858 Not available NTIS
National Bureau of Standards, Washington, DC.
Fourier Transform Infrared Spectroscopy of Polymers. Theory and Application.
Final rept.,
B. M. Fanconi. Jan 84, 7p
Pub. in Jnl. of Testing and Evaluation, p33-39 Jan 84.

Keywords: *Infrared spectroscopy, *Polymers, Reviews, Composite materials, Reprints, *Fourier transform spectroscopy.

The Fourier transform infrared (FT-IR) technique is replacing conventional dispersive instruments in the acquisition of IR spectroscopic data. For standards organizations this implies that existing standard test methods involving IR spectral analysis need to be modified. In an FT-IR system all spectral information is contained in the interferogram produced by scanning the Michelson interferometer. The factors controlling spectral resolution and sensitivity are, therefore, different from those governing these properties of dispersive instruments. The FT-IR technique has the advantages of greater signal-to-noise ratio, and digitized data that open up new areas of application as well as provide greater sensitivity in the more traditional uses of IR spectroscopy. A review of the field of vibrational spectroscopy of polymers identifies time-dependent phenomena and characterization of structural imperfections as two areas likely to see major advances as a result of FT-IR. Examples of the use of FT-IR in polymer research are given to illustrate the potential of the technique. At the National Bureau of Standards FT-IR has been used to determine the role of chain scission in the mechanical degradation of polymers, to measure the extent of chemical reactions during processing polymer composites, and to characterize polymeric materials.

400,170

PB84-218874 Not available NTIS
National Bureau of Standards, Washington, DC.
Variation of the Threshold Energies for Core-Electron Excitation in Electron Energy-Loss Spectra as a Function of Incident Electron Energy.
Final rept.,
N. E. Erickson, and C. J. Powell. Jun 83, 4p
Pub. in Jnl. of Vacuum Science and Technology A., v1 p1165-1168 Apr-Jun 83.

Keywords: *Titanium, *Nickel, Atomic energy levels, Ionization, Excitation, X ray analysis, Reprints, *Electron energy loss spectroscopy, Threshold effects(Electron energy), Electron energy.

Measurements have been made of the 3p, 3s, and 2p core-electron energy-loss spectra of Ti and Ni as a function of incident electron energy. Attention was focussed on the threshold energy for core-level ionization to investigate possible changes in core-electron binding energies as a function of excitation conditions. Measured threshold energies decreased by between 0.1 and 1.5 eV, depending on the specific core level, as the incident electron energy was lowered from about 1500 eV to about 20-50 eV above the core threshold. The measured changes in threshold energies are due in part to different core-electron binding energies for bulk and surface atoms, to varying populations of final states, and to dynamical screening effects. These factors can account for differences in binding energies measured by x-ray photoelectron spectroscopy and by appearance potential spectroscopy.

400,171

PB84-218890 Not available NTIS
National Bureau of Standards, Washington, DC.
Coadsorption of Water and Sodium on the Ru(001) Surface.
Final rept.,
D. L. Doering, S. Semancik, and T. E. Madey. 1983, 22p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in Surface Science 133, p49-70 1983.

Keywords: *Surface chemistry, *Water, *Sodium, Ruthenium, Adsorption, Catalysts, Electrolytes, Metals, Reprints, *Electron stimulated desorption ion angular distributions methods, *Thermal desorption, *Low energy electron diffraction, *Auger electron spectroscopy.

The coadsorption of water and sodium on a Ru(001) surface has been studied as a model system of the

interaction of adsorbed water with electropositive ions. A variety of surface sensitive methods were employed: electron stimulated desorption ion angular distributions (ESDIAD), thermal desorption spectroscopy (TDS), Auger electron spectroscopy (AES) and low energy electron diffraction (LEED). The striking dependence of the water surface chemistry on the coverage of preadsorbed Na has been associated with the electropositive properties of the Na-Ru layer. The influence of Na on the adsorption of water on Ru(001) is important for understanding processes occurring at the metal-electrolyte interface in an electrochemical cell as well as the catalytic promotion of transition metal catalysts by adsorbed alkalis.

400,172

PB84-218908 Not available NTIS
National Bureau of Standards, Washington, DC.
Oxidation of Polystyrene in Solution.
Final rept.,
B. Dickens, and J. Marchal. 1984, 31p
Pub. in Polymer Degradation Stability 6, p211-241 1984.

Keywords: *Polystyrene, *Oxidation, Solutions, Polymers, Gamma rays, Reprints.

Polystyrene (PS) has been oxidized in carbon tetrachloride, chloroform, methylene chloride and cyclohexane under O₂ at atmospheric pressure using γ -initiation. Benzaldehyde, acetophenone and reductions in molecular weight were observed in all solvents. Yields of benzaldehyde and acetophenone were used to show that attack in chlorinated solvents is essentially random along the polymer chains and is predominantly by Cl radicals. Intramolecular propagation is much faster for attack on tertiary carbons than on secondary carbons. There are more neighboring hydroperoxide groups in PS oxidized in carbon tetrachloride and methylene chloride than in PS oxidized in chloroform, because, in chloroform, the solvent hydrogen is abstracted by polymer-based peroxy radicals. For one set of conditions, about six intramolecular propagation steps took place in carbon tetrachloride and one in chloroform. At lower rates of initiation, the kinetic oxidation chains are longer and more intramolecular propagation occurs. HCl added in excess of that formed in these experiments decomposes hydroperoxide groups to give an auto-accelerating effect.

400,173

PB84-218916 Not available NTIS
National Bureau of Standards, Washington, DC.
Vapor Composition Profiles Estimated for Thermally Degrading Polyethylene.
Final rept.,
B. Dickens. 1982, 9p
Pub. in Thermochemical Acta 55, p217-229 1982.

Keywords: *Polyethylene, *Thermal degradation, *Thermogravimetry, Activation energy, Vaporizing, Heat of vaporization, Reprints.

Calculated vapor pressures have been used to estimate the equilibrium composition of the vapor over an equimolar mixture of linear alkanes and to make inferences about the effects of pressure on the thermal degradation of polyethylene as studied using thermogravimetry. The bubbling in molten PE degrading under vacuum conditions has been related to the boiling out of molecules in the range C₃₀ to >C₈₀. The effect of pressure in lowering the apparent overall activation energy has been ascribed to contributions from the latent heats of vaporization of molecules in the range C₁₅ to about C₃₀.

400,174

PB84-218924 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermally Degrading Polyethylene Studied by Means of Factor-Jump Thermogravimetry.
Final rept.,
B. Dickens. 1982, 323p
Pub. in Jnl. of Polymer Science 20, p1065-1087 1982.

Keywords: *Polyethylene, *Thermal degradation, *Thermogravimetry, Activation energy, Reaction kinetics, Reprints, *Factor-jump thermogravimetry.

Degradation of polyethylene in both linear (NBS 1475) and branched (NBS 1476) form has been studied using factor-jump thermogravimetry. The degradations were carried out in vacuum and under N₂ flowing at 100 standard ml/s at pressures of 8 mm and 800 mm Hg. Changing the flow rates over the range 1 to 4 mm/

s did not affect the results. In vacuum the rate of weight loss was erratic because of bubbling in the sample. The apparent activation energy was determined to be 65.4(5) kcal/mol (273(2) kJ/mol). There was no distinguishable difference between linear and branched samples. Values cited in the literature for comparable apparent activation energies of degradation range between 45 kcal/mol and 77 kcal/mol.

400,175
PB84-218957 Not available NTIS
 National Bureau of Standards, Washington, DC.
Two-Dimensional J-Resolved Proton Nuclear Magnetic Resonance Spectrometry of Hydroxyl-Coupled A- and B-D Glucose.
 Final rept.,
 B. Coxon. 1983, 6p
 Pub. in Analytical Chemistry, v55 n14 p2361-2366 1983.

Keywords: *Nuclear magnetic resonance, *Glucose, Catalysis, Reprints, *Molecular conformation, *Chemical shifts(Nuclear magnetic resonance), Glucopyranose, Hydroxyl radicals.

Two methods have been investigated for the simplification and analysis of the proton NMR spectra obtained from the 12-proton spin systems of alpha- and beta-D-glucopyranose in dimethyl-d(6) sulfoxide solutions. Analysis of the resulting hydroxyl proton coupled spectra was facilitated at 400 MHz either by two-dimensional, J-resolved proton NMR spectrometry or by the spectral simplification induced by rapid chemical exchange of the hydroxyl protons, catalyzed by trifluoroacetic acid. By means of these techniques, a complete set of chemical shifts and CH and OH proton-proton coupling constants has been obtained for the anomeric D-glucopyranoses. The implications of the proton coupling constants for conformational analyses of the anomers are discussed.

400,176
PB84-218981 Not available NTIS
 National Bureau of Standards, Washington, DC.
Laser Mass Spectrometry of Solids. A Bibliography 1963-82.
 Final rept.,
 R. J. Conzemius, D. S. Simons, Z. Shankai, and G. D. Byrd. 1983, 32p
 Prepared in cooperation with Ames Lab., IA.
 Pub. in Microbeam Analysis, p301-332 1983.

Keywords: *Mass spectroscopy, *Solids, *Bibliographies, Ionization, Sources, Reprints, *Laser spectroscopy.

The use of lasers as an ionization source for solid samples in mass spectrometry has proliferated in recent years. The main reasons for this increased attention are twofold—the availability of commercial instruments that use the laser as a microprobe, primarily for the analysis of inorganic species, and the increased emphasis in organic mass spectrometry on 'soft' ionization sources for the analysis of thermally labile materials. The laser is unique as an ionization source for solids because of the spatial and temporal characteristics of the laser beam and because the ionization mechanism can be altered by changing the power density. The following bibliography is a best-effort attempt to include all papers published in the open literature through the end of 1982 where a laser is used as an ionization source in mass spectrometry for a solid phase sample. It is organized chronologically by year, and alphabetically by first author within each year. A comprehensive cross-reference index by subject is included as an aid in locating references on a specific aspect of laser mass spectrometry. (906 references.)

400,177
PB84-219013 Not available NTIS
 National Bureau of Standards, Washington, DC.
Heat Capacity and Thermodynamic Properties of Rho-Terphenyl: Study of Order-Disorder Transition by Automated High-Resolution Adiabatic Calorimetry.
 Final rept.,
 S. S. Chang. Dec 83, 8p
 Pub. in Jnl. of Chemical Physics, v79 n12 p6229-6236 Dec 83.

Keywords: *Thermodynamic properties, *Specific heat, Heat measurement, Melting point, Enthalpy, Reprints, *Terphenyl, *High resolution adiabatic calorimetry.

The heat capacity of a sample of zone-refined, high-purity p-terphenyl has been determined from 4 to 370

K in a fully automated high-resolution vacuum adiabatic calorimeter and from 320 to 580 K in a differential scanning calorimeter. The melting point of p-terphenyl is 487.0 K and the enthalpy of fusion is 35.3kJ/mol. A lambda-type solid-solid transition occurs with a peak temperature of 193.55 K. The transition is highly reproducible without observable hysteresis, even after various thermal treatments. In the transition region which spans from 140 to 240 K, the sample reaches a state of thermal equilibrium within a period of one-half to one hour, as normally required in adiabatic calorimetry. These characteristics are desirable for the application of the equilibrium lambda transitions as a calibration standard for use in dynamic calorimetry. The behavior of the lambda transition at equilibrium is mapped in high temperature resolution, with small temperature increments of measurement down to 0.01 K by adiabatic calorimetry. In the temperature region between the transition and the fusion, the heat capacity of the high-temperature form of the crystal is proportional to the temperature $C(p) = 0.94 T J/K/mol$ to within 1%. The heat capacity of p-terphenyl in the liquid state above its melting point of 487.0 K appears to be an extension of the heat capacity of the liquid, and the supercooled liquid, state of o-terphenyl above its glass transition temperature of about 243 K.

400,178
PB84-219054 Not available NTIS
 National Bureau of Standards, Washington, DC.
Roles of Octacalcium Phosphate in Surface Chemistry of Apatites.
 Final rept.,
 W. E. Brown, M. Mathew, and L. C. Chow. 1984, 16p
 Sponsored in part by American Dental Association Health Foundation, Chicago, IL.
 Pub. in Adsorption on and Surface Chemistry of Hydroxyapatite, p13-28 1984.

Keywords: *Surface chemistry, *Dental materials, *Calcium phosphates, Colloids, Solubility, Crystal growth, Mechanical properties, Reprints, *Hydroxyapatite.

This paper reviews the effects of octacalcium phosphate (OCP), $\text{Ca}_8\text{H}_2(\text{PO}_4)_6 \cdot 5\text{H}_2\text{O}$, on the interfacial and colloidal properties of apatitic precipitates. The structural deductions are based on a combination of well established crystallographic concepts 1,2,3 and plausible projections regarding the chemical behavior of OCP. Although the colloidal nature of the systems makes difficult the verification of these properties, the ideas provide a substantive basis for interpretation of many experimental results. Apatitic systems are of such vital importance in so many areas, and the relationships between OCP and hydroxyapatite (OHAP), $\text{Ca}_5(\text{PO}_4)_3\text{OH}$, are so close and so ubiquitous that the possibilities described here cannot be ignored. OCP seems to play important roles, also, in establishing the composition, solubility, reactivity, interfacial energy, nucleation, growth, and crystal-growth poisoning of apatitic materials. These all affect the surface and colloidal properties of apatitic precipitates.

400,179
PB84-219450 Not available NTIS
 National Bureau of Standards, Washington, DC.
1-Butyne Microwave Spectrum, Barrier to Internal Rotation, and Molecular Dipole Moment.
 Final rept.,
 B. M. Landsberg, and R. D. Suenram. 1983, 11p
 Pub. in Jnl. of Molecular Spectroscopy 98, p210-220 1983.

Keywords: *Molecular rotation, *Microwave spectra, Dipole moment, Stark effect, Reprints, *Butyne.

Measurements of rotational transitions of 1-butyne have been made in the range of about 20-130 GHz. Both a-type transitions up to $J = 46$ and b-type transitions up to $J = 42$ have been measured and fitted to the Hamiltonian of Watson (8). In addition to the five quartic centrifugal distortion constants, three sextic coefficients had to be included to reproduce the observed frequencies to experimental error. The results of the analysis are sufficient for the prediction of all strong transitions throughout the millimeterwave range. A barrier to internal rotation of the methyl group of 3.260 Kcal/mol has been derived from the first excited torsional state.

400,180
PB84-219807 Not available NTIS
 National Bureau of Standards, Washington, DC.
Capillary Rise, Wetting Layers, and Critical Phenomena in Confined Geometry.
 Final rept.,
 M. R. Moldover, and R. W. Gammon. 1 Jan 84, 10p
 Contracts NASA-C-62861-C, NASA-H-27954-B
 Pub. in Jnl. of Chemical Physics 80, n1 p528-535, 1 Jan 84.

Keywords: *Capillary flow, *Sulfur hexafluoride, *Surface properties, Critical points, Van der Waals equation, Interfacial tension, Wettability, Reprints.

The authors have used an interferometric technique to measure the capillary rise of sulfur hexafluoride (SF_6) between closely spaced, nearly parallel plates. These layers are a factor of 3 thicker than our theoretical estimates which are based on very simple models which assume that the thickness is governed by a competition between the gravitational force which tends to thin the layers and long-ranged van der Waals forces which tend to thicken the layers. Furthermore the capillary rise data are consistent with the hypotheses that the surface tension and the difference between the liquid density and the vapor density of this confined sample of SF_6 are the same as those of bulk SF_6 at the same temperature. These results concerning critical phenomena contrast with results obtained in certain earlier studies of binary liquid mixtures near their consolute temperatures. The earlier experiments were interpreted without consideration of wetting layers to indicate that large critical temperature shifts and a crossover to two-dimensional behavior did occur in a confined geometry and temperature range similar to the one we use. We briefly discuss the effects that wetting layers have on other experiments near the critical point of SF_6 .

400,181
PB84-219914 Not available NTIS
 National Bureau of Standards, Washington, DC.
Multichannel Quantum Defect Analysis of Two-State Couplings in Diatomic Molecules.
 Final rept.,
 F. H. Mies, and P. S. Julienne. 15 Mar 84, 11p
 Sponsored in part by Air Force Office of Scientific Research, Bolling AFB, DC.
 Pub. in Jnl. of Chemical Physics 80, n6 p2526-2536, 15 Mar 84.

Keywords: *Quantum interactions, *Diatomic molecules, Dissociation, Reprints, *Multichannel quantum defect analysis, Atomic scattering, Resonance scattering.

A multichannel quantum defect analysis (MCQDA) for non-coulomb potentials is applied to two-channel coupling in diatomic molecules. Given the exact 2×2 scattering matrix $S(E)$ obtained at a single energy above the dissociation threshold $\epsilon > 0$, the author can extract an analytic, energy-insensitive 2×2 matrix $Y(\epsilon)$ which can be extrapolated across thresholds and yield a complete description of predissociating molecules. The predicted widths, shifts, and line-shapes obtained from MCQDA are in quantitative agreement with the exact numerical results and confirm the remarkable simplicity that can be achieved in describing diatomic systems near dissociation limits. The analysis is equally applicable to either adiabatic avoided crossings or diabatic curve crossings. The validity of MCQDA is independent of coupling strength and can quantitatively describe strongly overlapped predissociating resonance states. The application of MCQDA to the bound state spectrum, when both channels are closed, is discussed.

400,182
PB84-219922 Not available NTIS
 National Bureau of Standards, Washington, DC.
Multichannel Quantum Defect Analysis of Diatomic Predissociation and Inelastic Atomic Scattering.
 Final rept.,
 F. Mies. 15 Mar 84, 12p
 Sponsored in part by Air Force Office of Scientific Research, Bolling AFB, DC.
 Pub. in Jnl. of Chemical Physics 80, n6 p2514-2525, 15 Mar 84.

Keywords: *Quantum interactions, *Diatomic molecules, Dissociation, Inelastic scattering, Reprints, *Multichannel quantum defect analysis, Atomic scattering.

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

Given an $N(\sup \tau) \times N(\sup \tau)$ interaction matrix $W(R)$ which describes the dissociation of a diatomic molecule into $N(\sup \tau)$ asymptotic atomic channel states, the authors can generate exact numerical solutions to the close-coupled scattering equations. However, based on a multichannel quantum defect analysis (MCQDA) of the coupled equations he finds that the numerical $S(E)$ matrix can be made to yield a real, symmetric matrix $Y(E)$ which is analytic in E . This matrix can then be analytically continued across threshold to provide rigorous analytic descriptions of the multichannel diatomic wave functions in the predissociating and bound-state regions of the energy spectrum.

400,183
PB84-219948 Not available NTIS
National Bureau of Standards, Washington, DC.
Liquid Chromatographic Determination of Polycyclic Aromatic Hydrocarbons in Air Particulate Extracts.
Final rept.,
W. E. May, and S. A. Wise. 1984, 8p
Pub. in Analytical Chemistry 56, n2 p225-232 1984.

Keywords: *Aromatic polycyclic hydrocarbons, *Particles, *Chemical analysis, Urban areas, Air pollution, Fluorescence, Exhaust emissions, Chromatographic analysis, Reprints, *Standard reference materials, *Air pollution detection, *Reversed phase liquid chromatography, High performance liquid chromatography, Diesel engine exhaust.

Reversed-phase liquid chromatography (LC) with fluorescence detection was used for the determination of 13 polycyclic aromatic hydrocarbons (PAH) in urban air particulate material as part of the process of certifying this material as Standard Reference Material (SRM) 1649. The fluorescence excitation and emission wavelengths were changed during the chromatographic analysis to optimize the selectivity for individual PAH. A second approach was employed which involves normal-phase LC on an aminosilane phase to isolate PAH fractions based on the number of aromatic carbons, followed by analysis of these fractions by reversed-phase LC with UV or fluorescence detection. Results obtained by use of these LC methods are compared with results obtained by gas chromatography. Analytical results obtained by using these LC methods are presented for the analysis of a second urban particulate material (SRM 1648) and a diesel exhaust particulate sample.

400,184
PB84-219955 Not available NTIS
National Bureau of Standards, Washington, DC.
Characterization of Polycyclic Aromatic Hydrocarbons in Air Particulate Extracts by Liquid Gas Chromatographic Methods.
Final rept.,
W. E. May, S. N. Chesler, H. S. Hertz, L. R. Hilpert, and R. E. Rebbert. 1984, 32p
Pub. in Identification and Analysis of Organic Pollutants in Air, Chapter 13, p197-230 1984.

Keywords: *Aromatic polycyclic hydrocarbons, *Particles, *Gas chromatography, *Chemical analysis, Mass spectroscopy, Urban areas, Air pollution, Sulfur organic compounds, Solvent extraction, Reprints, *Standard reference materials, *Air pollution detection.

Liquid chromatographic, gas chromatographic, and gas chromatographic/mass spectrometric methods for the analysis of polynuclear aromatic hydrocarbons (PAH) and polynuclear aromatic sulfur heterocycles (PASH) in an urban air particulate sample are described. Quantitative data derived from the use of two independent solvent extraction schemes will be given for the PAH. Qualitative data is reported for the PASH.

400,185
PB84-219971 Not available NTIS
National Bureau of Standards, Washington, DC.
Infrared Tunable Diode Laser Spectra of Lithium Fluoride at High Temperatures.
Final rept.,
A. G. Maki. 1983, 7p
Pub. in Jnl. of Mol. Spectrosc. 102, p361-367 1983.

Keywords: *Infrared spectroscopy, *High temperature tests, *Lithium fluorides, Reprints, *Laser spectroscopy.

At temperatures up to 1300 K the high resolution spectrum has been measured for the 1-0 through 7-6 vibrational transitions of 7LiF and the 1-0 through 8-7 vibra-

tional transitions of 6LiF . These infrared ro-vibrational measurements have been combined with microwave measurements taken from the literature to obtain a set of ten Dunham potential constants that reproduce all the measurements for both isotopic species to within their experimental uncertainty.

400,186
PB84-219989 Not available NTIS
National Bureau of Standards, Washington, DC.
Dynamical Properties of Alkali Intercalates in Graphite.
Final rept.,
A. Magerl, H. Zabel, J. J. Rush, and A. J. Dianoux. 1983, 6p
Pub. in Synthetic Metals 7, p227-232 1983.

Keywords: *Dynamic properties, *Alkali metals, Line widths, Diffusion coefficient, Graphite, Rubidium compounds, Reprints, *Clathrate compounds, *Graphite rubidium clathrates, Quasielastic scattering.

The authors report on neutron quasi-elastic measurements of in-plane Rb dynamics in a C_{24}Rb compound. The spectra show diffusion broadened linewidths, yielding a diffusion constant of $.000026 \text{ sq cm/s}$ at 343 K which increases by a factor of 3 at 618 K. From the Q dependence of the linewidth the difference in the dynamics between an usual three-dimensional liquid and a single Rb layer is elucidated.

400,187
PB84-220029 Not available NTIS
National Bureau of Standards, Washington, DC.
Reaction of Ethynyl Radicals with O_2 . Rate Constant for Formation of CO .
Final rept.,
A. H. Laufer, and R. Lechleider. Jan 84, 3p
Sponsored in part by National Oceanic and Atmospheric Administration, Washington, DC.
Pub. in Jnl. of Physical Chemistry 88, n1 p66-68 Jan 84.

Keywords: *Reaction kinetics, *Carbon monoxide, Free radicals, Chemical reactions, Reprints, *Chemical reaction mechanisms, *Ethynyl radicals.

Absolute rate constants and branching ratios for reactions of the $\text{C}_2\text{H}-\text{O}_2$ system have been obtained from observation of the CO product build up. In the system, C_2HO produced in (3a) subsequently reacts with O_2 to produce CO . The relationship of the $\text{C}_2\text{H} + \text{O}_2$ rate constants to those for reaction of C_2H with hydrocarbons is discussed.

400,188
PB84-220961 Not available NTIS
National Bureau of Standards, Washington, DC.
Photoionization Cross Section of Helium for Photon Energies 59-67 eV: The $(\text{sp}, 2(+n))$ singlet $P(\text{sub } 0)$ Rydberg Series of Autoionizing Resonances.
Final rept.,
H. D. Morgan, and D. L. Ederer. Apr 84, 6p
Pub. in Physical Review A 26, n4 p1901-1906 Apr 84.

Keywords: *Helium, *Atomic energy levels, *Ultraviolet spectroscopy, Photons, Line width, Resonance scattering, Excitation, Reprints, *Autoionization, *Rydberg series.

The central position of the $2s2p$ singlet $P(\text{sub } 0)$ two-electron resonance of He at 206.21 Å has been re-measured using the background continuum of the National Bureau of Standards storage ring facility. In addition, the line-shape parameter q and width P of the resonance have also been obtained. We obtained a value of $60.151 \pm 0.010 \text{ eV}$ for the resonance position, -2.6 ± 0.3 for the line-shape parameter, and $0.038 \pm 0.002 \text{ eV}$ for the width of the resonance. Our value for the resonance position is in good agreement with the theoretical calculation of 60.145 eV of Bhatia and Temkin and lies within the error budget of the previous experimental measurements of Madden and Codling. Parameter values for the other resonances have also been obtained and are in good agreement with the earlier measurements of Madden and Codling.

400,189
PB84-220987 Not available NTIS
National Bureau of Standards, Washington, DC.
Molecular Dynamics Investigation of Homogeneous Nucleation for Inverse Power Potential Liquids and for a Modified Lennard-Jones Liquid.
Final rept.,
R. D. Mountain, and A. C. Brown. Mar 84, 5p
Pub. in Jnl. of Chemical Physics 80, n6 p2730-2734 Mar 84.

Keywords: *Nucleation, *Phase transformation, *Liquid phases, *Crystallization, Solid phases, Supercooling, Dynamics, Computerized simulation, Reprints, *Lennard-Jones system, Lennard-Jones potential.

The influence of the harshness of the repulsive part of the pair potential on the onset of the process of homogeneous nucleation of the crystal from the supercooled liquid has been investigated using the computer simulation method of molecular dynamics. An inverse twelfth power and an inverse seventh power system were studied along with a modified Lennard-Jones system. The authors find that the times required for both the onset and the completion of the homogeneous nucleation process increase significantly with the harshness of the repulsion. Local orientational order in supercooled liquids was also examined. Values of the orientational order parameter Q_6 intermediate between those of a normal liquid and of a crystal were found to be associated only with amorphous solid states.

400,190
PB84-221019 Not available NTIS
National Bureau of Standards, Washington, DC.
Structure of Cesium-Exchanged Zeolite-RHO at 293K and 493K Determined from High Resolution Neutron Powder Data.
Final rept.,
J. B. Parise, and E. Prince. 1983, 12p
Pub. in Material Research Bulletin 18, p841-852 1983.

Keywords: *Crystal structure, *Ion exchange resins, *Aluminum silicates, Neutron diffraction, Reprints.

The crystal structure of Cs-exchanged zeolite rho (1 (bar 4) 3m) has been solved using neutron powder data collected at 293K and 493K. The model differs from that proposed by Robson, Shoemaker, Ogilvie, and Manor (1973) for the hydrogen form. Structure modeling studies (DLS) suggested a starting point for the refinement. Cs at (1/2, 0, 0) is in the elliptically distorted double 8-ring blocking absorption. An increase in temperature decreases the elliptical distortion of the double 8-ring which is restored at lower temperature.

400,191
PB84-221027 Not available NTIS
National Bureau of Standards, Washington, DC.
Predictions of Multiphoton Resonances in SF_6 and SiF_4 .
Final rept.,
C. W. Patterson, and A. S. Pine. 1 Jan 83, 5p
Pub. in Optics Communications 44, n3 p170-174, 1 Jan 83.

Keywords: *Sulfur hexafluoride, *Silicon tetrafluoride, *Infrared spectroscopy, *Electromagnetic absorption, Absorption, Photons, Reprints, *Anharmonicity(Electrical), Numerical solution.

The frequency dependence of the multiphoton resonances to the rotation-vibrational levels of the first two nu 3 overtones are calculated for SF_6 and SiF_4 . From these calculations we can identify most of the features seen in the high intensity SF_6 absorption data and predict those features that would be seen in similar SiF_4 data.

400,192
PB84-221035 Not available NTIS
National Bureau of Standards, Washington, DC.
Tunable Laser Spectra of the Infrared-Active Fundamentals of Cubane.
Final rept.,
A. S. Pine, A. G. Maki, A. G. Robiette, B. J. Krohn, and J. K. G. Watson. 1984, 7p
Pub. in Jnl. of American Chemical Society 106, n4 p891-897 1984.

Keywords: *Infrared spectroscopy, Perturbation theory, Molecular structure, Chemical bonds, Molecu-

lar vibrations, Reprints, *Cubane, *Laser spectroscopy, *Molecular confirmation.

Confirmation of the octahedral symmetry and improved bond length measurements are obtained from high-resolution tunable laser spectra of the three infrared-active fundamental vibrations of cubane in the vapor phase. The C-H stretching band (ν 10) was recorded with a difference-frequency laser and is found to be severely perturbed by a second-order Coriolis resonance with another nearby (nominally inactive) C-H stretch. The C-H bend (ν 11) and the C-C stretch (ν 12), which were studied with diode lasers, are relatively unperturbed, revealing the symmetry from the nuclear spin weight intensities of the ro-vibrational clusters and the bond lengths from an analysis of the rotational fine structure. The data also provide the f (sup 1u) block sigma constants, which have been used, together with vibrational fundamentals from an earlier solid state study of cubane and its isotopic derivatives, to determine a quadratic force field for the molecule resulting in some minor reassignments of the modes.

400,193

PB84-221050

Not available NTIS

National Bureau of Standards, Washington, DC.

Spectra and Energy Levels of Ions in the Copper Isoelectronic Sequence from Ru(+15) to Sn(+21).

Final rept.,
J. Reader, N. Acquista, and D. Cooper. 1983, 6p
Pub. in Jnl. of Optical Society of America 73, n12 p1765-1770 1983.

Keywords: *Atomic energy levels, *Ionization potentials, Palladium, Rhodium, Ruthenium, Silver, Tin, Indium, Ions, Cadmium, Hartree-Fock approximation, Comparison, Plasmas(Physics), Reprints, *Isoelectronic sequence, *Laser spectroscopy, Numerical solution.

Spectra of the copperlike ions Ru(+15), Rh(+16), Pd(+17), Ag(+18), Cd(+19), In(+20), and Sn(+21) were observed with a laser-produced plasma and a 10.7m grazing-incidence spectrograph. Wavelengths, energy levels, and ionization energies were determined for each of these ions. The wavelengths are compared with relativistic Hartree-Fock calculations.

400,194

PB84-221225

Not available NTIS

National Bureau of Standards, Washington, DC.

Theory and Computations for Electron Collisions with Polar Molecules.

Final rept.,
D. W. Norcross. 1983, 8p
Pub. in Proceedings of U.S.-Japan Seminar Electron-Molecule Collisions Photoionization Processes held at California Institute of Technology on October 26-29, 1983 p71-78 1983.

Keywords: *Photoionization, Photochemical reactions, Polarity, Perturbation theory, *Electron-molecule interactions, Numerical solution.

In this paper the author discusses recent advances in theory that have occurred on several fronts: in applications and extensions of perturbation theory, semiclassical methods, and the adiabatic-nuclei approximation; in the development of more realistic and complete representations of the interaction at short as well as long range; in computational techniques for carrying out ever more elaborate and precise calculations; and in the application of these advances to more complicated collision processes such as vibrational excitation.

400,195

PB84-221340

Not available NTIS

National Bureau of Standards, Washington, DC.

Surface-Enhanced Raman Spectroscopy of Pyridine Derivatives: Effects of Adsorption on Electronic Structure.

Final rept.,
K. A. Bunding, and M. I. Bell. 1982, 16p
Pub. in Surface Science 118, p329-344 1982.

Keywords: *Raman spectroscopy, *Surface chemistry, Carbinols, Comparison, Adsorption, Electrodes, Substrates, Electronic spectra, Pyridines, Reprints, *Pyridine carboxaldehydes, *Ketone/methyl, Pyridine carboxaldehyde/N-methyl.

The surface-enhanced Raman (SER) spectra of 2-, 3-, and 4-pyridinecarboxaldehydes, methylketones, and 3- and 4-carbinols are compared with the spectra of the neat compounds and aqueous solutions, and ef-

fects of the adsorbate-substrate interactions which occur when these molecules are adsorbed on silver electrodes are identified. The 4-substituted carboxaldehyde and methylketone exhibit weaker carbonyl stretching bands when adsorbed on silver than in solution, while no such effect is found for the corresponding 3-substituted compounds. This is consistent with an interaction of the nitrogen lone-pair electrons with the silver, leading to electron withdrawal from 4-substituents and increased hydration of carbonyl groups at that position. Examination of solution spectra of the N-methylpyridinium salts shows a similar trend, with N-methylation increasing hydration and reducing the carbonyl band intensity in N-methyl 4-pyridiniumcarboxaldehyde but not in N-methyl-3-pyridiniumcarboxaldehyde. The surface enhanced spectrum of 4-pyridinecarboxaldehyde is identical to that of 4-pyridylcarbinol indicating that the aldehyde is completely hydrated on the electrode. Thus SER spectroscopy allows identification of a surface species which is quite different from that found in bulk solution. The reduction potentials of the pyridinecarboxaldehydes and methylketones are determined to show that no electrochemical reductions take place at the potentials used.

400,196

PB84-221381

Not available NTIS

National Bureau of Standards, Washington, DC.

Analysis of the Kinetics of Thermogravimetry: Overcoming Complications of Thermal History.

Final rept.,
J. H. Flynn. 1981, 17p
Pub. in Proceedings of Eastern Analytical Symposium held at New York, New York on November 19, 1980, paper in Thermal Analysis in Polymer Characterization, p43-59 1981.

Keywords: *Reaction kinetics, *Thermogravimetry, *Polymers, Degradation, Chemical reaction mechanisms.

The kinetic analysis of thermogravimetry of polymers requires the comparison of data from experiments performed at differing temperature programs. These data reflect divergent physical properties and thermal histories. This paper discusses how these differences arise, their effects upon the kinetic parameters, how they can be detected and what techniques and methods of data analysis are best suited to interpret them. The degradation of polystyrene in a vacuum is used as an illustrative example.

400,197

PB84-221415

Not available NTIS

National Bureau of Standards, Washington, DC.

Summary of the Usefulness of Signal-to-Noise Treatment in Analytical Spectrometry.

Final rept.,
M. S. Epstein, and J. D. Winefordner. Apr 84, 71p
Pub. in Prog. Anal. Atom. Spectrosc. 7, p67-137 Apr 84.

Keywords: *Atomic spectroscopy, *Chemical analysis, *Molecular spectroscopy, Noise, Performance evaluation, Reprints, *Signal detection.

The signal-to-noise ratio (S/N) of an analytical measurement is a most important 'figure-of-merit' which can be used to characterize an analytical technique for a specific application. This review article develops the significance of S/N characterization by summarizing the most useful concepts and conclusions resulting from S/N theory. The manner in which instrumental parameters influence (or do not influence) the S/N of atomic and molecular spectroscopic techniques is discussed and the current literature in this area is critically reviewed.

400,198

PB84-221449

Not available NTIS

National Bureau of Standards, Washington, DC.

Simple Explanation of the Polymer Collapse Transition: The (6/5)ths and the (2/3)rds Laws.

Final rept.,
E. A. Di Marzio. Apr 84, 3p
Pub. in Macromolecules 17, p969-971 Apr 84.

Keywords: *Polymers, *Phase transformation, *Collapse, Molecular weight, Reprints.

A simple mean field treatment of the collapse transition in an isolated polymer is given. The two limiting laws (R sup 2 proportional to $n(1.2)$ for the expanded polymer and R sup 2 proportional to $n(2/3)$ for the collapsed polymer) are obtained where R sup 2 is the mean square end-to-end length and n the molecular weight. The transition for this model is second-order.

400,199

PB84-221639

Not available NTIS

National Bureau of Standards, Washington, DC.

Photofragment Dynamics.

Final rept.,
S. R. Leone. 1982, 70p
Grants NSF-CHE76-22600, NSF-PHY79-04928
Sponsored in part by Department of Energy, Washington, DC.
Pub. in Advances in Chemical Physics, Dynamics of the Excited State, p255-324 1982.

Keywords: *Dissociation, *Photochemical reactions, *Dynamics, *Molecules, Fluorescence, Angular distribution, Reprints.

Molecular photodissociation has been studied by a wide variety of techniques for many years. Photofragment dynamics represents a subfield of photodissociation with special emphasis on fragmentation details, such as final state distributions, dissociation lifetimes, product angular distributions, fluorescence polarization fragments, and translational energy distributions. The field of photofragment dynamics is still remarkably young. Experimental tools have become available only very recently to explore the photofragmentation process in such great detail. At least for simple molecules, it is possible that their photofragment dynamics can be accurately described theoretically. This review considers in turn the developments in experimental technique (not intended to be exhaustive), the theoretical advances in describing photofragment dynamics, and finally the results for a number of specific systems. The bibliography contains 305 entries.

400,200

PB84-221761

Not available NTIS

National Bureau of Standards, Washington, DC.

Rotational Spectrum of the CD₂ Radical Studied by Far Infrared Laser Magnetic Resonance Spectroscopy.

Final rept.,
P. R. Bunker, T. J. Sears, A. R. W. McKellar, K. M. Evenson, and P. J. Lovas. Aug 83, 9p
Sponsored in part by National Aeronautics and Space Administration, Washington, DC.
Pub. in Jnl. of Chemical Physics, v79 n3 p1211-1219 Aug 83.

Keywords: *Deuterium compounds, *Infrared spectroscopy, *Far infrared radiation, Molecular rotation, Molecular energy levels, Reprints, *Methyl radicals, *Laser spectroscopy, Laser magnetic resonance spectroscopy.

The authors report the detection of seventeen pure rotational transitions in the ground vibronic state of the CD₂ radical using far infrared laser magnetic resonance spectroscopy. Fitting the data using an effective rotational Hamiltonian yields values for the three rotational constants, seven centrifugal distortion constants, the three electronic spin-rotation and two electronic spin-spin parameters. They also fit this data, using CD₂ nu 2 band data (published separately), using the semirigid bender Hamiltonian and obtain the effective bending potential for CD₂. Combining this with previous CH₂ results enables us to predict the rotation bending energy levels of CHD. The authors also report here the detection of two further rotational transitions in the nu 1 excited vibrational state of CH₂.

400,201

PB84-221886

Not available NTIS

National Bureau of Standards, Washington, DC.

Nitrogen-15 Nuclear Magnetic Resonance Spectroscopy of Neomycin B and Related Aminoglycosides.

Final rept.,
R. E. Botto, and B. Coxon. Feb 83, 8p
Pub. in Jnl. of the American Chemical Society 105, n4 p1021-1028, 23 Feb 83.

Keywords: *Nuclear magnetic resonance, *Nitrogen isotopes, *Isotopic labeling, *Neomycins, Molecular structure, Antibiotics, Reprints, *Chemical shifts(Nuclear magnetic resonance), *Nitrogen 15.

Natural-abundance (15)N NMR spectra of four neomycin B derivatives and their structurally related components are reported. Complete (15)N chemical shift titration data for the antibiotic are used to compute pK sup a values for the individual nitrogen functions to within + or - 0.04 pK sup a unit and also to determine the extent and sites of protonation in commercial neo-

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mycin sulfate preparations. In general, (^{15}N) protonation shifts are found to be downfield (6.4-14.2 ppm) and have been correlated with nitrogen structural types.

400,202

PB84-221951 Not available NTIS
National Bureau of Standards, Washington, DC.

Electronic Structure and Spectra of the Lowest Five 1 sup sigma (+1) and 3 sup sigma (+1) States, and Lowest Three 1 sup pi, 3 sup pi, 1 sup delta, and 3 sup delta States of NaK.

Final rept.,

W. J. Stevens, D. D. Konowalow, and L. B. Ratcliff. 1 Feb 84, 10p

Pub. in Jnl. of Chemical Physics 80, n3 p1215-1224, 1 Feb 84.

Keywords: *Molecular energy levels, *Electronic spectra, *Sodium inorganic compounds, *Potassium inorganic compounds, Potential energy, Reprints, *Molecular configurations, Pseudopotentials.

The authors calculated the potential energy curves for all molecular states of NaK which may be obtained from the interactions $\text{Na}(3s) + \text{K}(4s)$, $\text{Na}(3s) + \text{K}(4p)$, $\text{Na}(3p) + \text{K}(4s)$, $\text{Na}(3s) + \text{K}(5s)$, $\text{Na}(3s) + \text{K}(3d)$, and for the delta states corresponding to the interactions $\text{Na}(3d) + \text{K}(4s)$ and $\text{Na}(4p) + \text{K}(4p)$ by full-valence configuration interaction computations which utilize effective core potentials to describe the core electrons, core-valence orthogonality constraints and the core-valence correlation (CVC) energy. The differences between our computed curves and those deduced from experimental spectra are generally small and can be accounted for by: (1) the modest size of the basis set, which is insufficiently diffuse to describe $\text{Na}(+1)$ and $\text{K}(-1)$ resonances and related molecular Rydberg character, and (2) the approximate way in which the CVC interaction is included.

400,203

PB84-221993 Not available NTIS
National Bureau of Standards, Washington, DC.

Effective Thermal Conductivity of Glass-Fiber Board and Blanket Standard Reference Materials.

Final rept.,

D. R. Smith, and J. G. Hust. 1983, 14p
Sponsored in part by Department of Energy, Oak Ridge, TN. Oak Ridge Operations Office.

Pub. in Proceedings of the Thermal Conductivity 17, Gaithersburg, MD, June 15-18, 1981, p483-496 1983.

Keywords: *Thermal conductivity, *Glass fibers, Nitrogen, Argon, Helium, Temperature, Density(Mass/volume), Standards, Reprints, *Standard reference materials.

Measurements of effective thermal conductivity, λ , have been performed on a series of specimens of glass-fiber board and glass-fiber blanket. Measurements of λ were conducted as a function of temperature from 85 to 360 K, of temperature difference with $\Delta T = 10$ to 100 K, of bulk density from 11 to 148 kg/cu m and for nitrogen, argon, and helium inter-fiber fill gases at pressures from atmospheric to high vacuum. Results are analyzed and compared with values from the published literature and NBS certification data for similar material. Polynomial expressions are given for the functional relation between conductivity, temperature, and density for board and for blanket.

400,204

PB84-222009 Not available NTIS
National Bureau of Standards, Washington, DC.

Chain Scission and Mechanical Degradation of Polyethylene.

Final rept.,

B. M. Fanconi, G. B. McKenna, K. L. DeVries, and R. H. Smith. Jul 82, 1p

Pub. in Proceedings of the International Union Pure Applied Chemistry Macromolecular Symposium (28th), Amherst, Massachusetts, July 12-16, 1982, p34.

Keywords: *Polyethylene, *Infrared spectroscopy, *Degradation, Polymers, Molecular weight, *Molecular conformation, *Polymeric chains, Free radicals.

Knowledge of molecular processes associated with mechanical degradation of polymers is important to the development of service life prediction and accelerated test procedures as well as the design of improved polymeric materials. One process thought to be involved in mechanical degradation is the scission of carbon-carbon backbone bonds. In a model due to

Zhurkov and co-workers, the free radicals formed during the initial chain scissions produce a high localized concentration of bond ruptures due to extensive free radical reactions. These lead to microvoid formation from which cracks develop that result in macroscopic failure. An important aspect of this model is that a large number of chain scissions result from the initial bond rupture through free radical propagation reactions. The evidence for multiple chain scissions per initial free radical comes from comparisons of the electron spin resonance measured number of free radicals generated during mechanical degradation with the number of chain scissions determined from infrared spectroscopic measurements of new end group concentrations. Other estimates of the number of chain scissions are derived from measurements of the reduction in the viscosity average molecular weight. However, it has been found that the number of chain scissions per free radical determined by viscosity measurements on mechanically damaged polyethylene is at least three orders of magnitude lower than the ratio evaluated from previous infrared data.

400,205

PB84-222058 Not available NTIS
National Bureau of Standards, Washington, DC.

Prompt Gamma-Ray Neutron Activation Analysis.

Final rept.,

G. E. Gordon, D. L. Anderson, M. P. Failey, W. H. Zoller, and W. B. Walters. 1978, 5p

Contract DOE-EY-76-S-05-5173

Pub. in Proceedings of Nuclear Methods in Environmental and Energy Research, Columbia, Missouri, October 10-13, 1977, p83-87 1978.

Keywords: *Chemical analysis, *Neutron activation analysis, *Gamma ray spectroscopy, Boron, Cadmium, Sampling, Environmental surveys, Geology, Irradiation, Forensic science, Biological processes.

The observation of prompt gamma rays during neutron irradiation of samples allows one to determine concentrations of some elements that are difficult or impossible to measure by off-line instrumental neutron and photon activation analysis (e.g., boron and cadmium). Furthermore, by bringing a beam out of the reactor to an external irradiation facility one can irradiate very large samples. Because of the very low fluxes and negligible heating, the technique is almost totally non-destructive and there should be no losses of volatile materials. As in the case of the off-line nuclear methods, self-absorption problems are usually negligible, but the in-beam method has the advantage of rapid turn-around time, as data can be reduced immediately after irradiations. A system for detailed investigation of the technique as applied to a wide range of environmental, biological, geological and forensic samples has been installed at the National Bureau of Standards reactor and is now being tested.

400,206

PB84-222116 Not available NTIS
National Bureau of Standards, Washington, DC.

Accurate Wave-number Measurements for the (4)He I 1s2p-1s3d Transitions and Comparisons of Several Term Separations with Theory.

Final rept.,

C. J. Sansonetti, and W. C. Martin. 1984, 10p

Pub. in Physical Review A 29, n1 p159-168 1984.

Keywords: *Atomic energy levels, *Helium, Doppler effect, Atomic structure, Atomic spectroscopy, Atomic theory, Reprints, *Laser spectroscopy.

The authors have measured the $(4)\text{He}$ 2 triplet P - 3 triplet D (5875 Å) and 2 singlet P - 3 singlet D (6678 Å) lines by Doppler-free intermodulated fluorescence spectroscopy, and also the spin-forbidden 2 triplet P sup(1,2) - 3 singlet D sup(2) (5874 Å) and 2 singlet P sup(1) - 3 triplet D sup(2) (6679 Å) lines as observed in Doppler-limited fluorescence spectra. The positive column of a low-pressure discharge was the source of the excited He atoms. The wave number of the tunable dye laser inducing the fluorescence was measured relative to an iodine-stabilized He-Ne laser by photographic Fabry-Perot interferometry. They give new parametric values for the other $(4)\text{He}$ 1s3d interactions (three magnetic fine-structure interactions and the exchange energy) and for the singlet-triplet mixing coefficient.

400,207

PB84-222140 Not available NTIS
National Bureau of Standards, Washington, DC.

Limiting Thickness of an Adsorbed Polymer Chain. Random Flight Model.

Final rept.,

R. J. Rubin, and G. H. Weiss. 15 Feb 83, 5p

Pub. in Jnl. of Chemical Physics 78, n45 p2039-2043, 15 Feb 83.

Keywords: *Polymers, *Adsorption, *Surface chemistry, *Random walk, *Mathematical models, Thickness, Reprints, *Polymeric chains, *Molecular configurations.

The probability density of the span of an adsorbed polymer chain in the direction normal to the solution surface is derived in de Gennes' model for weakly adsorbed chains. The average value of the span is $1/2 \cdot 1/k \ln N$ for $N \gg 1$. This quantity is identically equal to the distance from the adsorbing solution surface at which the exponential step density obtained in this model is equal to unity.

400,208

PB84-222157 Not available NTIS
National Bureau of Standards, Washington, DC.

Cryogenic Homogenization Procedure of Biological Tissues.

Final rept.,

R. L. Zeisler, J. K. Langland, and S. H. Harrison. Dec 83, 4p

Pub. in Analytical Chemistry, v55 n14 p2431-2434 Dec 83.

Keywords: *Tissues(Biology), *Neutron activation analysis, *Homogenizing, *Cryogenics, Sampling, Chemical analysis, Brittle fracturing, Reprints, Procedures.

Biological matrices frequently are inhomogeneous if small subsamples are taken for analysis. To obtain precise and accurate analytical data on a bulk sample, homogenization of the bulk sample is necessary. The cryogenic homogenization (brittle fracture) technique is a very effective method to obtain homogenates of biological matrices. A new high capacity mill made from Teflon is described and evaluated. Soft tissues can be homogenized in this mill at near liquid nitrogen temperatures, with minimal sample contamination, resulting in fine powders with 500 micrometers to smaller than 50 micrometer particles. Sampling uncertainty due to inhomogeneity of the bulk is less than 2% for 1 g subsamples.

400,209

PB84-222165 Not available NTIS
National Bureau of Standards, Washington, DC.

Trace Elements in Human Livers Using Quality Control in the Complete Analytical Process.

Final rept.,

R. Zeisler, S. H. Harrison, and S. A. Wise. 1984, 19p
Pub. in Biological Trace Element Research 6, p31-49 1984.

Keywords: *Trace elements, *Livers, *Chemical analysis, Sampling, Humans, Clinical medicine, Quality control, Reprints, Standard reference materials.

The validity and intercomparability of data in research related to medical, environmental, and geochemical health problems is of utmost concern and requires specific consideration in the development of an analytical approach. The Environmental Protection Agency/National Bureau of Standards Pilot Environmental Specimen Bank Program provides a vehicle for developing the precise and accurate determination of trace constituents in human livers. This approach, when implemented, gives specific consideration to a valid relationship between the analytical result and the true value in the sample. This is accomplished by minimizing contamination of the sample and/or loss of constituents, and by assuring representative analytical test portions. The analysis of the liver specimens is performed under strict quality control. The applied analytical techniques (atomic absorption spectrometry, isotope dilution mass spectrometry, neutron activation analysis, and voltammetry) have been verified for accuracy through the analysis of Standard Reference Materials. In addition, several elements are determined using two or three of these independent techniques. The first year of the program provided results on 31 elements including Se and Pb in 36 human livers.

400,210
PB84-222173 Not available NTIS
 National Bureau of Standards, Washington, DC.
Chronocoulometry of a System with Deposition of the Product on the Electrode.

Final rept.,
 W. T. Yap, R. T. Burke, E. A. Blubaugh, and R. A. Durst. 1983, 7p
 Pub. in Jnl. of Electroanalytical Chemistry 159, p287-293 1983.

Keywords: *Electrodes, *Electrodeposition, *Mathematical models, Concentration(Composition), Solubility, Reprints, *Chronocoulometry.

The charge-time relation for double potential-step large-amplitude chronocoulometry was developed for a system with electrodeposition of the product. The model assumes that the concentration of the product near the electrode cannot be larger than the solubility of the product.

400,211
PB84-222181 Not available NTIS
 National Bureau of Standards, Washington, DC.
Spectroelectrochemistry of a System with Product Deposition.

Final rept.,
 W. T. Yap, E. A. Blubaugh, R. A. Durst, and R. T. Burke. 1984, 6p
 Pub. in Jnl. of Electroanalytical Chemistry 160, p73-78 1984.

Keywords: *Electrochemistry, *Mathematical models, *Thermodynamics, *Laser materials, Nitrogen organic compounds, Equilibrium, Nernst effect, Dyes, Reprints, Pyridinium toluene sulfonate/methyl-(phenyl-oxazolyl).

An analysis of the spectroelectrochemistry of systems containing a species which deposits onto the electrode is presented. In this model, in addition to the Nernst equation, a thermodynamic condition for phase equilibrium between the deposited and solution species of the product is assumed. Relations between the variables of the Nernst plot were derived and procedures for obtaining the formal potential, number of electrons involved, and the maximum equilibrium concentration of the product are presented. These results are applied to the experimental data on the aqueous solution of the laser dye, 1-methyl-4-(5-phenyl-2-oxazolyl)pyridinium p-toluenesulfonate.

400,212
PB84-222199 Not available NTIS
 National Bureau of Standards, Washington, DC.
Modification of Selectivity in Reversed-Phase Liquid Chromatography of Polycyclic Aromatic Hydrocarbons Using Mixed Stationary Phases.

Final rept.,
 S. A. Wise, L. C. Sander, and W. E. May. 1983, 13p
 Pub. in Jnl. of Liquid Chromatography, v6 n14 p2709-2721 1983.

Keywords: *Aromatic polycyclic hydrocarbons, *Chromatographic analysis, Polymers, Surfaces, Concentration(Composition), Reprints, *Reversed phase liquid chromatography, Monomers.

Monomeric and polymeric C(18) materials provide significantly different selectivities for polycyclic aromatic hydrocarbons (PAH) in reversed-phase liquid chromatography. Selectivity factors vary in a regular manner with respect to surface concentration of C(18) groups on different C(18) columns. In this study, the authors investigated the feasibility of 'customizing' a C(18) column to provide an intermediate selectivity by mixing 5 micrometer polymeric C(18) material from two different lots with high and low C(18) surface concentrations. The use of mixed phase columns is illustrated for the analysis of a fraction containing five condensed ring PAH isomers (molecular weight 278) isolated from an air particulate sample.

400,213
PB84-222595 Not available NTIS
 National Bureau of Standards, Washington, DC.
Applications of Fluorescence Techniques to Polymer Systems: Polymer Compatibility and Segmental Mobility.

Final rept.,
 F. W. Wang. 1983, 4p
 Pub. in Polymer Preprints, Japan, v32 n1 p79-82 1983.

Keywords: *Polymers, *Fluorescence, *Energy transfer, Polymethyl methacrylate, Reprints, *Excimers, Vinylidene fluoride polymers, Polyethyl methacrylate.

Non-radiative energy transfer technique was used to determine the phase behavior of a poly(methyl methacrylate) - poly(ethyl methacrylate) blend and to evaluate the effectiveness of poly(vinylidene fluoride) as a compatibility enhancer for this blend. Excimer fluorescence technique was used to determine the segmental mobilities of poly(methyl methacrylate) polymers and a poly(methyl acrylate) polymer.

400,214
PB84-222835 Not available NTIS
 National Bureau of Standards, Washington, DC.
Operation of the U.S. Pilot National Environmental Specimen Bank Program.

Final rept.,
 S. A. Wise, K. A. Fitzpatrick, S. H. Harrison, and R. Zeisler. 1984, 22p
 Pub. in Proceedings of International Workshop on Environmental Specimen Banking and Monitoring as Related to Banking, Saarbruecken, Germany, F.R., May 10-15, 1982, p108-129 1984.

Keywords: *Environmental surveys, *Chemical analysis, *Trace elements, *Pesticides, Sampling, Gas chromatography, Liver, Chlorine organic compounds, Neutron activation analysis, *Specimen banks.

In 1979, a Pilot Environmental Specimen Bank was established at the National Bureau of Standards to evaluate the storage of biological and environmental specimens. This pilot effort was designed to provide actual working experience in all aspects of specimen banking. In this article, the experience gained during the pilot specimen bank program relating to sample collection, processing, storage, and analysis of the first sample type, human liver, is reviewed. Contamination-free protocols for sampling and homogenization of specimens were developed and implemented. The results of the analyses of 30 liver samples for trace elements and chlorinated pesticide residues are described. The potential advantages and uses of specimen banking as related to monitoring of the environment are discussed.

400,215
PB84-222884 Not available NTIS
 National Bureau of Standards, Washington, DC.
Decay Rate of Critical Fluctuations in Carbon Dioxide-Ethane Mixtures Near the Critical Line.

Final rept.,
 R. F. Chang, and T. Doiron. 1982, 5p
 Pub. in Proceedings of Symposium on Thermophysical Properties of Fluids (8th), Gaithersburg, Maryland, June 1982, 1, p458-462.

Keywords: *Binary systems(Materials), *Carbon dioxide, *Ethane, *Decay, Mixtures, Thermophysical properties, Critical point, *Critical line.

Using the techniques of photon correlation spectroscopy the authors have measured the decay rate of fluctuations of two binary mixtures of ethane and carbon dioxide near the plait point of the mixtures, along with pure ethane near its critical point at 90-degree scattering angle. The compositions of the two mixtures are 5.4% and 35.8% mole fractions of carbon dioxide with the remaining amount being ethane. Our experimental data indicate that the relaxation rate can be described satisfactorily by the predictions of the mode-coupling theory with the exponent $\nu=0.625$ provided background contributions are not neglected.

400,216
PB84-222892 Not available NTIS
 National Bureau of Standards, Washington, DC.
Determination of Serum Urea by Isotope Dilution Mass Spectrometry as a Candidate Definitive Method.

Final rept.,
 M. J. Welch, A. Cohen, H. S. Hertz, F. C. Ruegg, and R. Schaffer. 1984, 7p
 Pub. in Analytical Chemistry, v56 n4 p713-719 1984.

Keywords: *Isotopic labeling, *Urea, *Blood analysis, Gas chromatography, Mass spectrometry, Oxygen isotopes, Standards, Nitrogen organic compounds, Reprints, *Isotope dilution mass spectrometry, *Oxygen 18, Standard reference materials, Pyrimidine/methyl-bis(trimethyl-silyl)oxy.

An isotope dilution mass spectrometric (ID/MS) method for serum urea is described. The method utilizes urea-18O as the labeled internal standard and involves isolation of urea from serum, conversion to 6-methyl-1-2,4-bis(trimethyl-silyl)oxy pyrimidine, capillary column gas chromatography for sample introduc-

tion, and measurement of the abundance ratio of the (M-15)(+1) ions from the labeled and unlabeled derivative. Quantitation is achieved by measurement of each sample between measurements of two standards whose unlabeled/labeled ratios bracket that of the sample. Results are of high precision, with coefficients of variation for a single measurement of 0.17 percent for NBS Standard Reference Material 909, a freeze-dried human serum pool, and 0.19 percent overall for five frozen serum pools, and have been shown to be free of measurement interferences. The method is therefore of sufficient accuracy and precision to be considered a 'definitive' method.

400,217
PB84-223130 Not available NTIS
 National Bureau of Standards, Washington, DC.
Calorimetric Studies of Clathrate Hydrates.

Final rept.,
 J. E. Callanan, and E. D. Sloan. 1983, 9p
 Pub. in Proceedings of Int. Gas Res. Conf., Hilton International, London, England, June 6-16, 1983, 9p.

Keywords: *Heat measurement, *Hydrates, *Natural gas, Thermophysical properties, Specific heat, Heat of dissociation, Ethylene oxide, Cyclopropane, *Clathrate compounds, Furan tetrahydro.

World resources of natural gas in hydrate form are abundant. Thermophysical property measurements are vital to the determination of the exploitability of this resource. The natural gas hydrates are clathrates; the hydrate lattice exists in one of two special structures (I and II), both of which form with cavities or cages in which molecules in specific size ranges can be trapped. Heat capacities as a function of temperature and, where appropriate, heats of dissociation have been measured for tetrahydrofuran (II), ethylene oxide (I), and cyclopropane (I and II) hydrates by differential scanning calorimetry. The heat capacities were found to vary both with structure and with guest. Scanning calorimetric techniques and sample handling techniques suitable for dealing with hydrates in the subambient region were developed.

400,218
PB84-223155 Not available NTIS
 National Bureau of Standards, Washington, DC.
Principles of Laser-Enhanced Ionization Spectrometry in Flames.

Final rept.,
 J. C. Travis, G. C. Turk, J. R. DeVoe, P. K. Schenck, and C. A. van Dijk. 1984, 43p
 Pub. in Progr. Anal. Atom. Spectrosc. 7, n2 p199-241 1984.

Keywords: *Flames, *Ionization, Forecasting, Reprints, *Laser enhanced ionization, *Flame spectroscopy.

Laser-enhanced ionization (LEI) is a highly sensitive and selective flame spectrometric analytical technique. An overview of LEI is given, with special emphasis on the basic physical principles of the method. Topics covered include the production (with and without laser enhancement), destruction, and transport of ions and electrons in flames; the perturbation of an electric field by free charges; and the induction of current in the measurement circuit by moving charges in the flame. These principles are related to practice through discussions of the present analytical performance of, and future prospects for, the technique.

400,219
PB84-223171 Not available NTIS
 National Bureau of Standards, Washington, DC.
Study of Microstructural Effects in the Strength of Alumina Using Controlled Flaws.

Final rept.,
 B. R. Lawn, S. W. Freiman, T. L. Baker, D. D. Cobb, and A. C. Gonzalez. Apr 84, 3p
 Sponsored in part by Office of Naval Research, Arlington, VA.
 Pub. in Jnl. of American Ceramic Society 67, n4 pC-67-C-69 Apr 84.

Keywords: *Aluminum oxide, *Fracture strength, Trends, Nondestructive testing, Microstructure, Ceramics, Reprints.

A study is made of strength characteristics as a function of Vickers indentation load for two grain-size aluminas. At low loads the strengths tend to well-defined plateaus, the levels of which bear an inverse relationship with grain size. These trends are consistent with a

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transition from indentation-controlled to microstructure-controlled behavior as flaw size diminishes. The conventional indentation fracture formalism is modified to account for this transition.

400,220

PB84-223197 Not available NTIS
National Bureau of Standards, Washington, DC.
Simulation of the Dynamic and Equilibrium Properties of Many-Chain Polymer Systems.
Final rept.,
D. E. Kranbuehl, and P. H. Verdier. 1984, 7p
Contract W-7405-eng-48, Grant NSF-CHE77-21305
Pub. in *Macromolecules* 17, n45 p749-755 1984.

Keywords: *Polymers, *Dynamics, *Chemical equilibrium, Reprints, *Polymer chain.

Computer simulation of the motions of systems of lattice-model polymer chains on a simple cubic lattice was employed in order to study the effects of excluded volume and chain entanglement on the relaxation behavior and equilibrium properties of polymer chains. Multiple chains of from 8 to 64 beads each were studied, with periodic boundary conditions and occupying up to 80% of the lattice sites. As chain concentration increased, equilibrium dimensions were found to approach random-walk values, in agreement with results obtained by previous workers. The long relaxation times inferred from the limiting long-time behavior of the autocorrelation functions for end-to-end vector show a dramatic increase with increasing concentration. The variation of the long relaxation time with chain length and concentration is represented reasonably well by a simple free volume effect and an additional chain-length dependent factor.

400,221

PB84-223205 Not available NTIS
National Bureau of Standards, Washington, DC.
Signal Detection of Pulsed Laser-Enhanced Ionization.
Final rept.,
G. J. Havrilla, P. K. Schenck, J. C. Travis, and G. C. Turk. Feb 84, 8p
Pub. in *Analytical Chemistry* 56, n2 p186-193 Feb 84.

Keywords: *Mathematical models, *Ionization, *Flames, Trends, Reprints, *Laser enhanced ionization, *Signal detection, *Flame spectroscopy.

A point charge model has been developed to describe the proposed detection mechanisms of laser enhanced ionization (LEI) which are based upon charge induction theory. The model predictions are in good agreement with experimentally observed LEI electron and ion signal pulses. This investigation provides theoretical as well as experimental basis for establishing experimental methodology that is necessary to the development of LEI as a technique for trace metal analysis. The predicted effects and behavioral trends of alkali metal matrix concentration and laser beam position were confirmed by experimental results. The development of this model provides a basis upon which the analytical capability of LEI can be refined and improved.

400,222

PB84-223320 Not available NTIS
National Bureau of Standards, Washington, DC.
Normal- and Reversed-Phase Liquid Chromatographic Separations of Polycyclic Aromatic Sulfur Heterocycles.
Final rept.,
S. A. Wise, R. M. Campbell, W. E. May, M. L. Lee, and R. N. Castle. 1982, 20p
Pub. in *Polynuclear Hydrocarbons: Int. Symp. Formation Metabolism Measurement (7th)*, p1247-1266 1982.

Keywords: *Aromatic polycyclic hydrocarbons, *Sulfur organic compounds, *Chemical analysis, Reprints, *Reversed phase liquid chromatography, *Liquid chromatography, Coal liquids, Isomers.

Normal- and reversed-phase liquid chromatographic (LC) retention data are reported for 27 Kata-condensed four- and five-ring polycyclic aromatic sulfur heterocyclic (PASH) isomers and for ten pericondensed five-ring PASH isomers. The application of normal-phase LC prefractionation followed by reversed-phase LC is described for the analysis of a sulfur enriched fraction from a coal liquid.

400,223

PB84-223387 Not available NTIS
National Bureau of Standards, Washington, DC.
Laser Studies of Methyl Radical Reactions with Cl₂ and Br₂: Absolute Rate Constants, Product Vibrational Excitation, and Hot Radical Reactions.
Final rept.,
L. J. Kovalenko, and S. R. Leone. 15 Apr 84, 13p
Grants NSF-CHE79-11340, NSF-CHE82-00805
Pub. in *Jnl. of Chemical Physics* 80, n8 p3656-3667, 15 Apr 84.

Keywords: *Reaction kinetics, Excitation, Molecular vibration, Dynamics, Chemiluminescence, Halogen organic compounds, Reprints, *Methyl radicals, *Laser spectroscopy, Methane/dichloro, Methane/dibromo.

Reactions of methyl radicals with Cl₂ and Br₂ are studied by pulsed laser dissociation of CH₃I followed by time-resolved detection of infrared vibrational fluorescence from the C-H stretch modes of the methyl halide product. This method provides a determination of the absolute rate constants for the methyl radical reactions. From the fluorescence intensity of the methyl halide product, an estimate can be made of the fraction of energy available upon reaction that goes into product vibration. For both reactions this is determined to be about 0.5. In addition, the reaction rates are observed to be considerably enhanced for hot methyl radicals produced in the dissociation of CH₃I. The enhancement is shown to be due predominantly to the translational excitation, as opposed to the vibrational excitation, imparted in the photofragmentation.

400,224

PB84-223825 Not available NTIS
National Bureau of Standards, Washington, DC.
Tunable Far-Infrared Spectroscopy.
Final rept.,
K. M. Evenson, D. A. Jennings, and F. R. Petersen. 15 Mar 84, 3p
Sponsored in part by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Applied Physics Letters*, v44 n6 p576-578, 15 Mar 84.

Keywords: *Infrared spectroscopy, *Far infrared radiation, Carbon dioxide lasers, Continuous radiation, Reprints, *Laser spectroscopy, *Far infrared spectroscopy, *Tunable lasers, Waveguide lasers.

Tunable, cw, far-infrared radiation has been generated by nonlinear mixing of radiation from two CO₂ lasers in a metal-insulator-metal (MIM) diode. The FIR difference-frequency power radiated from the MIM diode antenna to a calibrated indium antimonide bolometer. Two-tenths of a microwatt of FIR power was generated by 250 mW from each of the CO₂ lasers. The combination of lines from a waveguide CO₂ laser, with its larger tuning range, with lines from CO₂, N₂O, and CO₂ isotope lasers promises complete coverage of the entire far-infrared band from 100 to 5000 GHz (3 to 200/cm) with stepwise-tunable cw radiation.

400,225

PB84-223866 Not available NTIS
National Bureau of Standards, Washington, DC.
Polymer Dynamics: When Do Scaling Laws Apply.
Final rept.,
D. W. Schaefer, and C. C. Han. Mar 81, 2p
Pub. in *ACS (American Chemical Society) Polymer Preprints*, v2 n1 p66-67 Mar 81.

Keywords: *Polymers, *Light scattering, *Polystyrene, *Dynamics, Molecular structure, Reprints, *Polymer chains.

The random motion of a flexible polymer chain is exceedingly complex. In spite of this complexity, however, recent theoretical developments suggest that universal behavior should be observed in certain dynamic regions, regardless of the detailed structure of a particular polymer. In this paper, some experimental results derived from dynamic light scattering will be compared with theoretical predictions. The limits of validity of scaling laws will be discussed.

400,226

PB84-223890 Not available NTIS
National Bureau of Standards, Washington, DC.
Resonance Ionization Mass Spectrometry of Iron-Quantitative Aspects.
Final rept.,
J. D. Fassett, L. J. Moore, and J. C. Travis. 1984, 6p
Pub. in *Analytic Spectroscopy* 19, p137-142 1984.

Keywords: *Iron, Mass spectroscopy, Ionization, Comparison, Reprints, *Resonance ionization spectroscopy, *Laser spectroscopy.

Resonance ionization mass spectrometry has been used to study the formation of atomic ions of iron. Iron was thermally vaporized from a filament at 1250 K. A one-wavelength, two-photon ionization scheme was employed which utilized the tunable UV light provided by a Nd:YAG pumped tunable dye laser with frequency doubling. The systematics of the resonance ionization process has been studied and a comparison with thermal ionization made.

400,227

PB84-223916 Not available NTIS
National Bureau of Standards, Washington, DC.
Rotational Spectrum and Hyperfine Structure of the Methylene Radical CH₂ Studied by Far-Infrared Laser Magnetic Resonance Spectroscopy.
Final rept.,
T. J. Sears, P. R. Bunker, A. R. W. McKellar, K. M. Evenson, and D. A. Jennings. Dec 82, 15p
Pub. in *Jnl. of Chemical Physics*, v77 n11 p5348-5362 Dec 82.

Keywords: *Molecular rotation, *Hyperfine structure, Excitation, Microwave spectroscopy, Interstellar matter, Deuterium compounds, Reprints, *Methylene radicals, *Laser magnetic resonance spectroscopy, *Far infrared spectroscopy, Laser spectroscopy.

Thirteen pure rotational transitions of CH₂ in its X triplet B sub 1 ground vibronic state have been measured and assigned using the technique of far-infrared laser magnetic resonance (LMR) spectroscopy. The analysis of these observations yields precise rotational constants as well as spin-spin, spin-rotation, and hyperfine interaction parameters for gas phase CH₂. Its rotational spectrum may enable interstellar CH₂ to be detected by radio astronomy. Two rotational transitions within the nu(1)=1 excited vibrational state have also been identified in the LMR spectrum. Future observations of vibrationally excited CH₂ may afford a means of determining the singlet-triplet splitting in methylene, and studies of CD₂ and CHD will result in improved structural determinations.

400,228

PB84-223924 Not available NTIS
National Bureau of Standards, Washington, DC.
Absolute Frequency Measurements of the 2-0 Band of CO at 2.3 Micrometers; Calibration Standard Frequencies from High Resolution Color Center Laser Spectroscopy.
Final rept.,
C. R. Pollock, F. R. Petersen, D. A. Jennings, J. S. Wells, and A. G. Maki. 1983, 12p
Pub. in *Jnl. of Molecular Spectroscopy* 99, p357-368 1983.

Keywords: *Frequency measurement, *Carbon monoxide, Line spectra, Band spectra, Near infrared radiation, Line width, Standards, Reprints, Pressure dependence, Color center lasers, Laser spectroscopy.

The absolute frequencies of 20 lines of the 2-0 band of CO have been measured near 4260/cm by heterodyne frequency measurement techniques. Eleven of the lines were measured by saturated absorption techniques which produced line widths of about 3 MHz. New ro-vibrational constants have been fitted to these measurements. A table of calculated transition frequencies is given. The pressure shifts of three have been measured and fall in the range from -0.9 to -3 kHz/Pa (-122 to -400/Torr). It is suggested that the generally accepted frequencies of the 1-0 band of CO should be shifted by -7 MHz.

400,229

PB84-223973

Not available NTIS
National Bureau of Standards, Washington, DC.**Mechanical Behavior of Isotactic Polypropylene Subjected to Various Strain Histories in Uniaxial Extension.**

Final rept.,

L. J. Zapas, and J. M. Crissman. Mar 83, 8p
Pub. in Polymer 24, p351-358 Mar 83.

Keywords: *Mechanical properties, *Polypropylene, Stability, Polymers, Stress relaxation tests, Strain tests, Creep rate, Loading rate, Reprints, *BKZ theory.

Bernstein and Zapas have recently extended the work of Ericksen on the discontinuous deformations of solid elastic bars to the case of viscoelastic materials which behave according to the BKZ theory. The theory cannot predict a priori when the material will exhibit the phenomenon of necking, but it does give an explanation for the formation of the neck, which depends upon the stretch history. In the work which the authors shall present here it will be their purpose (1) to present experimental data, obtained for a variety of different strain histories in uniaxial extension, for a material which can be described rather well by the BKZ theory, and (2) to show that by suitably extrapolating the available data into regions which are not accessible experimentally there is consistency between the theory and the experimental results. For this purpose, the authors have selected as a material a rather slowly quenched isotactic polypropylene. Experiments were performed which involved single step stress relaxation, constant rate of strain, constant rate of loading, and creep.

400,230

PB84-223981

Not available NTIS
National Bureau of Standards, Washington, DC.**Accordion Type LASER-Raman Scattering by Polymers.**

Final rept.,

A. Peterlin. 1982, 28p
Pub. in Jnl. of Polymer Science, Polymer Physics Edition 20, p2329-2356 1982.

Keywords: *Raman spectroscopy, *Polymers, *Acoustic waves, Crystals, Infrared spectroscopy, Reprints, *Laser spectroscopy.

All the improvements of the independent-rod model of longitudinal accordion-type acoustic mode (LAM) oscillations have assumed that the oscillation energy is retained either on the isolated macromolecule oscillating in a vacuum or in a narrow cylinder containing the straight sections of the macromolecules in the crystal lattice and their straight continuations through the amorphous layers. According to such concepts, concentration of the oscillation energy in gauche defects or amorphous layers occurs, respectively, whenever the axial elastic modulus of the straight sections (crystal lattice) is very much larger than that of the kinked sections (amorphous layers). The effect is enhanced by low crystallinity. Actually such behavior has never been observed. To agree with experimental data the model has to be modified in such a manner that the oscillation amplitude in the amorphous layer steadily decreases with increasing distance from the boundary between the two phases. The necessary large damping of the LAM oscillation in the kinked sections results from true damping in the viscoelastic amorphous component and energy transfer to adjacent chains which turns out to be just as easy as energy conduction along the kinked chain. Such a transfer is equivalent to radiation of the oscillation energy in all directions in the kinked phase. As a consequence of damping, the coupling of chains in adjacent crystals becomes so small that it may be completely neglected. Such a model explains in a satisfactory manner the observed accordion Laser-Raman spectra of the semicrystalline polymers and the infrared absorption of paraffins in the liquid state.

400,231

PB84-223999

Not available NTIS
National Bureau of Standards, Washington, DC.**Chemiluminescence of Fuels and Lubricants - A Critical Review.**

Final rept.,

D. B. Clark, and S. M. Hsu. Nov 83, 6p
Pub. in Lubrication Engineering, v39 n11 p690-695 Nov 83.

Keywords: *Chemiluminescence, *Fuels, *Lubricants, *Oxidation, Reviews, Chemical reactions, Reprints, Chemical reaction mechanisms.

Chemiluminescence (CL), light produced as a result of a chemical reaction, is a valuable but under-utilized tool for the study of fuel and lubricant oxidation. CL methods provide a practical means of studying the oxidation process under conditions similar to those experienced in service. The techniques are sensitive, rapid, non-intrusive, require only a small sample, and provide a continuous monitoring of the reaction. In spite of these advantages and a fair amount of CL research on simple hydrocarbons, the extension of that work to complex mixtures such as lubricants has been slow and rather limited. This review will describe the origin and mechanism of CL in hydrocarbon oxidation, present an overview of instrumentation for its measurement, and finally, discuss and critically evaluate the few studies available in the literature.

400,232

PB84-224070

Not available NTIS
National Bureau of Standards, Washington, DC.**Radial Distribution Function at Low Densities: Exact Results for Small and Large Separations for Smooth Potentials.**

Final rept.,

D. G. Friend. 1 Nov 83, 1p
Pub. in Jnl. of Chemical Physics, v79 n9 p4553, 1 Nov 83.

Keywords: Distribution functions, Numerical integration, Reprints, *Radial distribution functions.

Explicit expressions are obtained for the r approaches 0 and r approaches infinity limits of the first density coefficient of the radial distribution function. This double integral has also been evaluated numerically by Clenshaw-Curtis quadrature for Lennard-Jones and inverse power potentials. Our numerical results agree closely with previous work where overlap exists and confirm our analytic results in the r approaches 0 and r approaches infinity regions.

400,233

PB84-224120

Not available NTIS
National Bureau of Standards, Washington, DC.**Novel Excimer Fluorescence Method for Monitoring Polymerization. 1. Polymerization of Methyl Methacrylate.**

Final rept.,

F. W. Wang. May 84, 3p
Pub. in Polymer 25, p690-692 May 84.

Keywords: *Polymerization, *Fluorescence, *Polymethyl methacrylate, Molecular energy levels, Synthesis(Chemistry), Nondestructive testing, Pyrenes, Isotopic labeling, Reprints, *Excimers.

An excimer is formed by the association of an excited molecule with another molecule in its ground state. Such an excimer is characterized by a broad structureless fluorescence which is shifted to longer wavelengths compared to the fluorescence spectrum of the isolated molecule. Intramolecular excimer fluorescence has been observed in solutions of pyrene-labeled alkanes such as 1,3-bis-(1-pyrene) propane and 1,10-bis-(1-pyrene) decane.

400,234

PB84-224724

Not available NTIS
National Bureau of Standards, Washington, DC.**Measurement of the Electric-Field in the Vicinity of an Oil-Pressboard Interfaces Parallel to the Field.**

Final rept.,

R. E. Hebner, and E. F. Kelley. Dec 83, 4p
Sponsored in part by Department of Energy, Washington, DC. Div. of Electric Energy Systems.
Pub. in Proceedings of Conference on Interfacial Phenomena Practical Insulation System, Gaithersburg, MD., September 19-20, 1983, IEEE Conf. Rec. No. 83CH1946-3, p19-22 Dec 83.

Keywords: *Electric fields, *Insulating oil, *Kerr electrooptical effect, Electrodes, Pressboards.

Electro-optical Kerr-effect measurements are performed to measure the spatial variations of the electric field in transformer oil in a parallel plate electrode system with and without a pressboard interface bridging the gap between the electrodes. No space-charge field enhancements are observed at room temperature (25C) even with the interface present. At 125C space charge field enhancements are observed in transformer oil, but the field enhancement does not change upon the addition of an interface -- the field near the interface was the same as the field away from the interface to within + or - 5% precision of the experiment.

400,235

PB84-224732

Not available NTIS
National Bureau of Standards, Washington, DC.**Phase Transitions and Ferroelectric Polarization in a Vinylidene fluoride-Trifluoro-Ethylene Copolymer.**

Final rept.,

G. T. Davis. 1982, 6p
Pub. in Polymer Preprints, Japan, v31 n5 p937-942 1982.

Keywords: *Copolymers, *Phase transformation, *Ferroelectric materials, *Polarization(Charge separation), Piezoelectricity, Fluorine organic compounds, Reprints, *Vinylidene fluoride polymers, *Ethylene/trifluoro.

The ferroelectric to paraelectric phase transition in a copolymer of vinylidene-fluoride and trifluoroethylene (52/48 mole ratio) has been shown to be caused by a change in conformation of the polymer chain within the crystalline phase of the polymer. Polarization data from this copolymer are compared with predictions from a six-site model for ferroelectricity and the observed Curie point of 351.3 K is used to evaluate an energy parameter in the model.

400,236

PB84-224757

Not available NTIS
National Bureau of Standards, Washington, DC.**Preparation and Properties of Polymeric Solid Electrolyte: Polyethylene Oxide Sodium Iodide Complexes.**

Final rept.,

C. K. Chiang, G. T. Davis, C. A. Harding, and J. Aarons. 1983, 4p
Pub. in Solid State Ionics 9 and 10, p1121-1124 1983.

Keywords: *Polyoxyethylene, *Solid electrolytes, *Thermal properties, *Electrical properties, Polymers, Sodium iodides, Conductivity, Reprints, *Differential scanning calorimeters.

The thermal and electrical properties of mixtures of polyethylene oxide and sodium iodide were measured for concentrations of salt up to 25 mole%. A maximum in dc conductivity is observed at low concentrations of NaI, a region in which no crystalline complex is formed as determined from DSC measurements.

400,237

PB84-224765

Not available NTIS
National Bureau of Standards, Washington, DC.**Nature of Polymer Interfaces and Interphases.**

Final rept.,

I. C. Sanchez. Feb 84, 8p
Pub. in Polymer Engineering and Science, v24 n2 p79-86 Feb 84.

Keywords: *Polymers, *Interfacial tension, Surfaces, Liquids, Adsorption, Reprints.

An abbreviated review of the current state of knowledge of polymer interfacial phenomena is given. Classical thermodynamics treats the interfacial zone (the interphase) as a 'black box' and yields rigorous relationships among interfacial quantities. A recent reformulation of interphase thermodynamics, which eliminates the use of a Gibbs dividing surface, is shown to be an invaluable tool for investigating interfacial properties. Microscopic theories, such as the gradient theory, yield more details about what is in the black box, but the information is only approximate. The gradient theory has been used to: (1) relate the surface tension of a polymer liquid to its isothermal compressibility, (2) develop a quantitative theory of polymer liquid surface tension, and (3) determine the interfacial tension between two immiscible polymer liquids. The gradient theory will be shown to be in harmony with the microscopic theory of Helfand and co-workers although the latter treats polymer interfaces from a completely different point of view.

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400,238
PB84-224898 Not available NTIS
National Bureau of Standards, Washington, DC.
Influence of Increasing Nuclear Charge on the Rydberg Spectra of Xe, Cs (+) and Ba (+ +): Correlation, Term Dependence and Autoionization.
Final rept.,
W. T. Hill, III, K. T. Cheng, W. R. Johnson, T. B. Lucatorto, and T. J. McIlrath. 29 Nov 82, 5p
Contract W-31-109-ENG-38, Grant NSF-CPE79-18387
Pub. in Physical Review Letters, v49 n22 p1631-1635, 29 Nov 82.

Keywords: *Atomic energy levels, Xeon, Ions, Reprints, *Autoionization, *Rydberg series, Isoelectronic sequences, Barium ions, Cesium ions, Quantum defect.

The first experimental-theoretical study of Rydberg autoionizing resonances along an isoelectronic sequence is presented. This analysis demonstrates the intimate connection between electron-electron correlation, term dependence, and autoionization and underscores the power of multichannel quantum-defect theory in analyzing complex spectra.

400,239
PB84-224906 Not available NTIS
National Bureau of Standards, Washington, DC.
Far-Infrared Spectrum of the OH Radical.
Final rept.,
J. M. Brown, J. E. Shubert, K. M. Evenson, and H. E. Radford. 15 Jul 82, 5p
Pub. in Astrophysical Jnl. 258, p899-903, 15 Jul 82.

Keywords: *Infrared spectroscopy, *Astronomy, Reprints, *Hydroxyl radical, *Laser spectroscopy, Laser magnetic resonance spectroscopy.

The frequencies, wavelengths, and line strengths for transitions between the lowest spin-rotation levels of the OH molecule have been calculated from the recently reported laser magnetic resonance spectra.

400,240
PB84-224997 Not available NTIS
National Bureau of Standards, Washington, DC.
Dynamic Scattering from Biomodal Polymer Solutions. 1. Apparent Diffusion Coefficient.
Final rept.,
A. Z. Akcasu, B. Hammouda, T. P. Lodge, and C. C. Han. Jun 84, 8p
Pub. in Macromolecules, v17 n4 p759-766 Jun 84,

Keywords: *Polymers, *Diffusion coefficients, *Dynamics, Light scattering, Solutions, Molecular weights, Concentration(Composition), Reprints.

Dynamic scattering matrix $S(q,t)$ for scattering from multimodal systems is formulated and explicit results in the case of bimodal systems are presented in the small- q limit. The total dynamic scattering function is expressed, in this limit, as a weighted sum of two exponentials with decay rates γ_1 and γ_2 . Both the decay rates and the weighting factors are calculated in terms of the concentrations and molecular weights of the two components. The concentration dependence of the apparent diffusion coefficient and the collective diffusion coefficient in a single component system is expressed in terms of the pair correlation function for polymer molecules.

400,241
PB84-225234 Not available NTIS
National Bureau of Standards, Washington, DC.
Kinetics of the Manganese (III)-Sulfur (IV) Reaction in Aqueous Perchloric Acid Solutions.
Final rept.,
P. A. Siskos, N. C. Peterson, and R. E. Huie. 1984, 4p
Sponsored in part by Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
Pub. in Inorganic Chemistry, v23 n8 p1134-1137 1984.

Keywords: *Manganese, *Sulfur, *Reaction kinetics, Reprints, *Dithionate.

The reaction of Mn(III) with S(IV) has been studied in perchloric acid solutions. The stoichiometry of the reaction is one Mn(+3) consumed per SO₂ consumed and the production of dithionate was confirmed. The reaction shows a strong inverse dependence on acid concentration.

400,242
PB84-225259 Not available NTIS
National Bureau of Standards, Washington, DC.
Resonance Fluorescence and Raman Line Shapes Produced by Monochromatic Laser Fields: Effects of Branching Ratio and Homogeneous Broadening.
Final rept.,
F. H. Mies. 1983, 22p
Pub. in Jnl. of Quantitative Radiative Transfer, v29 n3 p237-258 1983.

Keywords: *Fluorescence, Excitation, Line spectra, Spectral lines, Reprints, *Laser spectroscopy, *Raman scattering, *Resonance fluorescence technique, *Resonance Raman spectra.

The Heitler-Ma damping theory is developed for a two level system in which the excited state is homogeneously, and irreversibly coupled to various continuum states with a total decay rate $1/\tau$. We give particular consideration to the channel consisting of a third, discrete, atomic level and a continuum of emitted photons, which simply corresponds to a spontaneous resonant Raman process. The theory applies to either a narrow, pulsed, laser beam, or injection of target atoms or molecules into a c.w. field.

400,243
PB84-225283 Not available NTIS
National Bureau of Standards, Washington, DC.
Polynomial Representation of the Decker Equations of State for NaCl and CsCl.
Final rept.,
S. D. Wood, and V. E. Bean. 1983, 2p
Pub. in High Temperature-High Pressure 15, p715-716 1983.

Keywords: *Sodium chloride, *Equations of state, High pressure tests, Calibrating, Pressure, Reprints, *Cesium chloride.

Polynomials expressing pressure as a function of temperature and lattice parameter have been developed thereby reducing the table of values representing the Decker equations of state for NaCl and CsCl to a form easily stored in a computer memory.

400,244
PB84-225325 Not available NTIS
National Bureau of Standards, Washington, DC.
Neutron Induced Atomic Excitation and Neutron Moderation.
Final rept.,
C. D. Bowman, and R. G. Johnson. 1983, 3p
Sponsored in part by European Physical Society, Geneva (Switzerland), Antwerp Univ., Wilrijk (Belgium), and International Union of Pure and Applied Physics, London (England).
Pub. in Proceedings of Conf. Nuclear Data Science Technology, Antwerp, Belgium, September 6-10, 1982, p971-973 1983.

Keywords: *Neutron scattering, *Atomic energy levels, Excitation, Neutron cross sections, Atoms.

The excitation of electrons in atoms due to neutron-nucleus scattering has been examined. The cross section for neutron scattering with an accompanying excitation of a particular electron has been derived. In addition, a procedure for estimating the probability of any electron excitation in neutron scattering has been formulated. Using these probability estimates the effect of electronic excitations in neutron moderation problems has been connected to a small fractional increase (of the order of .0001) in the average logarithmic energy decrement. In special cases this small increase may lead to effects of about 1%.

400,245
PB84-225341 Not available NTIS
National Bureau of Standards, Washington, DC.
History of Quantitative Electron Probe Microanalysis.
Final rept.,
K. F. J. Heinrich. Feb 84, 7p
Sponsored in part by Centre National d'Etudes Spatiales, Toulouse (France).
Pub. in Proceedings of Triennial Int. Cong. X-ray Opt. Microanalysis (IXCOM 10), Toulouse, France, September 5-9, 1983, Jnl. de Phys. Colloq. C2, n2 p3-8 Feb 84.

Keywords: *X ray analysis, *Microanalysis, *X ray fluorescence, *Chemical analysis, *Electron probes,

Monte Carlo methods, Standards, Performance evaluation, *Standard reference materials.

Quantitative microanalysis is based on empirical adjustment of simple models of electron-target interaction. The accuracy of analysis depends on measurements of X-ray emission from homogeneous well-characterized standard materials. As better standards and larger and faster computers become available, simplistic models can be replaced and the quality of adjustment improved. It is also possible to include some secondary processes such as excitation of X-rays by high-energy secondary electrons which were overlooked in the past.

400,246
PB84-225358 Not available NTIS
National Bureau of Standards, Washington, DC.
High Ionic Conduction in Polymers.
Final rept.,
G. T. Davis, and C. K. Chiang. 1983, 22p
Pub. in High Conducting Polymeric Materials, p1-22 1983.

Keywords: *Polymers, *Ion currents, Reviews, Transport properties, Electric batteries, Electrochemical cells, Membranes, Diffusion coefficient, Polypropylene, Reprints.

A review of ionic conductivity in polymers is presented with an emphasis on alkali metal salts in poly(ethylene oxide), PEO. Evidence for the formation of a specific crystalline complex between PEO and the salt is summarized as well as conductivity data as a function of temperature. It is concluded that ionic transport occurs primarily within the non-crystalline phase of the polymer-salt system rather than along specific pathways within the crystalline complex. The high-melting crystals that form provide rigidity to the system at temperatures where the non-crystalline phase and its dissolved ions become highly mobile. The concept of ionic transport in a non-crystalline phase has important implications regarding the development of improved polymeric conductors for solid state batteries, electrochemical sensors, separation membranes, and other applications.

400,247
PB84-225382 Not available NTIS
National Bureau of Standards, Washington, DC.
Parameter-Free Model of the Correlation-Polarization Potential for Electron-Molecule Collisions.
Final rept.,
N. T. Padiyal, and D. W. Norcross. Apr 84, 7p
Sponsored in part by Department of Energy, Washington, DC. Office of Basic Energy Sciences.
Pub. in Physical Review A 29, n4 p1742-1748 Apr 84.

Keywords: *Mathematical models, *Potential energy, *Polarizational(charge separation), Hydrogen, Nitrogen, Carbon dioxide, Hydrogen fluoride, Hydrogen chloride, Carbon monoxide, Reprints, *Electron molecule interactions.

A model potential that includes both correlation and polarization effects is proposed for electron-molecule collisions. It is based, as suggested by O'Connell and Lane, on a hybridization of local electron-gas theory for short distances and the asymptotic form of the polarization potential. It is energy independent and very simple to apply, depending only on the molecular charge density and polarizabilities. The potential has been calculated for several molecules (H₂, N₂, CO₂, HF, HCl, and CO); the crossing point between the correlation and polarization potentials is remarkably constant, averaging 0.96 eV. Application in scattering calculations for H₂ and N₂ yields very encouraging results.

400,248
PB84-225390 Not available NTIS
National Bureau of Standards, Washington, DC.
Resonant Multiphoton Ionization via Rydberg States - Angular Distributions of Photoelectrons.
Final rept.,
G. Leuchs, E. Matthias, D. S. Elliott, S. J. Smith, and P. Zoller. Oct 83, 3p
Grants NSF-PHY82-00805, NSF-INT81-20128
Pub. in Int. Conference Laser Spectroscopy (6th), Interlaken, Switzerland, June 27-July 1, 1983, p224-226 Oct 83.

Keywords: *Photoelectrons, *Angular distribution, Ionization, Reprints, *Laser spectroscopy, *Rydberg series.

The authors reported on the measurement of angular distributions of photoelectrons from aligned barium atoms in states of the 6s_{nd} Rydberg series for a range $19 < n <= 34$, encompassing a strongly perturbing state, 5d7d singlet D₂. Ionization was produced in a low density barium beam by pulsed 1.06 micrometers YAG-laser radiation, following resonant cascade excitation using two pulsed dye lasers. It was found that the total photoionization cross section is strongly enhanced by admixtures of the 5d7d singlet D₂ perturber state. Likewise, the angular distribution of the photoelectrons was shown to be a most sensitive method for determining the structure of the excited state from which ionization takes place. As an example A₆-coefficients were analyzed quantitatively and found to be consistent with singlet-triplet mixing ratios obtained by other methods.

400,249

PB84-225499 Not available NTIS
National Bureau of Standards, Washington, DC.
Benchmark Measurement of Iodobenzene Ion Fragmentation Rates,
R. Bombach, J. P. Stadelmann, J. Dannacher, H. M. Rosenstock, and R. Buff. 1983, 13p
Sponsored in part by Department of Energy, Washington, DC. Office of Environment.
Pub. in Chemical Physics 75, p23-35 1983.

Keywords: *Reaction kinetics, *Photoionization, Iodine organic compounds, Halogen organic compounds, Photochemical reactions, Ions, Photoelectrons, Reprints, *Benzene/iodo.

The unimolecular fragmentation rate of iodobenzene ion has been studied by variable residence time photoelectron-photoion coincidence techniques. The techniques employed variable wavelength with threshold photoelectron detection and fixed (58.4 nm) wavelength with variable energy photoelectron detection, respectively. Residence times of $1.0 +$ or $- 0.25$ or $5.9 +$ or $- 0.3$ and $21 +$ or $- 1$ or $57 +$ or $- 1$ microseconds were employed. The four sets of measurements were independently analyzed using exact counting of harmonic oscillator states, taking into account the appropriate (and different) apparatus functions and the thermal energy distributions of the parent ions. The resulting rate-energy dependences and fragmentation threshold values were in excellent agreement with one another. Some remaining uncertainties regarding the transition-state model are discussed.

400,250

PB84-225614 Not available NTIS
National Bureau of Standards, Washington, DC.
Spin Relaxation of Triplet Excitons in Molecular Crystals.
Final rept.,
N. F. Berk, J. Rosenthal, and L. Yarmus. 1 Nov 83, 7p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in Physical Review B 28, n9 p4963-4969, 1 Nov 83.

Keywords: *Crystals, *Molecular relaxation, *Excitons, *Spin lattice relaxation, Anthracene, Line spectra, Reprints.

The primary spin relaxation mechanism for triplet excitons in many molecular crystals arises from hopping transport between two orientationally inequivalent sites and is the source of both EPR linewidth and level equilibration. A generalized stochastic theory of resonance linewidth due to Blume that was previously applied to this mechanism and shown in its random phase approximation (RPA) to yield the linewidth spectrum is extended to give a complete formulation of both linewidth and equilibration rate. The method employs the averaged time development superoperator of Blume's theory in the RPA in order to construct an equation of motion for the appropriately averaged spin density matrix from which these two can be extracted. The authors show associations between this work and related studies by Kubo and Suna. Comparison is made between rates calculated for anthracene and values of $T(1)$ deduced by Haarer and Wolf from a Bloch analysis of their EPR saturation measurements.

400,251

PB84-225689 Not available NTIS
National Bureau of Standards, Washington, DC.
Orthobaric Liquid Densities and Dielectric Constants of (Methane + 2-Methylpropane) and (Methane + n-Butane) at Low Temperatures.
Final rept.,
W. M. Haynes. 1983, 9p
Pub. in Jnl. of Chemical Thermodynamics 15, p903-911 1983.

Keywords: *Density(Mass/volume), *Dielectric properties, *Methane, *Butane, *Binary system(Materials), Mixtures, Vapor pressure, Liquids, Liquefied natural gas, Mathematical models, Thermodynamics, Reprints, Propane/methyl, Numerical solution, Clausius-Mossotti function.

Measurements of the orthobaric liquid densities and dielectric constants of methane-rich binary mixtures of methane + isobutane and methane + normal butane have been obtained at temperatures between 110 and 140 K. Densities were determined with a magnetic suspension densimeter, while a concentric cylinder capacitor was used for simultaneous measurements of dielectric constant. These measurements were part of an experimental program that has provided a consistent and comprehensive set of density data for the major components of liquefied natural gas (LNG) and their mixtures, which was used to develop mathematical models for the calculation or prediction of LNG densities. Along with the methane-butane experimental densities are presented experimental vapor pressures, as well as excess volumes, Clausius-Mossotti functions, and excess Clausius-Mossotti functions derived from the density and dielectric constant data. Comparisons are shown between the excess volumes of the present work and those from independent measurements using an extended corresponding state model that had been optimized to the data from this work.

400,252

PB84-225697 Not available NTIS
National Bureau of Standards, Washington, DC.
Measurements of Densities and Dielectric Constants of Liquid Isobutane from 120 to 300 K at Pressures to 35 MPa.
Final rept.,
W. M. Haynes. 1983, 3p
Pub. in Jnl. of Chemical and Engineering Data, v28 n4 p367-369 1983.

Keywords: *Butanes, *Density(Mass/volume), *Dielectric properties, Pressures, Reprints, *Compressed liquid, Clausius-Mossotti function.

Measurements of the densities and dielectric constants of compressed liquid isobutane have been carried out at temperatures between 120 and 300 K to pressures of 35 MPa. These experimental data along with computed values for the Clausius-Mossotti function (CM) are reported in this paper.

400,253

PB84-226109 Not available NTIS
National Bureau of Standards, Washington, DC.
Regime III Crystallization in Polypropylene.
Final rept.,
E. J. Clark, and J. D. Hoffman. Apr 84, 8p
Pub. in Macromolecules, v17 n4 p878-885 Apr 84.

Keywords: *Polypropylene, *Crystallization, *Spherulites, Growth, Temperature, Reprints, *Regime III, Polymer chains.

The recently developed theory for Regime III crystallization from the melt is applied to isotactic polypropylene (i-PP) spherulite growth rate data. As the temperature decreases, a marked upward change in the slope of the published growth rate versus temperature curves is observed which is interpreted as a Regime II yields III transition. (A Regime I yields II transition would have exhibited a downward change in slope with decreasing temperature.) Growth rate data on syndiotactic polypropylene are discussed briefly. The significance of Regime III crystallization is discussed in a general way.

400,254

PB84-226125 Not available NTIS
National Bureau of Standards, Washington, DC.
Corresponding States in Polymer Mixtures.
Final rept.,
I. C. Sanchez. Apr 84, 2p
Pub. in Macromolecules 17, p967-968 Apr 84.

Keywords: *Polymers, *Binary systems(Materials), Mixtures, Molecular weight, Blends, Phase diagrams, Critical point, Reprints, Spinodal decomposition, Flory-Huggins theory.

It is shown that the Flory-Huggins theory of polymer solutions implies that all binary polymer mixtures satisfy a corresponding states principle near the critical point. By choosing the appropriate composition and temperature variables, coexistence and spinodal curves of binary mixtures that vary in molecular weight can be superimposed. This procedure should be very useful in correlating and predicting phase diagrams of oligomeric mixtures and polymer blends.

400,255

PB84-226141 Not available NTIS
National Bureau of Standards, Washington, DC.
New Values for Some 4HeI 1s_{nl} Energy Levels, Ionization Energies, and Lamb Shifts.
Final rept.,
W. C. Martin. Apr 84, 6p
Pub. in Physical Review A 29, n4 p1883-1888 Apr 84.

Keywords: *Atomic energy levels, *Helium, *Ionization potentials, Atomic theory, Atomic spectra, Lamb shift, Field theory.

Recent experimental determinations of energy separations within the 1s_{nl} term system ($n=2-6$) have been used to reevaluate 35 levels. Most of the levels have estimated errors less than 0.001/cm relative to the 2 triplet P levels. Addition of accurate theoretical term values (ionization energies) available for several 1s_{nl} levels to the corresponding experimental level values gives generally consistent values for the principal ionization energy $E(I)$. The theoretical energies are further confirmed by the agreement of the weighted average of seven of these $E(I)$ values with a value obtained by fitting Ritz formulas to three accurately determined 1s_{nl} series; the suggested new $E(I)$ is 198310.7745(40)/cm on an energy scale fixed by the value 171135.0000/cm for 2 singlet P. Lamb shifts are derived for the 2,3,4 triplet S sup 1, 2 singlet S sup 0, 2 triplet P sup 1, and 2 singlet P sup 1 levels as differences between experimental term values obtained with the new $E(I)$ and corresponding calculated term values not including Lamb shifts.

400,256

PB84-226158 Not available NTIS
National Bureau of Standards, Washington, DC.
Monte Carlo Calculations of the Hydrodynamic Radii of Polymers in Theta and Good Solvents.
Final rept.,
F. L. McCrackin, C. M. Guttman, and A. Z. Akcasu. Apr 84, 7p
Pub. in Macromolecules, v17 n4 p604-610 Apr 84.

Keywords: *Polymers, *Monte Carlo method, *Solvents, *Hydrodynamics, Temperature, Diffusion coefficient, Reprints, *Polymer chains, Numerical solution.

The inverse radius of a polymer chain at infinite dilution on cubic and face centered lattices is computed. The chains are created by a Monte Carlo simulation in which both volume exclusion and the energetics of nearest neighbor interactions are taken into account. Values of $\langle 1/R \rangle$ are calculated for various values of the energy parameter, ϵ/kT . The $\langle 1/R \rangle$ so computed are compared to those obtained from the Blob Model and the fit is found to be semi-quantitative. The values of the hydrodynamic radius, $R(H)$, computed from these values of $\langle 1/R \rangle$ are found to be in reasonable agreement with the temperature versus diffusion coefficient data obtained by Prichard and Caroline.

400,257
PB84-226166 Not available NTIS
 National Bureau of Standards, Washington, DC.
Forbidden Far Infrared nu6 Band of SF6.
 Final rept.,
 C. Chapados, and G. Birnbaum. 1984, 9p
 Sponsored in part by Natural Sciences and Engineering
 Research Council of Canada, Ottawa (Ontario).
 Pub. in Jnl. of Molecular Spectroscopy 105, p206-214
 1984.

Keywords: *Sulfur hexafluoride, Infrared spectroscopy,
 Vapor phases, Liquid phases, Fermi surfaces, Coriolis
 effects, Reprints, *Far infrared spectroscopy.

The authors have studied by far infrared spectroscopy
 the 300/cm region of SF6 in the gas phase at different
 pressures and in the liquid state. They have observed
 in the gas phase a small band situated at 351/cm with
 a PQR structure on the high frequency side of two dif-
 ference bands situated at 304.5/cm. Since the inte-
 grated intensity of the 351/cm band varies linearly with
 the density, it cannot be collision induced and they
 assume that it is the forbidden nu6 band that becomes
 active by Coriolis interactions. This band is seen in the
 liquid at about the same frequency, although there are
 some complications because the difference bands
 split into two components by Fermi resonance.

400,258
PB84-226190 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Alloy Chemical Comparison of the Refractory
 Metal-Noble Metal Phase Diagrams T5-T10 (T5
 equals V, Nb, Ta; T10 equals Pd, Pt).**
 Final rept.,
 R. M. Waterstrat, and B. C. Giessen. 1983, 6p
 Sponsored in part by American Dental Association
 Health Foundation, Chicago, IL.
 Pub. in Proceedings of Materials Research Society
 Symposium, Boston, MA., November 2-3, 1982, p423-
 428 1983.

Keywords: *Phase diagrams, *Refractory metal alloys,
 *Precious metals, Molecular structure, Comparison,
 Chemical properties, Intermetallics, Palladium alloys,
 Platinum alloys.

The six T5-T10 metal alloy phase diagrams containing
 Pd or Pt have now all been established. The alloy
 phases occurring in these systems are tabulated and
 reviewed here with respect to their structures.

400,259
PB84-226216 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Improved Rovibrational Constants and Frequency
 Tables for the Normal Laser Bands of 12C 16O2.**
 Final rept.,
 F. R. Petersen, E. C. Beaty, and C. R. Pollock. 1983,
 11p
 Pub. in Jnl. of Molecular Spectroscopy 102, p112-122
 1983.

Keywords: *Infrared spectroscopy, *Carbon dioxide,
 *Line spectra, Doppler effect, Molecular vibration, Mo-
 lecular rotation, Tables(Data), Isotopic labeling, Re-
 prints, *Laser spectroscopy, Carbon 13, Oxygen 18.

New frequency difference measurements between
 Doppler-free stabilized laser lines in the 9.4 and 10.4
 micrometers bands of 12C16O2, including high-J and
 across-the-band center measurements, have made
 significant improvements in the rovibrational con-
 stants. The absolute frequencies were referred to the
 methane stabilized 3.39 micrometers He-Ne laser.
 Frequency tables generated from these constants
 having absolute uncertainties of less than two parts in
 10 to the 10th power are about a factor of ten better
 than older tables. The laser lines P(15) in 13C16O2
 and R(126) in 12C18O2, which were used as reference
 lines in recent visible laser frequency measurements,
 were also measured to about the same accuracy.

400,260
PB84-226265 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Molecule-Surface Interactions and Dynamics
 (Summary Abstract).**
 Final rept.,
 R. R. Cavanagh, and D. S. King. 1984, 2p
 Pub. in Jnl. of Vacuum Science and Technology A2, n2
 p1036-1037 Apr-Jun 1984.

Keywords: *Nitrogen oxide(NO), *Surface chemistry,
 *Desorption, Thermodynamics, Reaction kinetics, Dy-

namics, Reprints, *Laser induced fluorescence, Mole-
 cule molecule interactions.

The desorption of atomic and molecular species repre-
 sent one of the simplest chemical processes at sur-
 faces. While the thermodynamics and kinetics of vari-
 ous desorption mechanisms have been widely studied,
 there are few experiments in the literature which di-
 rectly address the dynamics of such events. In this
 paper, detailed studies of the thermally induced des-
 orption of NO from various surfaces are reported.
 Laser excited fluorescence is used as a state specific
 diagnostic of both the rotational population, the angu-
 lar flux distribution, and the velocity distribution of the
 desorbed NO. Observed correlations between angular
 flux and molecular speeds are considered as a func-
 tion of the rotational state of the desorbed molecule.

400,261
PB84-226281 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Effect of Spatial Averaging on the Compositional
 Analysis of Crystals by Absorption Spectroscopy.**
 Final rept.,
 R. A. Forman, M. I. Bell, S. Mayo, and A. H. Kahn.
 15 Jan 84, 8p
 Pub. in Jnl. of Applied Physics 55, n2 p547-554, 15 Jan
 84.

Keywords: *Chemical analysis, *Crystals, *Absorption
 spectra, *Mathematical models, Semiconductors, Sur-
 faces, X ray analysis, Crystal growth, Spatial distribu-
 tion, Reprints, Gallium arsenide.

Calculations of optical absorption based on a model of
 a single crystal containing spatially periodic composi-
 tional variations are presented. These variations can
 contribute a significant source of systematic error in
 the analysis of composition by optical or surface tech-
 niques. The model is most appropriate for melt-grown
 crystals and in particular for striated semiconductor
 crystals, and the surface concentration profile which it
 predicts is confirmed by comparison with a published
 x-ray topographic study of silicon. Implications of the
 results for optical absorption studies of impurities in sil-
 icon crystals are discussed, and it is shown that signifi-
 cant measurement errors may occur.

400,262
PB84-226356 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Crystal Structures of the Synthetic Zeolites (Cs,
 K)-ZK5 and (Cs, D)-ZK5 Determined from Neutron
 Powder Diffraction Data.**
 Final rept.,
 J. B. Parise, E. Prince, and D. Cox. 1983, 16p
 Pub. in Zeitschrift fuer Kristallographie 165, p175-190
 1983.

Keywords: *Crystal structure, *Ion exchange resins,
 *Neutron diffraction, *Aluminum silicates, Reprints.

The structure of a dehydrated ZK5 zeolite with the cal-
 culated composition Cs9.7K13.0Si73.2Al22.8O192
 was refined using data collected on a high resolution
 neutron powder diffractometer at 294 K
 (a = 18.671(1)Å) and at 493 K (a = 18.660(1)Å) using a
 combination of Rietveld and Fourier techniques. There
 are significant distortions of pore openings upon ex-
 traction of the cations. The flat 8-ring is distorted ellip-
 tically. Both the ion-exchange properties of ZK5 and the
 positions of Cs and K can be explained in terms of the
 refined structure. The Cs preference for the flat 8-ring
 site sets an upper limit of 12 atoms/unit cell to its ex-
 change into ZK5. The proximity of the flat and puck-
 ered 8-ring sites (5.8Å) causes the Cs atom either to
 move towards the alpha cage if K is present or to relax
 toward the gamma cage if K is extracted.

400,263
PB84-226406 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Surface Thermodynamics of Liquid Polymers:
 Theory.**
 Final rept.,
 I. C. Sanchez, and C. I. Poser. 1983, 10p
 Pub. in Proc. ACS Int. Symp. Physico-Chemical As-
 pects Polymer Services, New York, August 24, 1981,
 Paper in Physico-Chemical Aspects of Polymer Sur-
 faces, p173-182 1983.

Keywords: *Surface chemistry, *Polymers, *Thermo-
 dynamic properties, *Density(Mass/volume), Temper-
 ature, Molecular weight, Equations of state, Interfacial
 tension.

A generalized density gradient theory of interfaces has
 been combined with a compressible lattice theory of

polymers. This yields a unified theory of bulk and sur-
 face thermodynamic properties. A unique feature of
 this theory is that it is parameterless. The only param-
 eters required to calculate a surface tension are ob-
 tained from pure component thermodynamic proper-
 ties. Since the theory is a mean field theory, it is only
 applicable to non-polar and slightly polar liquids. For
 such systems, surface tensions can be accurately cal-
 culated. The temperature and molecular weight de-
 pendence of liquid density on chain length. Polymer
 liquid surface tensions satisfy a corresponding states
 principle and can be estimated for many polymers with
 an error of less than 10%. This method of estimating
 polymer surface tensions appears to be the most ac-
 curate that is available.

400,264
PB84-226414 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Switch Function Applied to the Thermodynamic
 Properties of Steam Near and Not Near the Critical
 Point.**
 Final rept.,
 H. W. Woolley. 1983, 45p
 Pub. in Int. J. Thermophys. 4, n1 p51-95 1983.

Keywords: *Critical point, *Thermodynamic properties,
 *Steam, *Boolean functions, Reprints, *Helmholtz
 free energy.

A study is presented of the still-unsolved problem of
 estimating thermodynamic property values in a region
 intermediate between the critical region in which the
 scaling laws apply, and regions further from critical
 where classical behavior prevails. A procedure has
 been developed in which a varying weighting function
 is used in obtaining a weighted 'average' of the scaled
 and the classical Helmholtz free energy. Other prop-
 erties are then obtained by differentiation. It is first
 demonstrated that it is fundamentally impossible for the
 'averaged' Helmholtz free energy and its first two
 derivatives to all be intermediate between the corre-
 sponding values from the scaled and the classical for-
 mulations. The procedure has been developed and
 tested for steam. The scaled function is the simple
 linear model of Murphy et al., the classical equation
 that of Pollak.

400,265
PB84-226455 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Fluid Property Research at the National Bureau of
 Standards, Boulder.**
 Final rept.,
 H. J. M. Hanley. 1983, 8p
 Pub. in Proc. Int. Gas Res. Conf., London, England,
 June 13-16, 1983 8p.

Keywords: *Research projects, *Fluids, *Fuels, *Ther-
 mophysical properties, Liquefied natural gas, Mixtures,
 Butanes, Transport properties, Standards, Hydrogen
 sulfide, Carbon monoxide, Numerical solution.

The goals and philosophy of the Fluid Properties
 Group, NBS-Boulder, are discussed and the experi-
 mental facilities are reviewed. The group attempts to
 merge experiment, basic theory of fluids, and data cor-
 relation so that all facets complement and support
 each other to give an integrated program. Specific sys-
 tems selected for our studies are simple enough for
 unambiguous theoretical and experimental analysis
 but represent a class of systems of general interest.
 For example, the author report on PVT measurements
 of H2S and on CO, which are typical of polar and re-
 active components in synfuels; viscosity data for C1/C2
 mixtures are given to represent the transport behavior
 of fluids of interest to the gas industry. We mention
 fundamental studies of mixtures via computer simu-
 lation which raise very basic theoretical questions yet,
 with corresponding states, contribute to a practical
 prediction procedure to calculate thermophysical mix-
 ture properties. Three important correlations for pro-
 pane, n- and i-butane are also mentioned.

400,266

PB84-226463 Not available NTIS
National Bureau of Standards, Washington, DC.
Dynamic Light Scattering of Polymer Solutions in the Intermediate Momentum Transfer Region.
Final rept.,
C. C. Han, and A. Z. Akcasu. Mar 81, 2p
Pub. in ACS Polym. Prepr. 22, n1 p68-69 Mar 81.

Keywords: *Polystyrene, *Light scattering, *Hydrodynamics, Solutions, Momentum transfer, Polymers, Mathematical models, Reprints.

Polystyrene solutions in the dilute region have been studied by dynamic light scattering experiments. The first cumulant, $\omega(q)$, has been extracted consistently by either the cumulant analysis or the shape function analysis. It is found that $\omega(q)$ approaches q^2 dependence as $qR_g \ll 1$ and q dependence as $qR_g \gg 1$ with a broad transition region. It is also found that the asymptotic values at q region changes from theta-solvent to good solvent condition. In both cases, experimental results agree better with theoretical calculations with preaveraged Oseen tensor. This may be that the preaveraged Oseen tensor is a better physical model for the hydrodynamic interaction.

400,267

PB84-226802 Not available NTIS
National Bureau of Standards, Washington, DC.
Dynamic Light Scattering Measurements of Polystyrene in Semidilute Theta Solutions.
Final rept.,
E. J. Amis, C. C. Han, and Y. Matsushita. May 84, 9p
Pub. in Polymer 25, p650-658 May 84.

Keywords: *Polystyrene, *Light scattering, *Dynamics, *Diffusion coefficients, Solutions, Molecular weight, Concentration(Composition), Scale effect, Reprints, Numerical solution.

Measurements of the co-operative diffusion coefficient, D_c , and a center of mass translational diffusion coefficient, D_s , have been made by dynamic light scattering for the polystyrene-cyclohexane theta system as a function of molecular weight and concentration. A discussion of the assumptions and potential shortcomings of the blob model which is used in the derivation of the power law predictions and the dynamic scattering equations is included. In addition, monomeric friction coefficients have been obtained from the D_s results within the framework of Doi-Edwards model. A comparison is made of the concentration dependence of the monomeric friction coefficient from the present data to that from similar experiments on a good solvent (tetrahydrofuran) system and from shear relaxation modulus measurements on the polystyrene in Aroclor 1248.

400,268

PB84-226828 Not available NTIS
National Bureau of Standards, Washington, DC.
Pressure Dependent Linewidth and Line Shift Measurements in the Vibrational Q-Branch of N₂ from 4 to 200 kPa.
Final rept.,
G. J. Rosasco, W. Lempert, W. S. Hurst, and A. Fein. Jul 82, 15p
Pub. in Proceedings of the International Conference on Spectral Line Shapes, Boulder, Colorado, July 1982, Paper in Spectral Line Shapes 2, p635-649 1983.

Keywords: *Nitrogen, *Raman spectroscopy, Perturbation theory, Mathematical models, Temperature, Pressure, Line spectra, Line width.

The non-linear optical technique of CW-inverse Raman spectroscopy has been applied to measure the effects of pressure (in the range 4-200 kPa) on the Q-branch spectrum of pure N₂ gas at room temperature. The measurement approach provides a response linear in the third order susceptibility and a resolution of at least 20 MHz and frequency accuracy of 30 MHz. A number of simple models are tested quantitatively against the data; in particular, a first order in pressure perturbation theory is found to give a very useful description of the spectra. Use of such models is found to be required to extract accurate temperature measurements from such spectra.

400,269

PB84-226844 Not available NTIS
National Bureau of Standards, Washington, DC.
Chain Scission and Mechanical Failure of Polyethylene.
Final rept.,
P. Fordyce, K. L. DeVries, and B. M. Fanconi. Apr 84, 6p
Pub. in Polymer Engineering and Science 24, n6 p422-427 Apr 84.

Keywords: *Infrared spectroscopy, *Electron paramagnetic resonance, *Viscometry, *Polyethylene, Sampling, Free radicals, Concentration(Composition), Molecular weight, Mechanical properties, Cryogenics, Reprints, *Polymer chains.

The extent of molecular degradation of amorphous polystyrene when subjected to mechanical grinding at cryogenic temperature has been investigated using electron spin resonance, infrared spectroscopy, and viscometry. Essentially identical concentrations of chain ruptures in the degraded samples were found from infrared spectroscopic determinations of molecular end group concentrations and by the changes in the viscosity-average molecular weights. The chain-scission concentration was from two to four times the free-radical concentrations, indicating that free-radical-propagation reactions play a much less dominant role in the degree of molecular damage associated with mechanically induced chain scission in glassy polymers. In addition, experiments were carried out as a function of molecular weight and these indicated a virtual independent behavior with molecular weight.

400,270

PB84-227024 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermogravimetry Applied to Polymer Degradation Kinetics.
Final rept.,
B. Dickens, and J. H. Flynn. 1983, 23p
Pub. in ACS (American Chemical Society) Advances in Chemical Series 203, p210-232 1983.

Keywords: *Polymers, *Degradation, *Oxidation, *Reaction kinetics, *Thermogravimetry, Activation energy, Isotherms, Factor analysis, Reprints.

The kinetics of polymer degradations (and oxidations) may be represented in the simple general form $d(\alpha)/dt = f(\alpha)Ae^{-E/RT}$, where α is the extent of reaction, and A and E are Arrhenius parameters. The various attempts to represent $f(\alpha)$ in a simple way are discussed, with the conclusion that none is satisfactory for polymer degradation studies. Therefore, four methods of thermogravimetry have been devised and implemented which avoid any need to model $f(\alpha)$. These methods give values for the activation energy, E , and through it shed some light on the dominant contributors to the kinetic form. The methods are (1) factor-jump thermogravimetry, a series of isotherms requiring only a single sample, (2) isoconversional diagnostic plots, a variable heating rate method applied to a series of samples, (3) analysis of initial stage of reaction, a variable heating rate method requiring only one sample, and (4) variable heating rate analysis, applied to several samples to examine any change in component reactions in $f(\alpha)$.

400,271

PB84-227107 Not available NTIS
National Bureau of Standards, Washington, DC.
Constant Photoelectron Energy Spectroscopy of Acetylene.
Final rept.,
D. M. P. Holland, J. B. West, A. C. Parr, D. L. Ederer, and R. Stockbauer. 1 Jan 83, 7p
Sponsored in part by Department of Energy, Washington, DC., Office of Naval Research, Arlington, VA., and National Aeronautics and Space Administration, Washington, DC.
Pub. in Jnl. of Chemical Physics, v78 n1 p124-130, 1 Jan 83.

Keywords: *Acetylene, Photoelectrons, Ionization, Electron energy, Reprints, *Autoionization.

Constant photoelectron energy spectra of acetylene are reported for low electron energies. The details of the techniques, and its ability in probing autoionization structure are discussed. The experiment was performed using radiation emitted from SURF II, the National Bureau of Standards storage ring. Photoelectrons carrying a particular kinetic energy were detected

while the energy of the monochromated light was scanned.

400,272

PB84-227178 Not available NTIS
National Bureau of Standards, Washington, DC.
Free Radicals and New End Groups Resulting from Chain Scission: 2. Mechanical Degradation of Polyethylene.
Final rept.,
B. M. Fanconi, K. L. DeVries, and R. H. Smith. Jul 82, 8p
See also PB81-248593.
Pub. in Polymer 23, p1027-1034 Jul 82.

Keywords: *Degradation, *Polyethylene, *Infrared spectroscopy, Chemical bonds, Mechanical properties, Viscosity, Electron spin resonance, Reprints, *Free radicals, *Polymer chains, *Molecular conformation.

The number of chain scissions accompanying mechanical degradation of polyethylene has been estimated from IR analysis of new end groups concentrations. Polyethylene specimens fractured in tensile deformation and ground under liquid nitrogen were examined. The results are compared to the number of free radicals generated during mechanical degradation and measured by ESR. In comparisons with previous results in the literature we find our results to be lower by one-to-two orders of magnitude and in better agreement with estimates of the number of chain scissions from viscosity measurements. A ultra high molecular weight polyethylene was examined as a control specimen containing few end groups. The changes in the number of vinyl groups resulting from grinding of this specimen was estimated to be at least an order of magnitude lower than that found for lower molecular weight polyethylenes. This finding suggests that large errors may be introduced into the determination of concentrations of end groups through subtraction of relatively intense absorption bands.

400,273

PB84-227206 Not available NTIS
National Bureau of Standards, Washington, DC.
Sum Frequency Generation of Narrowband cw 194 Radiation in Potassium Pentaborate.
Final rept.,
H. Hemmati, J. C. Bergquist, and W. M. Itano. 1983, 2p
Pub. in Proceedings of Int. Laser Spectroscopy Conf. (6th), Interlaken, Switzerland, June 27-July 1, 1983, Laser Spectroscopy 6, p414-415.

Keywords: *Absorption spectra, *Ultraviolet spectroscopy, Doppler effect, Potassium inorganic compounds, Line width, Reprints, *Laser spectroscopy, *Potassium pentaborate.

Several microwatts of tunable cw radiation near 194 nm in a linewidth of less than 2 MHz have been generated by sum frequency mixing the radiation from a frequency doubled argon-ion laser with the radiation from a ring dye laser in a crystal of potassium pentaborate. An external ring cavity resonant with the dye laser give an enhancement factor of about 14 in the sum frequency-generated radiation power. The Doppler limited absorption spectrum of the first resonance line of natural Hg II has been resolved, and the vacuum wave number for the mass-202 isotope has been measured to be 51485.904(20)/cm. About 0.5 milliwatts 243 nm radiation has been generated with minor variations to the 194 apparatus.

400,274

PB84-227214 Not available NTIS
National Bureau of Standards, Washington, DC.
Fluorescence of the Na*-N₂ Collision Complex.
Final rept.,
W. Kamke, B. Kamke, I. Hertel, and A. Gallagher. 15 Apr 84, 11p
Grant NSF-PHY79-04928
Pub. Jnl. of Chemical Physics 80, n10 p4879-4889 Apr 84.

Keywords: *Fluorescence, *Nitrogen, *Visible spectroscopy, *Energy transfer, Atoms, Reprints, *Atom molecule interactions, *Sodium atoms.

The fluorescence spectrum of Na(3p) atoms in N₂ gas has been measured in the far wings of the Na resonance lines, from 550-790 nm. The authors observe a broad continuum from 630-790 nm that is independent of N₂ pressure and gas temperature, and which

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agrees with that calculated from the theoretical NaN₂ potentials of Habitz if one includes only free collision states of the Na⁺N₂ molecule. They conclude that this continuum is due to an attractive Na(3p)-N₂ interaction, but that bound states in this potential well predissociate to Na(3s) and vibrationally excited N₂ in much less than the Na⁺ radiative lifetimes of about 16 ns. The intensity on the blue wing of the Na resonance lines decreases rapidly with decreasing wavelength, and shows temperature dependence corresponding to a repulsive Na(3p)-N₂ interaction. Good agreement is obtained with a blue-wing spectrum calculated from the X and B states of Habitz.

400,275

PB84-227230 Not available NTIS
National Bureau of Standards, Washington, DC.

Theory of Ionization and Excitation Yields.

Final rept.,

L. V. Spencer. 1984, 29p

Sponsored in part by Office of Naval Research, Arlington, VA.

Pub. in Radiation Research 97, p219-236 1984.

Keywords: *Ionization, *Excitation, *Hydrogen, Electron energy, Reprints, Numerical solution, Fowler equation.

The Fowler equation for excitation and ionization yields due to fast electrons in H₂ is written down; and an approximation is developed which is expected to be accurate except for source electron energies below perhaps 200 eV. A general form for the solution is developed which is numerically evaluated. Results for the ionization yields, and also for the yield of all electronic excitations, agree within about 2% with more precise calculations except below about 300 eV. Extensions to more complex media, and to other fast particles are discussed.

400,276

PB84-227271 Not available NTIS
National Bureau of Standards, Washington, DC.

Factor-Jump Thermogravimetry as Applied to the Study of Polymer Degradation.

Final rept.,

B. Dickens. 1983, 46p

Pub. in Degradation and Stabilization of Polymers 1, Chapter 11, p554-599 1983.

Keywords: *Thermogravimetry, *Polymers, *Degradation, Polystyrene, Polypropylene, Evaporation, Activation energy, Reaction kinetics, Plastics, Temperature, Reprints.

Methods of thermogravimetry are reviewed briefly and the rationale for the factor-jump method given. The automated apparatus and experiment-driving computer program are described. Results are given for investigation on polystyrene and polypropylene. The effect of the evaporation of preformed molecules is treated, as are the conditions involved in temperature-extrapolation of rates of chemical degradation.

400,277

PB84-227289 Not available NTIS
National Bureau of Standards, Washington, DC.

Solubilities of Two n-Alkanes in Various Solvents.

Final rept.,

S. S. Chang, J. R. Maurey, and W. J. Pummer. 1983,

3p

Pub. in Jnl. of Chemical and Engineering Data 28,

p187-189 1983.

Keywords: *Solvents, *Alkanes, *Solubility, *Heat measurement, Temperature, Heat of fuse, Phase transformation, Equilibrium, Reprints, *Octadecane, *Dotriacontane, *Differential scanning calorimetry, Phase equilibrium, Tracer studies.

Solubilities and phase equilibria of n-octadecane and n-dotriacontane have been determined in the following solvents; n-heptane, ethanol, ethanol/water mixtures, tributyrin, trioctanoil, and mixed triglycerides. In addition, temperatures and heats of fusion and transition of the two n-alkanes were measured by differential scanning calorimetry, in order to estimate the ideal solubility as a function of temperature.

400,278

PB84-227339 Not available NTIS
National Bureau of Standards, Washington, DC.

Methanation Reaction.

Final rept.,

R. D. Kelley, and D. W. Goodman. 1982, 27p

Sponsored in part by Department of Energy, Washington, DC.

Pub. in Chemical Physics of Solid Surfaces and Heterogeneous Catalysis 4, Chapter 10, p427-454 1982.

Keywords: *Catalysts, *Surface chemistry, *Reaction kinetics, *Methane, Chemical reactions, Nickel, Ruthenium, Comparison, Catalysis, Crystals, Fuels, Reprints, *Methanation, *Chemical reaction mechanisms.

This chapter presents a review of recent studies on the kinetics and mechanism of the methanation reaction catalyzed by single crystal nickel and ruthenium. These studies, utilizing surface science techniques, are compared with traditional studies of high surface area catalysts.

400,279

PB84-227354 Not available NTIS
National Bureau of Standards, Washington, DC.

Diamond (111) Surface: A Dilemma Resolved.

Final rept.,

B. B. Pate, B. J. Wacławski, P. M. Stefan, C. Binns,

and T. Ohta. 1983, 3p

Sponsored in part by Army Research Office, Arlington,

VA.

Pub. in Physica 117B-118B, p783-785 1983.

Keywords: *Diamond, *Surface chemistry, Semiconductors, Deuterium, Atoms, Photoelectric emission, Exposure, Reprints, *Low energy electron loss spectroscopy, Photon stimulated desorption, Hydrogen atoms.

A dilemma due to the experimental observation of a "clean" unreconstructed elemental semiconductor surface without band gap states is resolved. Results from photon stimulated ion desorption, high resolution low energy electron loss spectroscopy and photo-emission spectroscopy find that the conventionally polished (in olive oil) diamond (111) 1 x 1 surface is atomically terminated and electronically stabilized by hydrogen. Thermal desorption of hydrogen upon heating (about 1000C) results in a reconstructed 2 x 2/2 x 1 surface with filled electronic surface states in and near the fundamental gap. Exposure of the reconstructed surface to atomic hydrogen (or deuterium) is found to again terminate the surface and remove the near band gap surface states. Apparent inconsistencies (with respect to the experimental literature) in the understanding of the diamond:hydrogen interaction are resolved in terms of our work.

400,280

PB84-227362 Not available NTIS
National Bureau of Standards, Washington, DC.

Absolute-Frequency Measurements of the 520 THz Hyperfine Components of Iodine and the 260 THz Emission of Neon.

Final rept.,

C. R. Pollock, D. A. Jennings, F. R. Petersen, J. S.

Wells, and R. E. Drullinger. 1982, 2p

Pub. in Proceedings of CPEM Digest, Conf. Precision Electro-Magnetic Measurement, 1982, Boulder, CO., Jun 28-Jul 1, 1982, pl-9-I-10.

Keywords: *Hyperfine structure, *Iodine, *Neon, *Frequency measurement, Carbon dioxide lasers, Helium neon lasers, *Laser spectroscopy, Color center lasers, Neon lasers.

The accuracy of the absolute frequency measurements of the 260 Tnz ($\lambda = 1.15$ micrometers) λ -dip stabilized 20 Ne laser, and the hyperfine components of the 127I₂ 17-1 P(6₂) transition at 520 THz ($\lambda = 0.576$ micrometer) has been extended by two orders of magnitude to 1 part in 10 to the 9th power. The frequencies were measured by comparing them with the known frequency of the 11.5 micrometer 13C16O₂ laser line by use of a 2.3 micrometer color center laser and a 1.15 micrometer He-Ne laser as frequency transfer oscillators. The accuracy of the absolute measurement is limited by the accuracy of the CO₂ laser frequency (1 part in 10 to the 9th power), however relative measurements between the CO₂ and I₂ frequencies were demonstrated to be precise to 1 part in 10 to the 10th power.

400,281

PB84-227370 Not available NTIS
National Bureau of Standards, Washington, DC.

Far-Infrared Laser Magnetic Resonance Spectrum of the OH Radical and Determination of Ground State Parameters.

Final rept.,

J. M. Brown, C. M. L. Kerr, F. D. Wayne, K. M.

Eveanson, and H. E. Radford. 1981, 11p

Pub. in Jnl. of Molecular Spectroscopy 86, p544-554 1981.

Keywords: *Infrared spectroscopy, Molecular energy levels, Free radicals, Reprints, *Laser spectroscopy, *Far infrared spectroscopy, *Hydroxyl radical, *Laser magnetic resonance.

The far-infrared Laser Magnetic Resonance (LMR) Spectrum of the OH radical in the $\nu = 0$ level of the X sup 2 Pi state has been studied in detail. All transitions that are accessible with currently available laser lines have been recorded. The measurements have been analyzed and subjected to a single least-squares fit using an effective Hamiltonian.

400,282

PB84-227396 Not available NTIS
National Bureau of Standards, Washington, DC.

Radiative Association of CH₃(+1) and H₂ at 13 K.

Final rept.,

S. E. Barlow, G. H. Dunn, and M. Schauer. 12 Mar 84, 4p

Grant NSF-PHY82-00805

Pub. in Physical Review Letters 52, n11 p902-905, 12 Mar 84.

Keywords: *Hydrogen, Interstellar matter, Low temperature tests, Reprints, *Methyl radicals, *Ion molecule interactions.

The authors report here the first observation and measurement of two-body ion-neutral association at low temperatures and densities. They have measured the rate at 13 K for CH₃(+1) + H₂ yields CH₅ + h ν to be $1.8 \pm 0.3 \times 10^{-13}$ power cu cm/s. The reaction conditions were such that the process could only have proceeded by radiative stabilization of the collision complex. Given implied complex lifetimes of about 6×10^{-7} to the -7th power to 6×10^{-8} powers from other measurements, the deduced radiation rate is about 100 to 1000/s.

400,283

PB84-227453 Not available NTIS
National Bureau of Standards, Washington, DC.

Liquid Structure Under Shear: Comparison between Computer Simulations and Colloidal Suspensions.

Final rept.,

H. J. M. Hanley, J. C. Rainwater, N. A. Clark, and B.

J. Ackerson. Nov 83, 11p

Grants NSF-DMR82-06472, NSF-DMR81-16119

Sponsored in part by Department of Energy, Washington, DC.

Pub. in Jnl. of Chemical Physics 79, n9 p4448-4458 Nov 83.

Keywords: *Colloid chemistry, *Shear properties, *Luminous intensity, Comparison, Dynamics, Debye-Scherer method, Non-Newtonian fluids, Reprints, Computer applications.

Simulated scattered light intensity plots are calculated for a soft sphere inverse-twelve system subjected to a shear and are compared to experimental plots for a colloidal suspension under approximately equivalent conditions. The simulated plots were obtained by a Fourier transform of the radial distribution function. The two sets show points of striking similarity: the Debye-Scherer rings become elliptical when both systems are subjected to the shear, and the light intensity around the rings is a function of polar angle. An interesting feature is the degree to which the experimental plots display non-Newtonian characteristics of the suspension. Overall, the work is a direct comparison of the results of a computer simulation with real experimental data. Suggestions for future work are given.

400,284
PB84-235332 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.
Chemical Engineering Science Div.
Experimental Thermal Conductivity Values for Hydrogen, Methane, Ethane and Propane,
H. M. Roder. May 84, 63p NBSIR-84/3006
Sponsored in part by National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.

Keywords: *Hydrogen, *Methane, *Ethane, *Propane, *Thermal conductivity, Laboratory equipment, Hot wire anemometers, Tables(Data).

The experimental measurements of thermal conductivity as obtained in a transient hot wire apparatus for hydrogen, methane, ethane and propane are recorded.

400,285
PB84-238427 Not available NTIS
American Chemical Society, Washington, DC.
Journal of Physical and Chemical Reference Data, Volume 13, Number 1, 1984.
Quarterly rept.
c1984, 318p
See also PB84-238435 through PB84-238492. Sponsored in part by National Bureau of Standards, Washington, DC. Prepared in cooperation with American Inst. of Physics, New York.

Keywords: *Physical properties, *Chemical properties, Thermodynamic properties, Sodium chloride, Refractivity, Zinc sulfides, Zinc selenides, Zinc tellurides, Oxides, Rare gases, High temperature tests, Metals, Water, Viscosity, Oxygen, Chemical equilibrium, Metal oxides.

The objective of the Journal is to provide critically evaluated physical and chemical property data, fully documented as to the original sources and the criteria used for evaluation. Critical reviews of measurement techniques, whose aim is to assess the accuracy of available data in a given technical area, are also included. The Journal is not intended as a publication outlet for original experimental measurements such as are normally reported in the primary research literature, nor for review articles of a descriptive or primarily theoretical nature.

400,286
PB84-238435 Not available NTIS
California Univ., Berkeley.
Thermodynamic Properties of Aqueous Sodium Chloride Solutions,
K. S. Pitzer, J. C. Peiper, and R. H. Busey. c1984, 102p
Prepared in cooperation with Oak Ridge National Lab., TN.
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p1-102 1984.

Keywords: *Thermodynamic properties, *Sodium chloride, *Solution, Laboratory equipment, Activity coefficients, Enthalpy, Equations of state, Specific heat, Tables(Data).

Experimental measurements of the osmotic and activity coefficients, the enthalpy, and the heat capacity were used to derive a semiempirical equation for the thermodynamic properties of NaCl(aq) at constant pressure. This equation may be combined with results contained in the previous paper on the volumetric properties to yield a complete equation of state valid in the region $273\text{ K} < T < 573\text{ K}$, saturation pressure $< P < 1\text{ kbar}$, $0 < m < 6.0\text{ mol/kg}$. It is shown that this equation may be extrapolated to higher solute molalities at lower pressures. An estimation of uncertainties in various quantities is given. Tables of values for various thermodynamic properties are presented in the appendix.

400,287
PB84-238443 Not available NTIS
Purdue Univ., Lafayette, IN.
Refractive Index of ZnS, ZnSe, and ZnTe and Its Wavelength and Temperature Derivatives,
H. H. Li. c1984, 48p
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p103-150 1984.

Keywords: *Refractivity, *Zinc sulfides, *Zinc selenides, *Zinc tellurides, Temperature, Optical measurement.

Refractive index data of ZnS, ZnSe, and ZnTe were searched, compiled, and analyzed. Recommended values of refractive index for the transparent spectral region were generated in the ranges 0.5-14 micrometers and 93-1000 K for ZnS, 0.55-18 micrometers and 93-618 K for ZnSe, and 0.55-30 micrometers at room temperature for ZnTe. Generation of these values was based on a dispersion equation that best fits selected data sets covering wide temperature and wavelength ranges where the available experimental data permit. Temperature and wavelength derivatives of refractive index were calculated from the first derivatives of the equation with respect to temperature and wavelength, respectively. The results are in concordance with the existing data.

400,288
PB84-238450 Not available NTIS
SRI International, Menlo Park, CA.
High Temperature Vaporization Behavior of Oxides. 1. Alkali Metal Binary Oxides,
R. H. Lamoreaux, and D. L. Hildenbrand. c1984, 23p
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p151-173 1984.

Keywords: *High temperature tests, *Vaporization, *Binary systems(Materials), *Alkali metals, Assessment, Enthalpy, Metals, Thermodynamic properties, Tables(Data), Gibbs free energy, *Metal oxides, Numerical solution.

In order to assess the high temperature vaporization behavior and equilibrium gas phase compositions of binary alkali metal oxides, the relevant thermodynamic and molecular constant data have been compiled and critically evaluated. Selected values of the Gibbs energy and enthalpy functions of condensed and vapor phases are given in the form of equations valid over wide temperature ranges, along with the standard entropies and enthalpies of formation. These data were used to generate plots of the equilibrium partial pressures of vapor species as functions of temperature for representative conditions ranging from reducing to oxidizing. Maximum vaporization rates have been calculated using the Hertz-Knudsen equation. Literature references are given.

400,289
PB84-238468 Not available NTIS
National Bureau of Standards (NML), Washington, DC.
Thermophysics Div.
Thermophysical Properties of Fluid H₂O,
J. Kestin, J. V. Sengers, B. Kamgar-Parsi, and J. M. H. L. Sengers. c1984, 9p
Prepared in cooperation with Brown Univ., Providence, RI. Div. of Engineering and Maryland Univ., College Park. Inst. for Physical Science and Technology.
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p175-183 1984.

Keywords: *Water, *Thermophysical properties, Fluids, Equations of state, Viscosity, Surface tension, Critical point, Steam, Thermal conductivity, Tables(Data), Numerical solution.

In view of the important role that water substance plays in science and industry, this paper lists the thermophysical properties of fluid H₂O which are most needed for engineering applications. The properties are described in a very compact form with the aid of explicit expressions for programming on a computer and for inclusion in data banks. The paper includes a fundamental equation in the form of the Helmholtz free energy expressed as an analytic function of temperature and density. This fundamental equation is a dimensionless version of the Provisional IAPS Formulation 1982 for the Thermodynamic Properties of Ordinary Water Substance for Scientific and General Use, which enables one to calculate all equilibrium thermodynamic properties in a wide range of states, but with the exclusion of a small region near the critical point. In the latter region, the equilibrium properties are described by a scaled fundamental equation in the form of the pressure as a function of chemical potential and temperature. In addition, the paper gives equations for the viscosity, thermal conductivity, and surface tension. All equations in the paper are mutually thermodynamically consistent. The set of equations and their constants listed here represents the most reliable information according to the judgment of the authors.

400,290
PB84-238476 Not available NTIS
National Bureau of Standards (NML), Washington, DC.
Thermophysics Div.
Representative Equations for the Viscosity of Water Substance,
J. V. Sengers, and B. Kamgar-Parsi. c1984, 21p
Prepared in cooperation with Maryland Univ., College Park. Inst. for Physical Science and Technology.
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p185-205 1984.

Keywords: *Viscosity, *Water, Assessments, Numerical solution.

The International Association for the Properties of Steam adopted in 1982 a new formulation for the thermodynamic properties of water substance for scientific and general use. In this paper, the authors present an assessment of currently available methods for calculating the viscosity of water substance when used in conjunction with the new formulation for the equilibrium properties.

400,291
PB84-238484 Not available NTIS
Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
Atlas of the Schumann-Runge Absorption Bands of O₂ in the Wavelength Region 175-205 nm,
K. Yoshino, D. E. Freeman, and W. H. Parkinson. c1984, 21p
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p207-227 1984.

Keywords: *Oxygen, *Ultraviolet spectroscopy, *Wavelengths, Absorption spectra, Numerical solution, Schumann-Runge bands.

After a critical summary of previous wavelength measurements and rotational line assignments of the Schumann-Runge absorption bands of O₂, the results of the present study performed at high resolution with a 6.65 m vacuum spectrograph are given.

400,292
PB84-238492 Not available NTIS
Brown Univ., Providence, RI. Div. of Engineering.
Equilibrium and Transport Properties of the Noble Gases and Their Mixtures at Low Density,
J. Kestin, K. Knierim, E. A. Mason, B. Najafi, and S. T. Ro. c1984, 26p
Included in Jnl. of Physical and Chemical Reference Data, v13 n1 p229-254 1984.

Keywords: *Rare gases, *Mixtures, *Binary systems(Materials), *Chemical equilibrium, *Transport properties, Helium, Neon, Argon, Xenon, Krypton, Tables(Data), Graphs(Charts).

The report contains a set of easy-to-program expressions for the calculation of the thermodynamic and transport properties of the five noble gases (He, Ne, Ar, Kr, Xe) and of the 26 binary and multicomponent mixtures that can be formed with them. The properties in question are second virial coefficient B, viscosity (η), thermal conductivity (λ), self-diffusion and binary diffusion coefficient D, and thermal diffusion factor ($\alpha_{sup} T$). The calculation of properties is restricted to low densities ($\rho < B/C$) but covers the full range of compositions and a temperature interval extending from absolute zero to the onset of ionization. Owing to the careful theoretical basis on which the algorithm has been erected, all properties are thermodynamically consistent with each other. Reference to a selected set of critically evaluated measurements provides a basis for the estimation of uncertainties. The report contains 54 abbreviated tables of numerical data and 86 deviation plots. It is asserted that the results are comparable to the best measurements that could be performed at present.

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PB84-239284

Not available NTIS
National Bureau of Standards, Washington, DC.
Flowing Afterglow Studies of Ion Reaction Dynamics Using Infrared Chemiluminescence and Laser-Induced Fluorescence.

Final rept.,

V. M. Bierbaum, G. B. Ellison, and S. R. Leone.

1984, 38p

Grants NSF-PHY79-04928, AFOSR-78-3565

Pub. in Gas Phase Ion Chemistry (Chapter 17), p2-39
1984.

Keywords: *Ions, *Reaction kinetics, Excitation, Molecular energy levels, Fluorescence, Chemiluminescence, Thermochemistry, Dynamics, Infrared spectroscopy, Reprints, *Ion molecule interactions, *Flowing afterglow, *Laser induced fluorescence.

In this chapter the authors describe new experiments to determine the initial vibrational energy distribution of ion reaction products in their ground electronic states; in the most recent work, information on nascent rotational populations and on vibrational deactivation of ions is also obtained. These studies are made possible by monitoring optically the excited products of ion-molecule reactions carried out in a flowing afterglow apparatus. Two complementary optical techniques are used: direct observation of wavelength dispersed infrared chemiluminescence from AB(v,J) and laser-induced fluorescence detection, i.e., laser excitation of product AB(v,J) molecules to bound electronic states and detection of the resulting visible fluorescence. Methods to probe the final product states resulting from neutral-neutral reactions (A+BC) are well established. A similar experimental program concerned with ions is a much more difficult enterprise for several reasons. The number density of reacting ions is much lower (by several orders of magnitude) than in the comparable neutral case. Reactant ions are difficult to prepare under known, controllable conditions. Moreover, in many cases, thermochemical and spectroscopic information is not available for ions. To overcome some of these difficulties we employ the flowing afterglow technique, which provides high densities of thermal ions and serves as a well-characterized medium for the study of ion reaction kinetics and dynamics.

400,294

PB84-239300

Not available NTIS
National Bureau of Standards, Washington, DC.
Microwave and Far infrared Spectra of the CH Radical.

Final rept.,

J. M. Brown, and K. M. Evenson. 1 May 83, 6p

Pub. in Astrophysical Jnl. 268, pL51-L56, 1 May 83.

Keywords: *Microwave spectroscopy, Infrared spectroscopy, Astrophysics, Reprints, *Methyl radicals, *Far infrared spectroscopy, Laser magnetic resonance, Laser spectroscopy.

The frequencies, wavelengths and linestrengths for transitions of the CH molecule at microwave and far infrared wavelengths have been calculated from an analysis of the laser magnetic resonance spectrum. The low frequency transitions are between lambda-type doublets while the higher frequency transitions are between different spin-rotation levels.

400,295

PB84-239326

Not available NTIS
National Bureau of Standards, Washington, DC.
Measurement of Beta Values and Branching Ratios in the Region of the 3s3p sup 6 4p singlet p (sup 0) (sub 1) Resonance in Ar and the 5s5p sup 6 6p singlet p (sup 0) (sub 1) Resonance in Xe.

Final rept.,

K. Codling, J. B. West, A. C. Parr, J. L. Dehmer, and R. Stockbauer. Oct 80, 5p

Grant NATO-1939

Sponsored in part by National Aeronautics and Space Administration, Washington, DC., Office of Naval Research, Arlington, VA., and Department of Energy, Washington, DC.

Pub. in Jnl. of Physics B: Atomic Molecular Physics 13, pL693-L697 Oct 80.

Keywords: *Argon, *Xeon, *Molecular energy levels, Excitation, Angular distribution, Reprints.

Variations in asymmetry parameter, beta, and the ratio of partial photoionization cross sections sigma(doublet P(3/2)): sigma(doublet P(1/2)) have been determined in the region of the 3s3p sup6 4p singlet p(sup 0) (sub

1) resonance in Ar and the 5s5p sup 6 6p singlet P (sup 0) (sub 1) resonance in Xe. In both cases there is a considerable variation in beta through the resonance. In Ar the beta values for the spin-orbit components are similar; in Xe they are significantly different. In Xe, the branching ratio shows a modest variation through the resonance, whereas in Ar no noticeable change occurs.

400,296

PB84-239359

Not available NTIS
National Bureau of Standards, Washington, DC.
Specular and Off-Specular High Resolution Electron Energy Loss Spectroscopy of Acetylene and Ethylene on Tungsten (100).

Final rept.,

J. C. Hamilton, N. Swanson, B. J. Wacławski, and R. J. Celotta. Apr 81, 8p

Pub. in Jnl. of Chemical Physics 74, n7 p4156-4163
Apr 81.

Keywords: *Acetylene, *Ethylene, *Surface chemistry, *Molecular vibration, Tungsten, Chemical bonds, Adsorption, Reprints, *Electron energy loss spectroscopy.

High resolution electron energy loss spectroscopy (EELS) in both specular and off-specular directions has been used to identify the vibrational modes of acetylene and ethylene on tungsten (100). The off-specular data were essential to this study since, at low coverages, some of the vibrational modes were detectable only for off-specular scattering. In addition, analysis of the relative intensities of the specular and off-specular loss peaks allows us to infer orientations of molecular dipole derivative and bond directions for the adsorbed species. The authors found at 135K that ethylene on tungsten (100) dissociates to acetylene and hydrogen for exposures less than 1 L. At saturation coverage molecular ethylene is also adsorbed. Warming of this adsorbed ethylene causes dissociation to acetylene. Analysis of specular and off-specular loss intensities suggests a geometry with the C-H bonds lying parallel to the surface. Previous UPS data for this adsorption system can be reinterpreted giving a C-C bond length of 1.35 Å and a C-C-H bond angle of 180°. This reinterpretation is consistent with the geometry suggested by our EELS measurements. They also present data for acetylene adsorption at room temperature and for ethylene physisorption at 82K. Physisorbed ethylene shows vibrational losses identical to those seen in gas phase IR.

400,297

PB84-239367

Not available NTIS
National Bureau of Standards, Washington, DC.
Chemical Stability of Carbonate- and Fluoride-Containing Apatites.

Final rept.,

R. Z. LeGeros, and M. S. Tung. 1983, 11p

Sponsored in part by American Dental Association Health Foundation, Chicago, IL.

Pub. in Caries Research 17, p419-429 1983.

Keywords: *Dental caries, *Calcium phosphates, Stability, Acid treatment, Enamels, Dissolution, Carbonates, Fluorine organic compounds, Synthesis(Chemistry), Reprints.

Apatites containing CO₃ and/or F were synthesized and exposed to acid buffer. The extent of dissolution was determined (as m M Ca/ml buffer solution) and the apatites characterized by X-ray diffraction, IR absorption, and chemical analyses before and after acid exposure. Results showed that: (i) the extent of dissolution was directly proportional to the CO₃ contents but that the simultaneous presence of F in the apatite minimized the adverse CO₃ effect; (ii) the extent of dissolution during the second exposure was much less than during the first exposure; (iii) the lattice parameters, crystallinity and CO₃ and F contents of the apatites differed before and after exposure to the acid buffer, i.e., larger a-axis, initial decrease then increase in crystallinity, lower carbonate and higher fluoride contents of apatites after acid exposure. Results from this study suggest that the vulnerability of synthetic and biological apatites to acid dissolution is largely due to their carbonate constituent and that the caries process may involve a combination of dissolution of carbonate-rich/fluoride-poor apatites and reprecipitation of carbonate-poor/fluoride-rich enamel apatites and that the reprecipitated apatite is rendered more resistant to acid dissolution.

400,298

PB84-239862

Not available NTIS
National Bureau of Standards, Washington, DC.
Quenching of Triplet Vinylidene Radicals by Helium.

Final rept.,

A. H. Laufer. Jan 83, 4p

Pub. in Chemical Physics Letters 94, n2 p240-242 Jan 83.

Keywords: *Molecular energy levels, *Acetylene, *Ultraviolet spectroscopy, Excitation, Reaction kinetics, Absorption, Photolysis, Reprints, *Vinylidene radicals.

Triplet vinylidene radicals, produced in the vacuum-ultraviolet photolysis of acetylene, are observed in absorption at 137.4 nm. The lifetime in the presence of helium, for both the protonated and deuterated species, has been determined. An upper limit for removal by acetylene has been deduced.

400,299

PB84-239888

Not available NTIS
National Bureau of Standards, Washington, DC.
Structure of Atomic Spectra: Some Recent Laboratory Research of Interest for Stellar Spectroscopy.

Final rept.,

W. C. Martin. 1983, 5p

Pub. in Highlights of Astronomy 6, p775-779 1983.

Keywords: *Atomic spectra, *Stellar spectra, *Bibliographies, Atomic energy levels, Wavelengths, Line spectra, Reprints.

A bibliography covering atomic spectral wavelengths, line classifications, and energy levels is given. The references are selected as being of astrophysical interest and are mainly limited to the period from Sept. 1981 through Aug. 1982. Some ongoing laboratory, research of interest for astronomy is also reviewed.

400,300

PB84-239912

Not available NTIS
National Bureau of Standards, Washington, DC.
X-Ray Photoemission Spectroscopy of Environmental Particles.

Final rept.,

T. Jach, and C. J. Powell. Jan 84, 4p

Pub. in Jnl. of Environmental Science Technology 18, n1 p58-61 Jan 84.

Keywords: *Environmental surveys, *X ray analysis, *Particles, *Surfaces, Photoelectric emission, Sputtering, Reprints, *X ray photoelectron spectroscopy.

Particulate samples from three different environments were analyzed by x-ray photoemission spectroscopy. The surface constituents of particles were determined before and after repeated sputter-ion bombardment, and were compared to the elements reported by bulk analysis. Several sulfur and nitrogen compounds have been identified and changes of these with sputtering time is discussed.

400,301

PB84-240001

Not available NTIS
National Bureau of Standards, Washington, DC.
Far-Infrared Laser Magnetic Resonance.

Final rept.,

K. M. Evenson. 1981, 9p

Sponsored in part by National Aeronautics and Space Administration, Washington, DC.

Pub. in Discussions of the Faraday Chemical Society (England) 71, p6-14 1981.

Keywords: *Laboratory equipment, Zeeman effect, Free radicals, Paramagnetic materials, Atoms, Molecules, Reaction kinetics, Design criteria, Performance evaluation, Reprints, *Far infrared spectroscopy, *Laser magnetic resonance spectroscopy, Laser spectroscopy.

Far-infrared laser magnetic resonance (l.m.r.) is now a laboratory spectroscopic technique used in at least six laboratories throughout the world, and some 50 papers on l.m.r. spectroscopy have been published. L.m.r. is an extremely sensitive technique for finding rotational Zeeman spectra in paramagnetic atoms and molecules. Some 31 species have been detected, some of which had never been discovered before. L.m.r. is now also used in a number of laboratories to study the reaction rates of these paramagnetic free radicals. The field of mid-infrared l.m.r. using CO and

CO₂ lasers has also expanded rapidly and is summarized in McKellar's paper at this meeting. A review of far-infrared I.m.r. was presented a little over one year ago. The purpose of the present report is to bring that comprehensive paper up to date and to point out some recent results in the field of laser frequency measurements which are leading the way to a redefinition of the metre. In this publication, I will list all of the far-infrared I.m.r. spectroscopic papers chronologically; give a list of all the species observed with references, describe the design of a new I.m.r. spectrometer in the N.B.S. Boulder Laboratories; present some new ideas on the sensitivity of intracavity absorption; and finally show how recent laser frequency measurements are leading to a new definition of the metre in terms of the second, thus fixing the value of the speed of light.

400,302

PB84-240019 Not available NTIS
National Bureau of Standards, Washington, DC.

Laser Magnetic Resonance Spectroscopy of Atoms.

Final rept.,
K. M. Evenson, and M. Inguscio. 1983, 2p
Pub. in Proceedings of International Conference on Laser Spectroscopy VI, Interlaken, Switzerland, June 27-July 1, 1983, p80-81.

Keywords: *Atoms, *Laboratory equipment, *Laser magnetic resonance spectroscopy, Laser spectroscopy.

This paper describes, briefly, the applicability of laser magnetic resonance (LMR) to atoms, and the apparatus used in the experiments.

400,303

PB84-240936 PC A03/MF A01
National Bureau of Standards (NML), Washington, DC.
Center for Analytical Chemistry.

Fortran Version of the Quantitative Energy-Dispersive Electron Beam X-ray Analysis Program FRAME C.

Technical note,
R. L. Myklebust, and B. B. Thorne. Jul 84, 46p NBS/TN-1200
Also available from Supt. of Docs as SN003-003-02603-4.

Keywords: *X ray analysis, *Microanalysis, *Computer programs, X ray spectra, Fortran, Chemical analysis, *Electron probe microanalysis, FRAME C computer program, Fortran 77 programming language, VAX-11/780 computer, Listings.

A Fortran listing of the quantitative electron microprobe analysis routine, FRAME C, is presented. The source code is extensively documented and there are short summaries of the various parts of the program. Examples are also presented to demonstrate the versatility of the program.

400,304

PB84-242064 Not available NTIS
National Bureau of Standards, Washington, DC.

Melting Curve of o-Terphenyl.
Final rept.,
V. J. Fratello, and V. E. Bean. 1983, 7p
Pub. in Int. Jnl. of Thermophys. 4, n3 p253-259 1983.

Keywords: *Terphenyls, *Melting, *Thermal analysis, Recrystallization, Purity, High pressure tests, Reprints.

Melting of high purity o-terphenyl was investigated in the range 0-500 MPa by differential thermal analysis. The sample was purified by repeated recrystallization from methanol, followed by vacuum sublimation. This material was approximately 99.995% pure, and the results suggest that sample purity was maintained to within the experimental uncertainty. The sample was loaded into a high pressure cell with a teflon/nylon composite pressure transmitting diaphragm. A differential thermocouple and a calibrated temperature measuring thermocouple were in direct contact with the sample.

400,305

PB84-242080 Not available NTIS
National Bureau of Standards, Washington, DC.

Vibrational State Distributions and Absolute Excitation Efficiencies for T-V Transfer Collisions of NO and CO with H Atoms Produced by Excimer Laser Photolysis.

Final rept.,
C. A. Wight, and S. R. Leone. 15 Nov 83, 7p
Grants NSF-CHE79-11340, NSF-PHY82-00805
Pub. in Jnl. of Chemical Physics 79, n10 p4823-4829, 15 Nov 83.

Keywords: *Energy transfer, *Carbon monoxide, *Nitrogen oxide(NO), Fluorescence, Infrared spectroscopy, Photolysis, Excitation, Inelastic scattering, Molecular vibration, Reprints, *Atom molecule interactions, *Hydrogen atoms, *Laser applications.

Translation-to-vibration energy transfer from fast H atoms to NO and CO is studied by the excimer laser photolysis/infrared fluorescence method. The distribution is similar to that previously reported for H + CO collisions at the same energy. However, the absolute T-V transfer efficiency for H + CO is a strong function of initial energy, increasing from 7% at 0.95 eV to 28% at 3.1 eV, whereas the efficiency for H + NO is essentially constant at 14% over the same range of initial energies. This qualitatively different behavior is not expected from simple models of T-V energy transfer, but may be attributed to differences in the attractive regions of the potential energy surfaces of the HNO and HCO transient species.

400,306

PB84-242098 Not available NTIS
National Bureau of Standards, Washington, DC.

Measurement of Polymer-Polymer Compatibility by Non-Radiative Energy Transfer Technique.

Final rept.,
F. W. Wang, and R. E. Lowry. 1982, 2p
Pub. in Polym. Prepr. 23, n2 p205-206 1982.

Keywords: *Polymers, *Energy transfer, *Fluorescence, Blends, Polymethyl methacrylate, Fluorine organic compounds, Compatibility, Heat measurement, Reprints, Vinylidene fluoride polymers, Poly(Methacrylic acid/(ethyl-ester)).

Non-radiative energy transfer can take place between an energy donor and a suitable energy acceptor over distances of the order of 30 Å. Since the efficiency of energy transfer depends on the inverse sixth power of the distance between the donor and the acceptor, in a blend containing two polymers labeled with donor and acceptor chromophores, respectively, the efficiency of transfer will be small if the two polymers are incompatible and segregated but will be large if they are compatible and form a single phase. There have been recently some efforts to study polymer-polymer compatibility by non-radiative energy transfer technique. Since this technique is relatively new, it is important to further compare the results from this technique with those obtained from more conventional techniques. The author have used this technique to evaluate the effectiveness of poly(vinylidene fluoride) (PV2) as a compatibility enhancer for poly(methyl methacrylate) (PMMA) and poly(ethyl methacrylate) (PEMA), which are known to be incompatible. In this paper they describe our experimental procedure, which permits thermal treatment of polymer blends, and they give a comparison of our results with calorimetry results of Kwei and coworkers.

400,307

PB84-242452 Not available NTIS
National Bureau of Standards, Washington, DC.

Poling Behavior of Polyvinylidene Fluoride at Room Temperature.

Final rept.,
F. I. Mopsik, and A. S. DeReggi. Jan 84, 3p
Pub. in Jnl. of Applied Physics Letters 44, n1 p65-67 Jan 84.

Keywords: *Polarization(Charge separation), Electret, Reprints, *Vinylidene fluoride polymers, *Thermal pulse method.

The electrical polarization distribution for biaxially oriented polyvinylidene fluoride poled at room temperature was measured by means of the thermal pulse experiment. The evolution of the distribution as a function of poling field and poling time was studied. The resolution was one-tenth the sample thickness. In addition, the sample poled to the highest field was reverse

poled to successively higher fields to study the effects of field reversal. The film was found to pole easiest in the middle regions implying a higher coercive field near the surfaces.

400,308

PB84-242478 Not available NTIS
National Bureau of Standards, Washington, DC.

Adsorption and Decomposition of Hydrocarbons on Platinum Black: Vibrational Modes from NIS (Neutron Inelastic Scattering).

Final rept.,
R. R. Cavanagh, J. J. Rush, R. D. Kelley, and T. J. Udovic. 1 Apr 84, 7p
Sponsored in part by Department of Energy, Washington, DC. Office of Basic Energy Sciences.
Pub. in Jnl. of Chemical Physics 80, n7 p3478-3484 Apr 84.

Keywords: *Hydrocarbons, *Surface chemistry, *Neutron inelastic scattering, *Adsorption, *Decomposition, Chemisorption, Acetylene, Ethylene, Reprints, *Electron energy loss spectroscopy, Platinum black.

The adsorption and decomposition of acetylene and ethylene on platinum black has been investigated by neutron inelastic scattering (NIS) studies of the vibrations of chemisorbed species in the energy range 30-200 meV. Results are compared in detail with EELS data and with spectra of model inorganic complexes. The NIS spectra for C₂H₂ and C₂H₄ chemisorbed at 120-150K exhibit a number of spectral features (from both the internal modes and modes associated with vibrations against the surface metal atoms) which are in general agreement with EELS results for Pt(111). Detailed comparison of the spectral peak intensities and positions with various models for the adsorbed molecules rule out linear or planar species and are consistent with bent molecular configurations on the surface. Bond angles and force constants are derived from the model fits to the neutron data in each case. The NIS spectra of a 'saturated' C₂H₂ monolayer warmed to 300K indicates a rearrangement to more fully hydrogenated species. Subsequent introduction of H₂ at low pressure shows little evidence of chemical change while spectra measured at high H₂ pressure show co-existence of chemisorbed H and saturated hydrocarbons on the surface. Warming the saturated C₂H₄ monolayer to 300K produces a discrete NIS spectrum consistent with rearrangement to methylated species, possibly ethylidyne, as suggested from previous EELS studies.

400,309

PB84-242486 Not available NTIS
National Bureau of Standards, Washington, DC.

Comment on 'Quantum Motion of Chemisorbed Hydrogen on Ni Surfaces'.

Final rept.,
R. R. Cavanagh, J. J. Rush, and R. D. Kelley. 4 Jun 84, 1p
Pub. in Jnl. of Physical Review Letters 52, n23 p2100, 4 Jun 84.

Keywords: *Hydrogen, *Surface chemistry, *Band structure of solids, Molecular energy levels, Molecular vibration, Adsorption, Neutron scattering, Nickel, Reprints.

Recent theoretical efforts have suggested the vibrational energy levels of adsorbed hydrogen reflect band structure, rather than simple localized oscillator states. The experimental data relevant to such theories is reviewed and found not to support the notion of band structure for surface bound hydrogen. Hydrogen in metals is suggested as a more promising system in which to investigate the issue of such band structures.

400,310

PB84-242932 Not available NTIS
National Bureau of Standards, Washington, DC.

Stark Quenching of Metastable 2S States in Hydrogen and Helium at High Fields.

Final rept.,
H. K. Holt. Aug 83, 3p
Pub. in Physical Review A 28, n2 p1157-1159 Aug 83.

Keywords: *Hydrogen, *Helium, *Stark effect, Metastable state, Molecular energy levels, Electric fields, Reprints.

The time-dependent theory of the Stark quenching of 2S states in hydrogen and helium is developed for high electric fields, fields for which the Stark matrix element is large compared to the state separations. The meta-

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

stable 2S state of an atom is mixed with two P states by the field, and the subsequent decay is described.

400,311

PB84-242940 Not available NTIS
National Bureau of Standards, Washington, DC.
Spectra of the Ammonium Radical: The Schuster Band of ND₄.
Final rept.,
G. Herzberg, and J. T. Hougen. 1983, 11p
Pub. in *Jnl. of Molecular Spectroscopy* 97, p430-440 1983.

Keywords: *Visible spectrum, Ammonia, Free radicals, Deuterium compounds, Broadband, Reprints, *Ammonium radicals, *Schuster bands.

The Schuster band of ammonia occurs in many kinds of electric discharges through streaming ammonia if the pressure is not too low. While it is entirely diffuse for ordinary ammonia it shows a fairly clear structure (and an isotope shift) when produced with heavy ammonia (ND₃). Studies with intermediate isotopes show conclusively that there are four H atoms and a single N atom present in the molecule responsible for this spectrum, i.e., that it is due to the ammonium (NH₄) radical. An attempt is made to understand the structure of the ND₄ Schuster band in terms of a tetrahedral configuration of the molecule in both upper and lower state. The agreement of the wavenumber of the band origin with several recent ab initio calculations is not as good as one might wish and not as good as in the analogous case of H₃. This and other difficulties of the present interpretation of the spectrum are briefly discussed.

400,312

PB84-243872 Not available NTIS
National Bureau of Standards, Washington, DC.
Fluorescence Measurement of Antioxidant Migration from Low Density Polyethylene into 1-Propanol.
Final rept.,
F. Wang, and B. Howell. 1982, 4p
Pub. in *Proceedings of Organic Coatings and Applied Polymer Science*, Kansas City, MO., September 12-17, 1982, p41-44.

Keywords: *Antioxidants, *Fluorescence, *Transport properties, *Diffusion coefficient, *Polyethylene, Additives, Solvent extraction, *Low density polyethylene, Phenylene diamine/N-N-diphenyl.

Although the fluorescence technique has been used to determine additive concentration in polymers as far as the authors know, there has been no report on the use of this technique to measure the diffusion of an additive from a polymer matrix into an extracting solvent. To successfully carry out diffusion measurement by the fluorescence technique, they must take precautions to exclude oxygen from the extracting solvent since oxygen quenches the fluorescence of the additive and, in some cases, contributes to its photodegradation. In this paper, they describe how oxygen exclusion was incorporated into a procedure to measure the diffusion of an additive from a polymer matrix into an extracting solvent. They also describe the application of this procedure to the diffusion of an amine antioxidant, N,N'-diphenyl-p-phenylenediamine (DPPD), from low-density polyethylene (LDPE) into 1-propanol and the authors give a preliminary value for the diffusion coefficient of DPPD in LDPE at the experimental conditions.

400,313

PB84-243880 Not available NTIS
National Bureau of Standards, Washington, DC.
Family of Angle-Moments Proportional to r to the power $(-n)$, $n = 1, 2, \dots$, in Free Space.
Final rept.,
D. G. Hummer. 1984, 2p
Pub. in *Jnl. of Quantitative Spectroscopy and Radiative Transfer* 31, n3 p283-284 1984.

Keywords: Thermal radiation, Spheres, Reprints, *Radiative transfer.

The moments $(M_{\text{sub } n}(r))$ is identically $= 1/2$ the integral between 0 and 2π , of $((\cos \theta)^n (\sin \theta)^n)$ or the intensity $I(r, \theta)$ in free space surrounding a spherical object emitting radiation with an arbitrary directional dependence are shown to be exactly proportional to $(r^{\text{sup } -(n+1)})$, $n = 0, 1, \dots$

400,314

PB84-244011 Not available NTIS
National Bureau of Standards, Washington, DC.
Certificate Values - What Do They Mean and How They Should Be Used.
Final rept.,
H. H. Ku. Sep 83, 2p
Pub. in *Jnl. of Test. Eval.* 11, n5 p350-351 Sep 83.

Keywords: Probability theory, Standards, Reprints, *Standard reference materials, Certified values, Uncertainty.

The meanings of commonly used uncertainty statements associated with certified values of Standard Reference Materials are explained. In particular, the implications of these statements are interpreted in nonstatistical terms for the users.

400,315

PB84-244136 Not available NTIS
National Bureau of Standards, Washington, DC.
Anomalous N₂ 3 Auger Spectra of In and Sn.
Final rept.,
J. Fine, T. D. Andreadis, and J. A. D. Matthew. 1984, 4p
Pub. in *Jnl. of Physics C: Solid State Physics* 17, pL257-L260 1984.

Keywords: *Indium, *Tin, Reprints, *Auger spectroscopy.

The N₂ 3 Auger spectra of both In and Sn are shown to consist of single broad peaks with no electron emission peak in the N₂ 3N₄ 5N₄ 5 region, in sharp contrast to the conventional M₂ 3 Auger spectra of Ga and Ge.

400,316

PB84-244243 Not available NTIS
National Bureau of Standards, Washington, DC.
Precision Measurements of Laser Cooled (sup 9) Be(+ 1) Ions.
Final rept.,
J. J. Bollinger, D. J. Wineland, W. M. Itano, and J. S. Wells. 1983, 5p
Pub. in *Proceedings of Int. Laser Spectroscopy Conf. (6th)*, Interlaken, Switzerland, June 27-July 1, 1983, Paper in *Laser Spectroscopy* 6, p168-172 1983.

Keywords: Ions, Atomic energy levels, Zeeman effect, Fluorescence, Hyperfine structure, Doppler effect, *Beryllium ions, *Laser spectroscopy.

Laser assisted measurements of cyclotron frequencies, g-factors, hyperfine constants and ion cloud parameters for laser cooled (9)Be(+ 1) ions in a Penning trap were made. The cyclotron and hyperfine-Zeeman resonances of the (9)Be(+ 1) ions were detected by changes in laser fluorescence. A laser optical-pumping double-resonance technique was used to measure the ground state hyperfine constant A and the nuclear to electronic g-factor ratio $g_{\text{sub } 1/g_{\text{sub } J}}$ of (9)Be(+).

400,317

PB84-244268 Not available NTIS
National Bureau of Standards, Washington, DC.
Far Infrared LMR (Laser Magnetic Resonance) Detection of Hydroxymethyl.
Final rept.,
H. E. Radford, K. M. Evenson, and D. A. Jennings. 15 Mar 81, 3p
Pub. in *Chemical Physics Letters* 78, n3 p589-591, 15 Mar 81.

Keywords: *Infrared spectroscopy, Solids, Liquids, Reprints, *Laser magnetic resonance spectroscopy, *Far infrared spectroscopy, *Hydroxymethyl radicals.

Laser magnetic resonance spectra of the free hydroxymethyl radical, produced by the reaction of atomic chlorine with methanol vapor, have been observed at several laser wavelengths between 118 and 657 micrometer. The spectra are identified by chemical tests and by comparison with the ESR spectrum of hydroxymethyl in solids and liquids.

400,318

PB84-244276 Not available NTIS
National Bureau of Standards, Washington, DC.
Measurement of the Positronium 1 triplet S(sub 1)-2 triplet S(sub 1) Interval by Doppler-Free Two-Photon Spectroscopy.
Final rept.,
S. Chu, A. P. Mills, Jr., and J. L. Hall. May 84, 10p
Contract N00014-77-C-0656, Grant NSF-PHY82-00805
Pub. in *Physical Review Letters* 52, n19 p1689-1698 May 84.

Keywords: *Positronium, Molecular energy levels, Quantum electrodynamics, Spectral lines, Doppler effect, Reprints, *Laser spectroscopy.

The authors have measured the 1 triplet S(sub 1)-2 triplet S(sub 1) interval in positronium (Ps) to be 1,233,607,185 + n 15 MHz, in agreement to within 1% of the alpha (sup 3)R(infinity) QED prediction. The quoted 12-ppb uncertainty has equal contributions from the measurement of the Ps resonance relative to a Te₂ absorption line and the calibration of the Te₂ line relative to the deuterium 2S(1/2) - 4P(3/2) Balmer line.

400,319

PB84-244300 Not available NTIS
National Bureau of Standards, Washington, DC.
Comparison of L3-Shell Excitation Energies of 3d Transition Metals Obtained by XPS, AEAPS, and EELS - Summary Abstract.
Final rept.,
N. E. Erickson, and C. J. Powell. Jun 84, 2p
Pub. in *Jnl. of Vacuum Science and Technology A* 2, n2 p840-841 Apr/ Jun 84.

Keywords: *Molecular energy levels, *Metals, Nickel, Titanium, Vanadium, Chromium, Cobalt, Iron, Chemical bonds, X ray analysis, Reprints, X ray photoelectron spectroscopy, Auger spectroscopy, Electron energy loss spectroscopy.

A summary is given of measurements of L₃-shell binding energies of the elements Ti, V, Cr, Fe, Co, and Ni by the techniques of x-ray photoelectron spectroscopy, Auger-electron appearance-potential spectroscopy, and electron energy-loss spectroscopy.

400,320

PB84-244656 Not available NTIS
National Bureau of Standards, Washington, DC.
National Bureau of Standards, Polymer Science and Standards Division.
Final rept.,
R. K. Eby, M. B. Broadhurst, B. M. Fanconi, I. C. Sanchez, and G. T. Davis. May 84, 7p
Pub. in *Polymer News* 9, n6 p178-184 May 84.

Keywords: *Polymers, *Standards, *Research projects, Utilization, Reprints.

The National Bureau of Standards has a long and successful background of advancing polymer science, polymer standards and the effective use of polymers in solving national problems. The present program of the Polymer Science and Standards Division continues this service with emphasis on the applications of polymers to the growth of industrial productivity, improved national security, increased conservation of critical materials, more efficient government, better materials utilization and improved health. Surveys and other planning activities suggest that in the future the polymer field and the Division will place increased emphasis on polymer blends, reinforced polymers, highly developed molecular orientation, conducting polymers, high strength polymers, and high temperature polymers.

400,321
PB84-244698 Not available NTIS
 National Bureau of Standards, Washington, DC.
Laser Magnetic Resonance Rotational Spectroscopy of 2 Sigma Radicals: Ethynyl (CCH).
 Final rept.,
 R. J. Saykally, L. Veseth, and K. M. Evenson. 15 Mar 84, 9p
 Sponsored in part by Department of Energy, Washington, DC. Office of Basic Energy Sciences.
 Pub. in Jnl. of Chemical Physics 80, n6 p2247-2255, 15 Mar 84.

Keywords: *Free radicals, *Molecular rotation, *Astronomical spectroscopy, Interstellar matter, Molecular energy levels, Least squares method, Reprints, *Ethynyl radicals, *Laser spectroscopy, *Laser magnetic resonance.

The first terrestrial measurement of the free ethynyl radical (CCH), made by far-infrared laser magnetic resonance, is described. Because of the very weak spin coupling in this state, the LMR spectrum is complex and badly overlapped. A theoretical formalism for the prediction and analysis of such weakly coupled 2 sup sigma states is presented, in which frequencies, linewidths, and intensities of all transitions are computed as a function of magnetic flux density, and the total absorption coefficient is computed at each field point in order to simulate the magnetic resonance spectrum. This formalism is used to analyze the LMR spectra of CCH. A combined least squares analysis of existing microwave, astronomical, and LMR data was carried out to determine an improved set of molecular parameters for this important interstellar molecule.

400,322
PB84-244706 Not available NTIS
 National Bureau of Standards, Washington, DC.
Pure Rotational Spectrum and Hyperfine Structure of CF Studied by Laser Magnetic Resonance.
 Final rept.,
 R. J. Saykally, K. G. Lubic, A. Scalabrin, and K. M. Evenson. 1982, 10p
 Grant NSF-CHE80-07042
 Pub. in Jnl. of Chemical Physics 77, n2 p58-67 1982.

Keywords: *Molecular rotation, *Hyperfine structure, Infrared spectroscopy, Reprints, *Laser spectroscopy, *Laser magnetic resonance, *Carbon fluoride.

Laser magnetic resonance spectra have been measured for four rotational transitions and one spin-changing transition in the 2 sup pi ground state of CF, generated in an intracavity methane-fluorine flame. Comparison of these integrals with those of the fluorine atom indicates that the unpaired electron has approximately 18% F character, implying a substantial degree of double bonding.

400,323
PB84-244730 Not available NTIS
 National Bureau of Standards, Washington, DC.
Thermodynamic Properties of Isobutane in the Critical Region.
 Final rept.,
 J. M. H. L. Sengers, B. Kamgar-Parsi, and J. V. Sengers. 1983, 9p
 Pub. in Jnl. of Chemical and Engineering Data 28, n4 p354-362 1983.

Keywords: *Butanes, *Thermodynamic properties, *Critical point, Tables(Data), Binary systems(Materials), Reprints, *Propane/methyl, Geothermal systems.

For geothermal applications, a scaled fundamental equation has been formulated to represent and tabulate the thermodynamic properties of isobutane in the critical region. In the supercritical range, the surface joins smoothly with that of Waxman and Gallagher, to which it is a complement.

400,324
PB84-244755 Not available NTIS
 National Bureau of Standards, Washington, DC.
Atomic Transition Probability Measurements for Spectral Lines of the 3S-4P Transition Array of Neutral Carbon.
 Final rept.,
 D. W. Jones, and W. L. Wiese. May 84, 8p
 Pub. in Physical Review A 29, n5 p2597-2604 May 84.

Keywords: *Atomic energy levels, *Carbon, *Emission spectroscopy, *Visible spectroscopy, Reprints.

Absolute transition probabilities for the 18 transitions of the 3s-4p transition array of neutral carbon have been studied in emission with a wall-stabilized arc. Values are given for ten individual lines and one pair of strongly blended lines (476.23 and 476.25 nm). An upper bound is set for the remaining six lines of the array which were too weak to be observed in this work. An important feature of this work is the use of digital least-squares-fitting techniques to separate overlapping lines and to provide accurate line-wing corrections. Problems associated with demixing effects have been avoided by normalizing relative transition probability measurements to an absolute scale set by atomic lifetimes.

400,325
PB84-244763 Not available NTIS
 National Bureau of Standards, Washington, DC.
Thermal Atomization Sources and Resonance Ionization Mass Spectrometry (RIMS).
 Final rept.,
 J. D. Fassett, J. C. Travis, and L. J. Moore. 1984, 8p
 Pub. in Society of Photo-Optical Instrumentation Engineers 482, p36-43 1984.

Keywords: *Ionization, *Thermal analysis, *Atomizing ions, Vanadium, Iron, Mass spectroscopy, Vaporization, Reprints, *Resonance ionization mass spectroscopy, *Laser spectroscopy.

Resonance ionization mass spectrometry has been used to study the formation of atomic ions. A one-wavelength, two-photon ionization scheme was used that is potentially applicable to nearly 50 elements. Thermal vaporization from rhenium filament substrates is described, and the controlling physical processes are enumerated. The laser characteristics which affect ionization are also discussed. Results are presented for vanadium and iron.

400,326
PB84-244771 Not available NTIS
 National Bureau of Standards, Washington, DC.
Transport Properties and Second Virial Coefficient of Argon: A Test of the Hulburt-Hirschfelder Potential.
 Final rept.,
 P. M. Holland, L. Biolsi, and J. C. Rainwater. Dec 83, 13p
 Pub. in Proceedings of Conference on Spectroscopic Probes of Van Der Waals Molecules, Oneonta, NY, March 20-21, 1981, p115-127 1983.

Keywords: *Argon, *Transport properties, Spectrochemical analysis, *Virial coefficients, *Hulburt-Hirschfelder potentials.

The Hulburt-Hirschfelder potential was used to calculate viscosity, thermal conductivity, self diffusion and second virial coefficients for argon without adjustable parameters. Comparison of the results with experimental data for these properties over a wide temperature range shows excellent overall agreement for the transport properties and good agreement for the second virial coefficient at higher temperatures. Deviations at lower temperatures are attributed to the difficulty of accurately determining the longer range part of the potential from spectroscopic data of the argon dimer. However, the H-H potential appears to accurately represent the true atom-atom potential over a wide range of interatomic separations so that the transport properties can be accurately estimated over a wide temperature range without the need to empirically adjust any of the experimentally determined spectroscopic constants used in the potential.

400,327
PB84-244821 Not available NTIS
 National Bureau of Standards, Washington, DC.
Cryoscopic Determination of the Purity of Benzene by Calorimetry.
 Final rept.,
 G. T. Furukawa, J. H. Piccirelli, and M. L. Reilly. 1984, 17p
 Pub. in American Society for Testing Materials, Special Technical Publication 838, p90-106 1984.

Keywords: *Heat measurement, *Cryoscopy, *Purity, Benzenes, Crystallization, Reprints, *Benzene.

To test the cryoscopic method for determination of purity, the impurity concentrations of duplicate samples taken from four prepared lots of benzene were determined on basis of the van't Hoff law of freezing-point lowering and on the assumption that the phases in equilibrium were pure solid benzene and liquid ben-

zene containing all of the impurities in ideal solution. The adiabatic calorimeter method was used in conjunction with automatic temperature controls and platinum resistance thermometry. Three of the lots contained weighed amounts of pure n-heptane, known only to the preparer, which were added to portions of the first lot which had been purified to better than 99.999 percent by a fractional crystallization technique. These results demonstrate that the cryoscopic determination of purity by calorimetry yields accurate values.

400,328
PB84-244839 Not available NTIS
 National Bureau of Standards, Washington, DC.
Some Effects of Spin-Orbit Interaction on Rotational Levels and Rotational Line Intensities in Vibrationally Unexcited 2A, 2E, and 2F Electronic States of XY4 Molecules.
 Final rept.,
 J. T. Hougen. 1984, 21p
 Pub. in Jnl. of Molecular Spectroscopy 106, p134-154 1984.

Keywords: *Spin orbit interactions, *Rotational spectra, Molecular energy levels, Molecular rotation, Angular momentum, Reprints.

Rotational energy levels in vibronic ground states of 2A, 2E, and 2F electronic states of open shell XY4 molecules are discussed, including the effects of spin-orbit interaction and tetrahedral splittings. Jahn-Teller effects are assumed to be small, and are only taken into account implicitly, through their contributions to various parameters in the effective Hamiltonian. Qualitative information is obtained by considering several coupling schemes among the electron spin angular momentum S, the electron orbital angular momentum L, and the pure rotational angular momentum R. These limiting cases are similar in spirit to Hund's coupling cases in diatomic molecules.

400,329
PB84-244847 Not available NTIS
 National Bureau of Standards, Washington, DC.
Small-Angle Neutron Scattering from a Polyurethane Block Copolymer.
 Final rept.,
 J. A. Miller, S. L. Cooper, C. C. Han, and G. Pruckmayr. 1984, 1p
 Pub. in Macromolecules 17, p1063 1984.

Keywords: *Neutron scattering, *Copolymers, *Polyurethane resins, Separation, Isotopic labeling, Reprints, *Small angle scattering, Polymer chains, Molecular conformations.

Small angle neutron scattering (SANS) experiments were performed on a series of polyether polyurethane block copolymers. The samples possessed the same chemical composition, but differed in the percentage of polyether soft segments that were completely deuterolabeled. The level of labelling covered a wide range, from no labelling up to 30% of the total polyether chains. At the highest level of deuteration, little interphase scattering occurs and the coherent portion of the scattering is dominated by the interchain scattering. The single chain scattering is dominated by the interchain scattering. The single chain scattering functions extracted from the scattering data yield a radius of gyration for the soft segment that is substantially larger than that reported for the polyether homopolymer in a theta solvent (35). Thus the soft segment chains in this lamellar block copolymer are in a somewhat extended conformation. Results of other work on a styrene-isoprene lamellar block copolymer indicate a similar chain conformation (23). Experimentally it was found that the technique of matching the interphase contrast yielded the single chain scattering function with greater accuracy than did the subtraction method. In addition, the smearing effects of wavelength polydispersity and collimation were analyzed. For this experiment, neither smearing phenomenon had any significant effect on the scattering data.

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Group 7D—Physical Chemistry

400,330
PB84-244854 Not available NTIS
National Bureau of Standards, Washington, DC.
Interlaboratory Isotopic Ratio Measurement of Nanogram Quantities of Uranium and Plutonium on Resin Beads by Thermal Ionization Mass Spectrometry.
Final rept.,
J. D. Fassett, and W. R. Kelly. Mar 84, 7p
Pub. in Analytical Chemistry 56, n3 p550-556 Mar 84.

Keywords: *Uranium, *Plutonium, *Chemical analysis, *Standards, *Anion exchanging, *Isotopic separation, Sources, Laboratories, Reprints, *Thermal ionization mass spectroscopy, *Standard reference materials.

The use of high sensitivity thermal ionization mass spectrometry for the accurate and precise measurement of uranium and plutonium isotopic ratios for safeguards accountability has been evaluated by means of an interlaboratory analysis program (round robin). Nanogram amounts of isotopic Standards Reference Materials (SRM's) and unknown samples were loaded onto anion exchange resin beads and transported to participating laboratories for measurement. U, Pu, and U plus Pu loaded beads were prepared and analyzed. It is concluded that isotopic fractionation is a major source of imprecision while the degree to which isotopic fractionation is a major source of imprecision while the degree to which isotopic fractionation is a major source of imprecision while the degree to which isotopic fractionation can be calibrated limits the measurement accuracy.

400,331
PB84-244870 Not available NTIS
National Bureau of Standards, Washington, DC.
Analysis of Human Liver Specimens in the U.S. Pilot National Environmental Specimen Bank Program.
Final rept.,
R. Zeisler, S. H. Harrison, and S. A. Wise. 1984, 21p
Pub. in Proceedings of International Workshop on Environmental Specimen Banking and Monitoring as Related to Banking, Saarbruecken, Federal Republic of Germany, May 10-15, 1982, p331-351 1984.

Keywords: *Chemical analysis, *Bioassay, *Environmental surveys, *Liver, Trace elements, Humans, Public health, Sampling, State of the art.

Integral part of the U.S. Pilot National Environmental Specimen Bank Program is the implementation of a valid chemical measurement strategy. During the first phase of working experience in the program a measurement system has been developed for human liver specimens, which includes the protocols for specimen collection as well as all aspects of the analytical measurements, i.e., the preparatory techniques, the analytical procedures, the quality assurance, and weight standardization. Goal of the strategy is the direct and unbiased relation of the data to the original sample. For contamination free homogenization of the specimens, a new brittle fracture procedure has been evaluated and implemented, providing 1 g analytical test portions with less than one percent error due to inhomogeneity. State-of-the-art analytical methodology is applied to determine more than thirty minerals and trace elements of biological and environmental importance in the tissue. The analytical methods are atomic absorption spectrometry, isotope dilution mass spectrometry, neutron activation analysis, and voltammetry. Data are presented for 36 individual liver specimens collected in the program. The large data base answers key issues of chemical measurements in the environmental and biological field and an interpretation is given on the quality of the developed measurement strategy.

400,332
PB84-244896 Not available NTIS
National Bureau of Standards, Washington, DC.
Mechanisms for Photon Stimulated Desorption of O⁺ from Cr(110).
Final rept.,
R. Stockbauer, D. Ramaker, E. Bertel, R. Kurtz, and T. E. Madey. Jun 84, 2p
Pub. in Jnl. of Vacuum Science and Technology A2, n2 p1053-1054 Apr-Jun 84.

Keywords: *Desorption, *Oxygen, *Chromium, Synchrotron radiation, Photons, Stimulation, Reprints, *Electron stimulated desorption, *Photon stimulated desorption.

The interaction of oxygen with Cr(110) has been studied using synchrotron radiation techniques. A major

objective of this work has been to determine the mechanism of electron and photon stimulated desorption (ESD/PSD) of O(+) from the surface of a non-maximal-valency, covalent oxide. The mechanism identified in this study is a generalization of the Knotek-Feibelman Auger decay model of ion desorption, because the driving force is the Coulomb correlation of a localized 2 hole state rather than the instability of the ion in the Madelung potential.

400,333
PB84-244912 Not available NTIS
National Bureau of Standards, Washington, DC.
Adsorption and Orientation of NH₃ on Ru(001).
Final rept.,
C. Benndorf, and T. E. Madey. 1983, 20p
Pub. in Surface Science 135, p164-183 1983.

Keywords: *Ammonia, *Surface chemistry, Adsorption, Chemical bonds, Ruthenium, Reprints, LEED(Low energy electron diffraction), Electron stimulated desorption ion angular distribution method, Thermal desorption.

The interaction of NH₃ with clean Ru(001) surfaces has been studied using LEED (low energy electron diffraction), ESDIAD (electron stimulated desorption ion angular distribution), TDS (thermal desorption spectroscopy), and work function changes (delta phi).

400,334
PB84-244920 Not available NTIS
National Bureau of Standards, Washington, DC.
Shape Resonances, Overtones, and Electron Energy Loss Spectroscopy of Gas Phase and Physisorbed Diatomic Molecules.
Final rept.,
J. W. Gadzuk. 15 Oct 83, 6p
Pub. in Jnl. of Chemical Physics 79, n8 p3982-3987, 15 Oct 83.

Keywords: *Diatomic molecules, *Oxygen, *Nitrogen, *Vapor phases, Substrates, Excitation, Reprints, *Electron energy loss spectroscopy, *Overtone spectroscopy, Physisorption.

Electron energy loss spectra of O₂ and N₂ physisorbed on metallic substrates showing a series of high overtone losses have recently been reported. In the case of N₂, the intense overtone excitation is credited to the formation of a well known temporary negative ion state with a resonance lifetime about 10 to the -15th power sec for gas phase N₂(-1). The principal distinction between the gaseous and physisorbed molecule EELS spectrum is a significant depletion of the overtone intensity which has been attributed to a surface-induced decrease in the resonance lifetime. In the present work, a time dependent quantum mechanical model applicable to vibrational excitation in resonance scattering is outlined which quantitatively accounts for the observed spectra and in particular, the surface modifications to the gas phase results. The essential feature of the model is one in which the intramolecular dynamics of the intermediate state is characterized by nuclear propagation over a harmonic potential curve spatially displaced from the ground state curve for a time duration equal to the resonance lifetime. The resulting calculated overtone spectra agree well with the experimentally observed ones. The results suggest that the physisorbed N₂(-1) lifetime is about 40% of that of the free molecule.

400,335
PB84-245232 PC A05/MF A01
National Bureau of Standards (NML), Washington, DC.
Technical Activities 1983: Office of Standard Reference Data,
S. P. Fivozinsky. Apr 84, 82p NBSIR-84/2864
See also PB83-193078.

Keywords: *Physical properties, *Chemical properties, *Standards, Information systems, Environmental surveys, Energy, Materials, *Office of standard reference data, *National standard reference data system.

The Office of Standard Reference Data is one of two program offices in the National Measurement Laboratory, National Bureau of Standards. The Standard Reference Data Program develops and disseminates data bases of critically evaluated physical/chemical properties of substances. These data bases are available through NBS and private publications, on magnetic tape, and from on-line retrieval systems. The Office of Standard Reference Data is responsible for management and coordination of the program. Work is carried out through a decentralized network of data centers

and projects referred to as the National Standard Reference Data System (NSRDS). This volume summarizes the activities of the program for the year 1983.

400,336
PB84-245794 Not available NTIS
National Bureau of Standards, Washington, DC.
Frequency-Dependent Conductivity of Polyacetylene.
Final rept.,
A. J. Glick, and G. W. Bryant. 1982, 8p
Pub. in Proceedings of International Conference on Low-Dimensional Conductors, Boulder, CO, August 9-14, 1981, Molecular Crystals and Liquid Crystals 83, n1-4 p1183-1190 1982.

Keywords: *Conductivity, Impurities, Chemical bonds, Density(Mass/volume), *Polymer chains, *Polyacetylene, Electron energy loss spectroscopy.

The finite temperature frequency dependent conductivity of a polymer chain such as trans-polyacetylene has been calculated using a two band tight-binding model. A collective mode in the dielectric response gives rise to energy adsorption below the interband threshold even when no account is taken of possible soliton modes. The effect of impurities on this mode has been included phenomenologically by introducing a collision time. The effect of impurities on the density of states has been studied with diagram techniques and the CPA approach. The contributions of these effects to the optical and electron energy loss spectra of trans-polyacetylene are discussed.

400,337
PB84-245836 Not available NTIS
National Bureau of Standards, Washington, DC.
Fermi Resonances and Vibrational Spectra of Crystalline and Amorphous Polymethylene Chains.
Final rept.,
S. Abbate, G. Zerbi, and S. L. Wunder. 1982, 10p
Pub. in Jnl. of Physical Chemistry 86, n16 p3140-3149 1982.

Keywords: *Raman spectroscopy, *Vibrational spectra, Infrared spectroscopy, Fermi surfaces, Reprints, *Polymer chains, *Polymethylene.

An improvement in the interpretation of the infrared and Raman spectra of polymethylene chains is obtained when Fermi Resonances are taken into account. In this paper Fermi resonances are considered both in the CH₂ bending and stretching regions. A method is proposed for dealing with k-dependent frequencies for chains either isolated or in the crystalline state. In this work use is made of previous intensity studies in infrared and Raman for a quantitative account of intensities and band shapes. The ratio, R, of the Raman intensities of the lines at 2850 and 2940/cm is shown to be a measure of conformational disorder. The validity of this theoretical prediction is demonstrated for the case of polyethylene samples of varying degrees of crystallinity. Under the assumption that the remaining amorphous material obeys Boltzmann statistics with pentane exclusion, R is found to be a linear function of gauche bond population.

400,338
PB84-245851 Not available NTIS
National Bureau of Standards, Washington, DC.
Dielectronic Recombination of Some Singly Charged Ions.
Final rept.,
G. H. Dunn, D. S. Belic, T. J. Morgan, D. W. Mueller, and C. Timmer. 1984, 9p
Pub. in Proceedings of International Conference on Physics of Electronic and Atomic Collisions (13th), Berlin, July 27-August 3, 1983, p809-817 1984.

Keywords: *Ions, *Recombination reactions, Magnesium, Calcium, Carbon, *Dielectronic recombination, Chemical reaction mechanisms.

Dielectronic recombination (DR) has recently yielded to measurement in four different laboratories. This paper, after discussing the mechanism of DR describes the experiments on singly charged ions. For all three ions, Mg(+1), Ca(+1), and C(+1), the measured cross sections are substantially larger than theoretical predictions. For the case of Mg(+1), taking account of extrinsic fields may account for most of the discrepancy, and new experiments to measure this are suggested. For Ca(+1) and C(+1) the extrinsic fields appear to have been very small, and the role of these

fields in explaining experiment/theory discrepancies is not clear.

400,339
PB84-245885 Not available NTIS
National Bureau of Standards, Washington, DC.
Preparation and Analysis of Vinyl Chloride Standards.

Final rept.,
E. E. Hughes, W. D. Dorko, S. M. Freund, and D. M. Sweger. 1976, 5p
Pub. in Proceedings of International Conference on Environmental Monitoring, Las Vegas, NV., September 15-19, 1975, IEEE (International Electrical and Electronics Engineers) Cat. No. CH1004-1, 1, Paper 2-5, 5p 1976.

Keywords: *Vinyl chloride, *Standards, *Chemical analysis, Air pollution, Stability, Gas chromatography, Sampling, Stark effect, *Air pollution detection, Laser spectroscopy.

Gaseous standards consisting of low concentration of vinyl chloride in air have been prepared in the range of 1000 to 2 ppmv. The standards were prepared in steel cylinders and an investigation was completed of the stability of the standards and on the accuracy with which they were prepared. The stability was studied by comparison of the gas chromatographic signal from vinyl chloride with the signal resulting from an internal standard of propane. A second check was made by comparison with freshly prepared standards. Accuracy was assessed by comparing replicate samples derived independently of each other using both gas chromatography and a recently developed analytical method using carbon monoxide and carbon dioxide lasers. Stark modulated absorption by vinyl chloride of the infrared laser radiation is the basis of this latter technique. The linearity of response of this technique, is excellent over at least four orders of magnitude of vinyl chloride concentrations ranging from 0.1 to 1000 ppm in air.

400,340
PB84-245919 Not available NTIS
National Bureau of Standards, Washington, DC.

Forward Depolarized Scattering of Semi-Dilute Solution of Poly (Alpha-Methyl Styrene).

Final rept.,
M. Delsanti, C. C. Han, and H. Yu. Mar 81, 2p
Pub. in ACS (American Chemical Society) Polymer Preprints 22, n1 p76-77 Mar 81.

Keywords: *Doppler effect, *Light scattering, *Depolarization, Solutions, Molecular weight, Polymers, Plastics, Reprints, *Poly(styrene/methyl), *Forward depolarized scattering techniques.

The Doppler broadened power spectrum of scattered light in the forward depolarized configuration has been used to deduce the internal normal modes of isolated linear macromolecules (1-4). A distinguishing virtue of the forward depolarized scattering (FDS) technique is to focus on the intramolecular motion while suppressing the contribution of the center of mass transport to the power spectrum. If one is interested in the cooperative processes in polymer solutions wherein the individual macromolecules are no longer isolated from one another but with a good deal of overlap in the chain configurations of different molecules, the FDS technique may also be useful in probing the cooperative rotatory dynamics. Inasmuch as the technique reveals the time dependent optical anisotropy changes induced by spontaneous thermal fluctuations, it is not a priori obvious as to exactly what kind of the dynamic processes that contributes predominantly to the FDS power spectrum.

400,341
PB84-245935 Not available NTIS
National Bureau of Standards, Washington, DC.
Dielectric Saturation and Dielectric Friction on an Ion in a Polar Solvent.

Final rept.,
J. B. Hubbard, and R. F. Kayser. 15 Apr 82, 6p
Pub. in Chemical Physics 66, n3 p377-382, 15 Apr 82.

Keywords: *Ions, *Dielectric properties, *Mathematical models, Solvents, Polarity, Reprints.

The effect of dielectric saturation on the mobility of an ion in a polar solvent is analyzed within the framework of a continuum dielectric friction model. It is shown that for large ions, polarization saturation results in an increased drag relative to the case of dielectric friction without saturation.

400,342
PB84-245943 Not available NTIS
National Bureau of Standards, Washington, DC.
Gas Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge and Trap Sampling with a Tin-Selective Detector.

Final rept.,
J. A. Jackson, W. R. Blair, F. E. Brinckman, and W. P. Iverson. Feb 82, 10p
See also AD-A100 150.
Pub. in Environmental Science and Technology 16, n2 p110-119 Feb 82.

Keywords: *Gas chromatography, *Water analysis, *Chesapeake bay, Chemical analysis, Traps, Mass spectroscopy, Sampling, Water pollution, Measuring instruments, In vivo analysis, Reprints, *Water pollution detection, *Purge flame photometric gas chromatography, *Water pollution sampling, Tin/tetramethyl, Tin hydride/methyl.

A method has been developed which permits simultaneous detection and speciation of both volatile and non-volatile organotin in aqueous media. The method employs a commercial gas chromatograph (GC) with a flame photometric detector (FPD) optimized for tin-selective detection. Solvated organotins are volatilized by hydride reduction with sodium borohydride during the purge cycle of a commercial automatic purge and trap sampler (P/T) which sparges volatile species from aqueous solutions with N₂ while concentrating and trapping volatiles and species volatilized by hydridization on a Tenax-GC filled trap at ambient temperature. Any Me₄Sn which is present in the sample is unaffected by the reduction process. The P/T-GC-FPD method was used to analyze water samples collected from the Chesapeake Bay. Varying amounts of methyltin compounds, including tetramethyltin and methyltin hydrides, were detected in polluted sites in Baltimore Harbor. Although tetramethyltin was identified, the detection and error limits are not yet satisfactory. Biogenic origins are suspected for the methylstannanes (Me_n)SnH_{4-n} (n=2,3) in the Chesapeake Bay. In vitro studies using GC-MS confirmed results of microbial methylation of inorganic Sn(IV) to form Me_n)SnH_{4-n} (n=2,3,4), by a strain of Pseudomonas species isolated from the Chesapeake Bay.

400,343
PB84-245968 Not available NTIS
National Bureau of Standards, Washington, DC.

Instrumental Effects on the Glass Transition Temperature.

Final rept.,
P. D. Garn, and O. Menis. 1977, 19p
Pub. in Jnl. of Macromolecular Science, Part B: Physics B13, n4 p611-629 1977.

Keywords: *Glass transition temperature, *Standards, *Polystyrene, *Thermal analysis, Sensors, Sites, Measuring instruments, Reprints, *Certified reference materials.

The testing and evaluation program leading to the certification of a selected batch of polystyrene as ICTA Reference Material GM 754 is described. Defined points from the glass transition curve were obtained first in a preliminary program, then in 24 laboratories using eight kinds of apparatus. Separation of the data by heating rate, sample holder configuration, temperature sensor location and combinations of these disclosed that (a) the reproducibility under a given set of conditions warranted certification; (b) the apparent heating rate dependence of the measured points is largely due to separation of the measuring point (sensor location) from the sample; and (c) the inherent time dependence of the glass transition leads to an intrinsic contribution to the apparent heating rate dependence.

400,344
PB84-245984 Not available NTIS
National Bureau of Standards, Washington, DC.

Core-Level Processes in the Electron Stimulated Desorption of CO from the W(110) Surface.

Final rept.,
J. E. Houston, and T. E. Madey. 15 Jul 82, 13p
Pub. in Physical Review B 26, n2 p554-556, 15 Jul 82.

Keywords: *Carbon monoxide, *Surface chemistry, Chemisorption, Adsorption, Excitation, Desorption, Reprints, *Electron stimulated desorption.

Franchy and Menzel recently reported a significant increase in the desorption (ESD) yield of O(+1) ions

from CO adsorbed on the (100) surface of W at 80K when the incident electron energy exceeded that necessary to excite the oxygen 1s core level. Disintegration of the adsorption complex which becomes multiply charged by Auger decay of the core hole was offered as an explanation. In the present work they have investigated this effect in detail for absorption of CO at 80K on the W(110) surface. In agreement with Franchy and Menzel, the authors observed an increased O(+1) ESD yield for electron energies above the O1s threshold for saturation coverages of CO adsorbed at 80K. In addition, we find that the O(+1) yield in this region is strongly dependent on coverage and post-absorption thermal annealing. We present data which indicates that, in fact, the magnitude of the O(+1) yield for energies much greater than the threshold appears to be rather insensitive to the CO binding site and follows closely the total CO coverage. In contrast, it is found that the O(+1) yield from excitation processes which have their thresholds at low energies, i.e., less than 100 eV, is strongly dependent upon the chemical state of the adsorbed CO and is greatly suppressed for coverages above about 0.5 monolayer.

400,345
PB84-245992 Not available NTIS
National Bureau of Standards, Washington, DC.

Temperature-Dependent Photoemission Line Shapes of Physisorbed Xenon.

Final rept.,
J. W. Gadzuk, S. Holloway, C. Mariani, and K. Horn. 3 May 82, 4p
Pub. in Physical Review Letters 48, n18 p1288-1291, 3 May 82.

Keywords: *Xenon, *Photoelectric emission, *Line width, *Surface chemistry, *Mathematical models, Temperature, Comparison, Copper, Reprints.

A model is presented for the temperature dependence of adsorbate photoemission line widths. By approximating the initial and final states as displaced harmonic oscillators, an analytic form for the observed line width is obtained. Comparison with angle-resolved photoemission spectra of xenon on Cu(110) yields excellent agreement.

400,346
PB84-246008 Not available NTIS
National Bureau of Standards, Washington, DC.

Equilibrium Properties of Polydisperse Systems.

Final rept.,
J. A. Gualtieri, J. M. Kincaid, and G. Morrison. 1982, 4p
Pub. in Proceedings of Symposium on Thermophysical Properties (8th), Gaithersburg, MD., June 15-18, 1981, Paper in Thermophysical Properties of Fluids 1, p331-334 1982.

Keywords: *Polymers, *Phase transformations, *Free energy, Mixture, Van der Waals equation, Critical point, Dispersion, *Phase equilibrium, Numerical solution.

The authors give a prescription for obtaining a polydisperse free energy from the free energy of a finite component mixture. The two-phase equilibrium conditions are solved for the polydisperse impurity case, and the shift in the location of the critical point is obtained. Their calculations are carried out within the context of a generalized van der Waals model.

400,347
PB84-246016 Not available NTIS
National Bureau of Standards, Washington, DC.

Anatomy of the Thermodynamic Surface of Water: The Formulation and Comparisons with Data.

Final rept.,
L. Haar, and J. S. Gallagher. 1982, 5p
Pub. in Proceedings of Symposium on Thermophysical Properties (8th), Gaithersburg, MD., June 15-18, 1981, Paper in Thermophysical Properties of Solids and of Selected Fluids for Energy Technology 2, p298-302 1982.

Keywords: *Water, *Thermodynamic properties, *Surface chemistry, Fluids, Equations of state, Enthalpy, Entropy, Specific heat, Comparison, Numerical solution.

A thermodynamic surface for water has been derived with which all thermodynamic properties for the fluid states can be calculated from the freezing line to in excess of 2000 K in temperature and from the dilute gas to in excess of 1 GPa in pressure. The calculated

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values are everywhere in good accord with accurate data.

400,348
PB84-246065 Not available NTIS
National Bureau of Standards, Washington, DC.
Laser Stark Spectroscopy of DCN and DC15N.
Final rept.,
S. M. Freund, and A. G. Maki. Jun 82, 5p
Pub. in *Jnl. of Molecular Spectroscopy* 93, n2 p433-437 Jun 82.

Keywords: *Stark effect, *Hydrogen cyanide, *Deuterium compounds, Infrared spectroscopy, Dipole moments, Reprints, *Laser magnetic resonance, *Laser spectroscopy.

Using a CO laser, laser Stark resonance spectra have been measured for the C-N stretching fundamentals (the 001 sup 0-00 sup 00 bands) of D sup 12C sup 14N and D sup 12C sup 15N near 1925/cm. Laser Stark resonances have also been measured for the hot band 01 sup 1 1-01 sup 1 0 of D sup 12C sup 14N. In addition to accurately determining the band centers, dipole moments are given for the different vibrational states involved.

400,349
PB85-100170 Not available NTIS
National Bureau of Standards, Washington, DC.
Protonation of C3H6 and C4H8 Isomers: Isotope Exchange and Isomerization.
Final rept.,
E. P. Hunter, and S. G. Lias. 1982, 7p
Pub. in *Jnl. of Physical Chemistry* 86, n14 p2769-2775 1982.

Keywords: *Isotope exchange, *Isomerization, *Cyclopropane, Deuterium compounds, Reprints, *Butene, *Ion cyclotron resonance spectrometers, *Ion molecule interactions.

Isotope exchange processes of the type $MH(+1) + C_3D_6$ yields $MD(+1) + C_3HD_5$ or $(MD(+1) + C_3H_6$ yields (where $C_3(H,D)_6$ is propylene or cyclopropane) have been studied in an ICR spectrometer. It is shown that for both reactant molecules, the efficiency of the exchange reaction can be correlated with the exothermicity of the formation of the complex ($M-C_3(H,D)_7(+1)$) from separated $M(H,D)(+1)$ and $C_3(H,D)_6$ reactants. In the case of propylene, all of the $M(H,D)(+1)$ reactants are chosen so that proton (deuteron) transfer is endothermic. For cyclopropane reactant molecules, some of the reactant pairs have available an exothermic channel leading to the formation of a sec-propyl ion product, but this process is shown to compete poorly with the isotope exchange process (which may or may not involve isomerization of the neutral cyclopropane to propylene in the collision complex). Isotope exchange reactions involving the partially deuterated propylenes $CD_3CH=CH_2$, $CH_3CH=CD_2$, and $CH_3CH=CHD$ provide evidence that when M is a nitrile, there is statistical scrambling of the H and D atoms in the $C_3(H,D)_7(+1)$ in the $(M\text{-}sec\text{-}C_3(H,D)_7(+1))$ complex; when M is an aldehyde or a format, the reaction involves only the H and D atoms on the methyl groups of the $sec\text{-}C_3(H,D)_7(+1)$ species in that complex.

400,350
PB85-100188 Not available NTIS
National Bureau of Standards, Washington, DC.
Reinvestigation of the I* Yield in the 193 nm Photodissociation of 1,2-C2F4IBr.
Final rept.,
C. A. Wight, and S. R. Leone. Dec 83, 2p
Contract DAAG29-82-K-0031
Pub. in *Jnl. of Chemical Physics* 87, n25 p5299-5300 Dec 83.

Keywords: *Iodine, *Ultraviolet spectroscopy, *Dissociation, *Photochemical reactions, Fluorescence, Fluorine organic compounds, Reprints, *Ethane/bromo-fluoro-iodo.

In a recent meeting, Y. T. Lee and co-workers reported that a high yield of excited I^* does result from the 193 nm photodissociation of C_2F_4IBr . Their measurements use the molecular beam time-of-flight method. This discrepancy prompted us to reinvestigate the I^* yield by the infrared fluorescence method. The authors report that the previous work of Baughcum, Pence and Leone is in error and that the high yield of I^* is also observed in infrared emission from the 193 nm dissociation. There is no obvious explanation for the previous result. The new results substantially change the

conclusions drawn concerning bond selective dissociation pathways in this class of compounds.

400,351
PB85-100196 Not available NTIS
National Bureau of Standards, Washington, DC.
Infrared Spectrum of the C2F5 Free Radical Trapped in Solid Argon in Discharge Sampling Experiments.
Final rept.,
M. E. Jacox. 1984, 4p
Pub. in *Jnl. of Chemical Physics* 88, n3 p445-448 1984.

Keywords: *Infrared spectroscopy, *Free radicals, Absorption, Chemical bonds, Fluorine organic compounds, Reprints, *Ethylene/fluoro.

When the products of the reaction between F atoms formed in a microwave discharge and C_2F_4 are frozen in a large excess of argon at 14 K, prominent absorptions of C_2F_5 and C_2F_6 appear in the infrared spectrum of the solid deposit. All of the absorptions above 400/cm previously attributed to C_2F_5 except that near 1040/cm have been confirmed. Very little fragmentation of C_2F_5 occurs under the conditions of these experiments. The most prominent absorptions of C_2F_5 are also present in the infrared spectrum of the quenched products of the excitation of an Ar: C_2F_6 sample in a low-power microwave discharge, but rupture of the C=C bond predominates the corresponding study of discharged Ar: C_2F_4 samples. The vibrational assignment of the C_2F_5 spectrum and the processes which account for the observed product distribution in the F + C_2F_4 experiments are discussed.

400,352
PB85-100220 Not available NTIS
National Bureau of Standards, Washington, DC.
Ro-Vibrational Excitation of HCl by Electron Impact.
Final rept.,
N. T. Padial, and D. W. Norcross. 1984, 4p
Contract DOE-EA-77-A-01-6010
Pub. in *Physics Review A* 29, n3 p1590-1593 1984.

Keywords: *Hydrogen chloride, *Molecular vibration, *Molecular rotation, Excitation, Inelastic scattering, Elastic scattering, Reprints, *Electron molecule interactions, Numerical solution.

Ab initio calculations of cross sections for simultaneous rotational and vibrational excitation of HCl by low-energy electrons have been made in the multipole-extracted adiabatic-nuclei approximation. These calculations employed a free-electron-gas model of the exchange interaction, and represent the first application of a new parameter-free model of the correlation-polarization interaction to vibrational excitation. The cross sections increase by an order of magnitude with the inclusion of this interaction, which is much more important for vibrationally inelastic than elastic collisions.

400,353
PB85-100246 Not available NTIS
National Bureau of Standards, Washington, DC.
Infrared Double-Resonance Spectroscopy of V-T,R Relaxation of HF($\nu=1$): Direct Measurement of the High-J Populations.
Final rept.,
H. K. Haugen, and S. R. Leone. Mar 84, 12p
Sponsored in part by Air Force Office of Scientific Research, Arlington, VA.
Pub. in *Jnl. of Chemical Physics* 80, n5 p1839-1850 Mar 84.

Keywords: *Hydrogen fluoride, *Infrared spectroscopy, *Molecular relaxation, Molecular rotation, Molecular vibration, Molecular energy levels, Reprints, *Laser spectroscopy.

The V-T,R relaxation of HF($\nu=1$) by HF is studied by infrared pulse-probe transient absorption measurements using a tunable F-center laser. It is found that a substantial fraction of the relaxation occurs through the high-lying rotational levels of $\nu=0$. The results indicate that the states $J=10-14$ comprise about 20%-40% of the population in the total relaxation, with the distribution increasing rapidly with decreasing J in this range.

400,354
PB85-100279 Not available NTIS
National Bureau of Standards, Washington, DC.
Numerical Methods for Asymptotic Solutions of Scattering Equations.
Final rept.,
D. W. Norcross. 1983, 19p
Pub. in Chapter 9 in *Atoms in Astrophysics*, p55-73 Jan 83.

Keywords: *Particle collisions, Applications of mathematics, *Scattering theory, Electron-atom collisions, Electron-ion collisions, Electron-molecule collisions.

Techniques for obtaining solutions of the coupled equations of electron-atom (ion, molecule) scattering in the asymptotic region (larger) are reviewed, with particular emphasis on the work of Prof. M. J. Seaton.

400,355
PB85-100345 Not available NTIS
National Bureau of Standards, Washington, DC.
Curie Transitions in Copolymers of Vinylidene Fluoride.
Final rept.,
A. J. Lovinger, T. Furukawa, G. T. Davis, and M. G. Broadhurst. 1983, 10p
Pub. in *Ferroelectrics* 50, p227-236 1983.

Keywords: *Copolymers, *Curie temperature, Plastics, X ray analysis, Dielectric properties, Reprints, *Ethylene/trifluoro, *Vinylidene fluoride polymers.

A series of random copolymers of vinylidene fluoride and trifluoroethylene containing 52, 65, 73, and 78 mol % VF₂ has been shown by X-ray and dielectric techniques to undergo Curie transitions.

400,356
PB85-102150 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of Hafnium in Zirconium Metal and Zircaloy 4 Metal Standard Reference Materials by Isotope Dilution Spark Source Mass Spectrometry.
Final rept.,
L. J. Powell, and P. J. Paulsen. 1984, 3p
Pub. in *Analytical Chemistry* 56, n3 p376-378 1984.

Keywords: *Chemical analysis, *Standards, *Hafnium, Metals, Cation exchanging, Reprints, *Standard reference materials, *Isotope dilution techniques, *Spark source mass spectroscopy, Ion chromatography.

A procedure has been developed for the determination of microgram per gram concentrations of hafnium in zirconium metal and zircaloy 4 metal Standard Reference Materials (SRM's) by stable isotope dilution spark source mass spectrometry. The concentration of hafnium in these SRM's ranges from 200 micrograms/g in SRM 1236 to 32 micrograms/g in SRM 1237. One half-gram samples were spiked with (179) Hf and dissolved in a mixture of hydrofluoric and sulfuric acids and the isotopically altered Hf was separated from Zr by cation exchange chromatography using 0.32 M sulfuric acid as an eluant. The isotopically altered, purified hafnium was evaporated onto 200 mesh gold powder which was subsequently homogenized and pressed into electrodes. The altered isotopic ratios were determined by spark source mass spectrometry using electrical detection.

400,357
PB85-102168 Not available NTIS
National Bureau of Standards, Washington, DC.
Liquid Chromatography-Gas Chromatography Procedure to Determine the Concentration of Dibenzothiophene in a Crude Oil Matrix.
Final rept.,
R. E. Rebbert, S. N. Chesler, F. R. Guenther, and R. M. Parris. 1984, 7p
Pub. in *Jnl. of Chromatography* 284, p211-217 1984.

Keywords: *Crude oil, *Chromatographic analysis, Hydrocarbons, Gas chromatography, Concentration(Composition), Chemical analysis, Reprints, *Dibenzothiophene, *Standard reference materials, *Matrix isolation techniques.

The concentration of dibenzothiophene in SRM 1582, Wilmington crude oil, was determined using a technique which combines liquid chromatography and gas chromatography. In particular, liquid chromatography was utilized for initial sample clean-up and separation of the thiophenes. A dual-flame photometric detector

specific for sulfur-containing compounds was used as the detector for gas chromatography. In order to further minimize possible sources of error due to the natural hydrocarbon matrix of the oil, a standard addition method was also utilized.

400,358

PB85-102176 Not available NTIS
National Bureau of Standards, Washington, DC.

Implicit Apodization of Interferograms in Fourier Transform Spectroscopy.

Final rept.,
A. Baghdadi. 1983, 4p
Pub. in *Applied Spectroscopy* 37, n6 p520-523 1983.

Keywords: *Infrared spectroscopy, *Chemical analysis, Spectrochemical analysis, Reprints, *Fourier transform spectroscopy, *Interferograms, Procedures.

The removal of secondary and tertiary interferograms from the main interferogram in Fourier transform spectroscopy can lead to an implicit apodization of the specimen interferogram. This effect can result in the generation of unwanted artifacts in the specimen's transmittance or absorption spectrum. One approach for avoiding this problem is to use an apodization function on the background and reference interferograms which matches the function used on the specimen interferogram.

400,359

PB85-102192 Not available NTIS
National Bureau of Standards, Washington, DC.

Heat Capacity and Electrical Resistivity of Nickel in the Range 1300-1700 K Measured with a Pulse Heating Technique.

Final rept.,
A. Cezairliyan, and A. P. Müller. 1983, 8p
Sponsored in part by Air Force Office of Scientific Research, Arlington, VA.
Pub. in *International Jnl. of Thermophysics* 4, n4 p389-396 1983.

Keywords: *Nickel, *Specific heat, *Electrical resistivity, Reprints, High temperature.

Measurements of heat capacity and electrical resistivity of nickel in the temperature range 1300-1700 K by a subsecond duration pulse heating technique are described. The results are given.

400,360

PB85-102200 Not available NTIS
National Bureau of Standards, Washington, DC.

Hysteresis in Copolymers of Vinylidene fluoride and Trifluoroethylene.

Final rept.,
G. T. Davis, M. G. Broadhurst, A. J. Lovinger, and T. Furukawa. 1984, 12p
See also AD-A137446.
Pub. in *Ferroelectrics* 57, p73-84 1984.

Keywords: *Copolymers, *Hysteresis, Phase transformation, Piezoelectricity, Pyroelectricity, Temperature, Fluorine organic compounds, Polymers, Reprints, *Ethylene/trifluoro, *Vinylidene fluoride polymers.

Copolymers of vinylidene fluoride (VDF) and trifluoroethylene (TrFE), with more than 50 mole percent VDF exhibit D-E hysteresis loops at room temperature which are much sharper than those exhibited by various crystal phases of the PVDF homopolymer. For the copolymer samples investigated here, appreciable conductivity develops at elevated temperatures which in the presence of electric fields leads to trapped charges in the polymer film. These charges then prevent the switching of dipoles at values of electric fields that were previously applied, the room temperature hysteresis is greatly reduced and polarization through the thickness of the film is highly non-uniform. Upon heating the copolymers above the ferroelectric to paraelectric transition temperature, the polarization is destroyed, the space charges are apparently released and room temperature hysteresis is restored. Experiments with aluminum, and gold electrodes and with mica blocking electrodes lead one to conclude that the charges are generated internally and are not injected from the electrodes.

400,361

PB85-102218 Not available NTIS
National Bureau of Standards, Washington, DC.

Two-Dimensional Dynamical Jahn-Teller Effects in a Mixed-Valence Benzotriazolato Copper Cluster, Cu₅(BTA)₆(RNC)₄.

Final rept.,
G. F. Kokoska, J. Baranowski, C. Goldstein, J. Orsini, and A. D. Mighell. 1983, 6p
Pub. in *Jnl. of the American Chemical Society* 105, n17 p5627-5633 1983.

Keywords: *Complex compounds, *Corrosion prevention, *Copper organic compounds, *Isonitriles, Hyperfine structure, Temperature, Reprints, *Space group symbols, *Jahn-Teller effect, *Thiophenoxide, *Benzotriazole.

Clusters of composition Cu₅(BTA)₆(RNC)₄(BTA = benzotriazolato(-1)) were prepared from the reaction of copper(I) thiophenoxide, benzotriazole, and an organic isocyanide. Cu₅(BTA)₆(1-C₄H₉NC)₄ crystallizes in space group P4₂ sub 1 c, a = 13.836 (4) Å. c = 16.686 (4) Å. Z = 2. D (calcd) = 1.413. D (obsd) = 1.41 (2) Mg/cu m. The structure solution, based on 903 reflections. The molecular structure has 4 symmetry; compressed octahedral copper(II) is surrounded by four tetrahedrally coordinated copper(I) ions. Data were recorded at 9.24 and 54 GHz. Furthermore, the EPR data are not consistent with a d ground state in spite of the compressed octahedral molecular geometry. The other three compounds also showed interesting temperature-dependent effects.

400,362

PB85-102234 Not available NTIS
National Bureau of Standards, Washington, DC.

Space Group Frequencies for Organic Compounds.

Final rept.,
A. D. Mighell, V. L. Himes, and J. R. Rodgers. 1983, 4p
Pub. in *Acta Crystallographica A* 39, p737-740 1983.

Keywords: *Organic compounds, *Crystal structure, *Crystal symmetry, Reprints, *Matrix(Crystals), *Space group symbols.

The space-group frequency for approximately 30,000 organic compounds in the NBS Crystal Data Identification File has been calculated for each of the 230 space groups. In contrast, there are 29 space groups with only one entry and 35 space groups with none at all. Although the space-group frequencies should be fairly representative of their distribution in nature, certain frequencies are over- or under-estimated. An analysis of the metric symmetry for about 30,000 lattices using a matrix technique has revealed that it is not uncommon for the metric symmetry to exceed the reported crystal symmetry. In many of these cases, the structures have been described in space groups of unnecessarily low symmetry. By explicitly checking for the highest possible metric symmetry during the space-group-determination procedure, errors of this type can be prevented.

400,363

PB85-102267 Not available NTIS
National Bureau of Standards, Washington, DC.

Real-Time Mass-Spectrometric Study of the Chemistry Initiated by Infrared-Laser Photolysis: CF₂HCl.

Final rept.,
R. I. Martinez, and J. T. Herron. 1981, 3p
Pub. in *Chemical Physics Letters* 84, n1 p180-182 1981.

Keywords: *Mass spectroscopy, *Infrared spectroscopy, *Photolysis, Free radicals, Dissociation, Chemical reactions, Chlorine organic compounds, Reprints, *Laser spectroscopy, *Methane/chloro-difluoro.

The infrared-laser photolysis/mass-spectrometric (ILP/MS) technique was used to monitor directly in real time the free-radical and stable reactants and products present in the reactive system initiated by the multiphoton-induced dissociation of CF₂HCl. The experimental observations indicate that in addition to the major channel CF₂HCl + micro h nu yields CF₂ + HCl, three additional minor channels can be accessed: CFCl + HF, CHCl + F₂, and CHF + ClF. A reaction scheme is proposed to explain the observations.

400,364

PB85-102747 Not available NTIS
National Bureau of Standards, Washington, DC.

ENDOR of Triplet State Systems in Solids.

Final rept.,
M. D. Kempe. 1979, 7p
Pub. in *Paper in Multiple Electron Resonance Spectroscopy*, p409-436 1979.

Keywords: *Solids, *Organic compounds, *Molecular energy levels, Ions, Excitation, Nuclear resonance, Reprints, *Electron nuclear double resonance.

A critical review of the application of electron nuclear double resonance (ENDOR) techniques to the study of paramagnetic triplet state systems in solids is given. Particular emphasis is placed on ground and excited triplet states of organic molecules but ions and defects in solids are covered as well. The general scheme of the manner in which ENDOR data are treated and interpreted is outlined in some detail. Experimental approaches are mentioned, and a considerable discussion of examples of ENDOR investigations of triplet states of various molecules, ions, and defects at high and zero applied static magnetic field is presented. A significant survey of the triplet ENDOR literature is included.

400,365

PB85-102762 Not available NTIS
National Bureau of Standards, Washington, DC.

Structure of Racemic CIS-4-Phenylcyclophosphamide⁺.

Final rept.,
V. L. Himes, A. D. Mighell, J. K. Stalick, and G. Zon. Mar 82, 4p
Pub. in *Acta Crystallographica, Section B: Structural Crystallography and Crystal Chemistry* 38, p1009-1012 Mar 82.

Keywords: *Crystal structure, *X ray diffraction, Chemical bonds, Reprints, *Cyclophosphamide/phenyl, Molecular conformation.

The molecule was found to exist in a chair conformation with the phenyl substituent and the phosphoryl oxygen atom in equatorial positions. The crystal structure consists of centrosymmetric dimers linked by hydrogen bonds between N-H and O = P.

400,366

PB85-102804 Not available NTIS
National Bureau of Standards, Washington, DC.

Stark Broadening of Visible Neutral Helium Lines in a Plasma.

Final rept.,
D. E. Kelleher. 1981, 30p
Pub. in *Jnl. of Quantitative Spectroscopy and Radiative Transfer* 25, n3 p191-220 Mar 81.

Keywords: *Stark effect, *Plasmas(Physics), Optical spectra, Line spectra, Line width, Reprints, *Helium plasma.

Side-on observations of the visible spectrum emitted by a helium plasma generated in a wall-stabilized arc are reported.

400,367

PB85-103125 Not available NTIS
National Bureau of Standards, Washington, DC.

Adsorption on Metal Surfaces: Some Key Issues.

Final rept.,
J. W. Gadzuk. 1983, 30p
Sponsored in part by Army Research Office, Arlington, VA., Office of Naval Research, Arlington, VA., and North Atlantic Treaty Organization, Brussels (Belgium). Pub. in *Paper in Atomistics of Fracture, NATO (North Atlantic Treaty Organization) Conference Series 6, Materials Science*, p391-420 1983.

Keywords: *Surface chemistry, *Adsorption, *Metals, Chemisorption, Reaction kinetics, Hydrides, Reprints.

The physical picture and basic philosophy of the principal techniques for performing theoretical calculations of the electronic structure of adsorbates on metal surfaces are presented. A discussion of spectroscopic probes and non-adiabatic effects is given. These ideas are illustrated via specific case studies.

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

400,368

PB85-104677

Not available NTIS

National Bureau of Standards, Washington, DC.

Extended Basis Set LCAO Chi-Alpha Treatment of NiH and Ni₂.

Final rept.,

B. I. Dunlap, and H. L. Yu. 1980, 5p

Pub. in Chemical Physics Letters 73, n3 p525-529 1980.

Keywords: *Nickel, *Molecular energy levels, Hartree-Fock approximation, Density(Mass/volume), Reprints, *Nickel hydrides, *Linear combination of atomic orbitals, Numerical solution.

Extended basis set LCAO X(alpha) calculations on NiH and Ni₂ are presented. The electronic structure of this state is in sharp disagreement with the ground state electronic structures found in various ab initio calculations. The differences between density functional and Hartree-Fock based calculations are analyzed for this molecule.

400,369

PB85-104701

Not available NTIS

National Bureau of Standards, Washington, DC.

Synthesis and Crystal-Chemistry of BaNd₂Ti₃O₁₀, BaNd₂Ti₅O₁₄, and Nd₄Ti₉O₂₄.

Final rept.,

D. Kolar, S. Gaberscek, B. Volavsek, H. S. Parker,

and R. S. Roth. 1981, 7p

Pub. in Jnl. of Solid State Chemistry 38, n2 p158-164 1981.

Keywords: *Synthesis(Chemistry), *Crystal structure, *X ray diffraction, *Barium oxides, *Neodymium oxides, *Titanium oxides, *Barium neodymium titanates, *Neodymium titanates.

Two new ternary compounds BaNd₂Ti₃O₁₀ and BaNd₂Ti₅O₁₄ have been identified in the BaO-Nd₂O₃-TiO₂ system. Single crystals of the compounds were grown and unit cell dimensions and space group symmetry were determined.

400,370

PB85-104719

Not available NTIS

National Bureau of Standards, Washington, DC.

Gas-Phase Reaction of SO₂ with a Criegee Intermediate in the Presence of Water Vapor.

Final rept.,

R. I. Martinez, and J. T. Herron. 1981, 14p

Pub. in Jnl. of Environmental Science and Health. Part A: Environmental Science and Engineering 16, n6 p623-636 1981.

Keywords: *Sulfuric acid, *Air pollution control, Sulfur dioxide, Industrial wastes, Combustion products, Flue gases, Electric power plants, Scrubbing, Aerosols, Water vapor, Reprints, *Criegee intermediate, Chemical reaction mechanisms, Flue gas desulfurization.

A reaction scheme is proposed to explain the H₂SO₄ aerosol formation experimentally observed in O₃-alkene-SO₂ systems in terms of adduct formation between SO₂ and a Criegee intermediate. The reaction scheme also provides the basis for a homogeneous gas-phase flue-gas desulfurization process of great potential utility in that it may greatly facilitate the use of high-sulfur fuels.

400,371

PB85-104776

Not available NTIS

National Bureau of Standards, Washington, DC.

Catalytic Methanation over Single Crystal Nickel and Ruthenium: Reaction Kinetics on Different Crystal Planes and the Correlation of Surface Carbide Concentration with Reaction Rate.

Final rept.,

R. D. Kelley, and D. W. Goodman. 1982, 1p

See also PB81-240251.

Pub. in Surface Science 123, No. 2-3, p743 1982.

Keywords: *Methanation, *Catalysis, *Reaction kinetics, Nickel, Ruthenium, Surface chemistry, Concentration(Composition), Hydrogen, Carbon monoxide, Reprints.

The kinetics of the reaction of H₂ and CO over single crystals of nickel ((100) and (111)) and ruthenium ((110) and (001)) has been studied as a function of pressure and H₂/CO ratio. A striking correlation has been observed between the measured surface carbide concentration and the rate of methane production while varying the H₂/CO ratio and the total pressure.

This correlation is shown to be a necessary consequence of the reaction mechanism previously proposed (1) for the catalytic methanation reaction over nickel.

400,372

PB85-104784

Not available NTIS

National Bureau of Standards, Washington, DC.

Structures of Lithium Inserted Metal Oxides: LiReO₃ and Li₂ReO₃.

Final rept.,

R. J. Cava, A. Santoro, D. W. Murphy, S. Zahurak,

and R. S. Roth. 1982, 12p

Sponsored in part by Bell Labs., Murray Hill, NJ. See also PB84-219021.

Pub. in Jnl. of Solid State Chemistry 42, n3 p251-262 1982.

Keywords: *Crystal structure, *Neutron diffraction, Electrodes, Reprints, *Lithium rhenium oxides, *Clathrate compounds.

The authors have determined the crystal structures of LiReO₃ and Li₂ReO₃, obtained by Li insertion into ReO₃, by neutron diffraction powder profile analysis. For both phases, the ReO₃ host lattice, made exclusively of corner shared octahedra, is altered significantly on Li insertion without breaking bonds. The original twelve coordinate perovskite like cavity is changed into two octahedral sites, which are occupied by the lithium ions.

400,373

PB85-104792

Not available NTIS

National Bureau of Standards, Washington, DC.

Spin-Orbit and Dispersion Energy Effects in XeF.

Final rept.,

M. Krauss, W. J. Stevens, and P. S. Julienne. 1982,

9p

Pub. in Jnl. of Computational Chemistry 3, n3 p372-380 1982.

Keywords: *Xenon halides, *Dispersion relations, *Spin orbit interactions, Excitation, Molecular energy levels, Perturbation theory, Separation, Lasers, Reprints, *Xenon fluorides, *Xenon chlorides, Energy curves, Effective core potential, Numerical solution, Excimer lasers.

Spin-orbit and dispersion energy contributions to the energy curves of XeF are examined. A rapid variation in the spin-orbit coupling with internuclear separation is found for both the ground and excited states. This result can explain the experimentally observed ordering of the ionic excited states when the spin-orbit perturbation couples sup 2 sigma and sup 2 pi energy curves obtained by both all-electron and effective core potential (ECP) calculations at the first-order configuration interaction (FOCI) level of accuracy.

400,374

PB85-104834

Not available NTIS

National Bureau of Standards, Washington, DC.

Surface Vibrational Spectroscopy with Neutron Inelastic Scattering.

Final rept.,

R. D. Kelley, R. R. Cavanagh, and J. J. Rush. 1982,

2p

Pub. in Jnl. of Vacuum Science and Technology 20, n3 p589-590 1982.

Keywords: *Inelastic scattering, *Neutron scattering, *Hydrogen, *Vibrational spectra, Chemisorption, Surface chemistry, Chemical bonds, Nickel, Reprints, *Raney nickel catalysts.

Neutron inelastic scattering (NIS) has been used to measure the vibrational spectra of hydrogen chemisorbed on Raney nickel. The binding site and geometry of the dominant surface species has been deduced from these measurements.

400,375

PB85-104859

Not available NTIS

National Bureau of Standards, Washington, DC.

Systematic Nomenclature for the 'Peroxyacyl Nitrates', the Functional and Structural Misnomers for Anhydride Derivatives of Nitrogen Oxo Acids.

Final rept.,

R. I. Martinez. 1980, 5p

Pub. in International Jnl. of Chemical Kinetics 12, n10 p771-775 1980.

Keywords: *Chemical compounds, *Organic nitrates, *Anhydrides, Reprints, *Chemical nomenclature.

'Peroxyacyl Nitrates' are functional and structural misnomers for anhydride derivatives of nitrogen oxo acids. Their systematic nomenclature is discussed.

400,376

PB85-107316

Not available NTIS

National Bureau of Standards, Washington, DC.

Laser Magnetic Resonance Spectroscopy of C₁₀ and Kinetic Studies of the Reactions of C₁₀ with NO and NO₂.

Final rept.,

Y. P. Lee, R. M. Stimpfle, R. A. Perry, J. A. Mucha,

and K. M. Evenson. 1982, 22p

Sponsored in part by Chemical Manufacturers Association, Washington, DC.

Pub. in International Jnl. of Chemical Kinetics 14, p711-732 1982.

Keywords: *Reaction kinetics, *Nitrogen dioxide, *Nitrogen oxide(NO), Comparison, Chemical reactions, Reprints, *Laser magnetic resonance, Far infrared spectroscopy.

Far-infrared rotational transitions in ClO(X sup 2 Pi sub 3/2, nu = 0) have been observed using laser magnetic resonance (LMR) with an optically pumped spectrometer. Five observed transitions at wavelengths between 444 and 713 micrometers have been compared with values predicted with spectroscopic constants from the literature. LMR detection of ClO has been used to study its reactions with NO and NO₂ in a discharge flow system under pseudo-first-order conditions for ClO. These results are compared with those from other studies.

400,377

PB85-107357

Not available NTIS

National Bureau of Standards, Washington, DC.

Use of Capillary Gas Chromatography-Mass Spectrometry for Identification of Radiation-Induced DNA Base Damage and DNA Base-Amino Acid Crosslinks.

Final rept.,

M. Dizdaroğlu. 1984, 19p

Sponsored in part by National Foundation for Cancer Research, Bethesda, MD.

Pub. in Jnl. of Chromatography 295, p103-121 1984.

Keywords: *Deoxyribonucleic acids, *Gas chromatography, *Mass spectroscopy, Amino acids, Crosslinking, Damage, Irradiation, Biochemistry, Reprints, Capillary gas chromatography.

Application of capillary gas chromatography-mass spectrometry (GC-MS) to isolation and identification of radiation-induced DNA base damage including DNA base-amino acid crosslinks was demonstrated. All gas chromatograms and mass spectra obtained are discussed in detail.

400,378

PB85-107373

Not available NTIS

National Bureau of Standards, Washington, DC.

Mechanistic Investigation of the HO + HO₂ Reaction.

Final rept.,

M. J. Kurylo, O. Klais, and A. H. Laufer. 1981, 20p

Pub. in Jnl. of Physical Chemistry 85, n24 p3674-3678 1981.

Keywords: *Reaction kinetics, *Free radicals, *Mass spectroscopy, Chemical reactions, Water, Oxygen, Photolysis, Reprints, *Chemical reaction mechanisms, *Hydroxyl radical.

A steady state photolysis experiment including mass spectrometric end product analysis was used to perform a mechanistic investigation of the HO(18) + HO₂ reaction system. The results obtained do not support the existence of an adduct reaction intermediate as suggested by a proposed pressure dependence for the title reaction.

400,379

PB85-107381 Not available NTIS
National Bureau of Standards, Washington, DC.
Molecular Dynamical Studies of the Dissociation of a Diatomic Molecular Crystal. 2. Equilibrium Kinetics.
Final rept.,
S. F. Trevino, and D. H. Tsai. Jul 84, 9p
See also PB84-105717.
Pub. in Jnl. of Chemical Physics 81, n1 p248-256 Jul 84.

Keywords: *Diatomic molecules, *Mathematical models, *Dissociation, *Chemical equilibrium, *Crystal structure, Thermodynamics, Chemical reactions, Reprints.

The properties of a molecular dynamical model undergoing equilibrium chemical reactions are reported. It is shown that the kinetics of the reaction is consistent with established thermodynamic considerations.

400,380

PB85-107431 Not available NTIS
National Bureau of Standards, Washington, DC.
Les Intensites Dans Les Bandes Nu sub 5, Nu sub 7 et Nu sub 8 + Nu sub 11 De L'Ethane (12) C₂H₆.
Final rept.,
M. Dang-Nhu, A. S. Pine, and W. J. Lafferty. 1984, 8p
Pub. in Jnl. of Canadian Physics 62, n5 p512-519 1984.

Keywords: *Infrared spectroscopy, *Ethane, Band spectra, Reprints, *Laser spectroscopy.

The intensity parameters of the Nu sub 5, Nu sub 7 and Nu sub 8 + Nu sub 11 (A_{2u}) bands of (12)C₂H₆ have been determined from the experimental line strengths in the 3 micrometer region with an infrared difference-frequency laser spectrometer.

400,381

PB85-108454 Not available NTIS
National Bureau of Standards, Washington, DC.
Impurity Effects in the Interaction of Oxygen with Rh(111).
Final rept.,
S. Semancik, G. L. Haller, and J. T. Yates. 1982, 13p
Pub. in Applications of Surface Science 10, p546-558 1982.

Keywords: *Oxygen, *Surface chemistry, Impurities, Crystals, Reprints, *Auger electron spectroscopy, *Electron energy loss spectroscopy.

High resolution electron energy loss spectroscopy (EELS) and Auger electron spectroscopy (AES) have been used to study a stable oxide-like species that can form on Rh(111) under ultrahigh vacuum dosing conditions. The results presented here demonstrate that this species develops because of the interaction of oxygen with low level boron impurities at the surface of the rhodium crystal. Although this oxide is difficult to detect and identify using Auger spectroscopy, even very small amounts of the boron oxide can be easily detected using EELS.

400,382

PB85-108645 Not available NTIS
National Bureau of Standards, Washington, DC.
Infrared Absorption Intensities for N₂O₃.
Final rept.,
R. H. Kagann, and A. G. Maki. 1984, 2p
Pub. in Jnl. of Quantitative Radiative Transfer 31, n2 p175-176 1984.

Keywords: *Nitrogen oxides, *Infrared spectroscopy, Absorption, Reprints, *Fourier transform spectroscopy.

A Fourier transform spectrometer has been used to measure the absorption intensity of the nu₁ and nu₃ bands of N₂O₃ near 1830 and 1300/cm, respectively. Digital spectral subtraction techniques were used to eliminate interference from NO, NO₂, and N₂O₄ present in equilibrium with the N₂O₃.

400,383

PB85-110112 Not available NTIS
National Bureau of Standards, Washington, DC.
Electrohydrodynamic Contribution to the Hall Effect in Electrolyte Solutions.
Final rept.,
J. B. Hubbard, and P. G. Wolynes. 1981, 4p
Pub. in Jnl. of Chemical Physics 75, n6 p3051-3054, 15 Sep 81.

Keywords: *Electrolytes, *Electrohydrodynamics, *Hall effect, Solutions, Lorentz transformations, Ions, Reprints.

The authors calculate the electrohydrodynamic forces on an ion moving in a polarizable liquid in a magnetic field. The result is a ponderomotive force which is about 30% of the Lorentz force and which acts in the opposite direction. The calculated effect is independent of ion size, charge, or solvent viscosity.

400,384

PB85-110138 Not available NTIS
National Bureau of Standards, Washington, DC.
Expressions for the Computer-Evaluation of the Four Kernel Functions for Line Formation with Doppler and Lorentz Profiles.
Final rept.,
D. G. Hummer. 1981, 9p
Grant NSF-AST80-19874
Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 26, n3 p187-195 Sep 81.

Keywords: *Line spectra, Reprints, *Radiative transfer, Kernel functions, Pade approximation, Computer applications.

Rational approximations for the kernel functions (K sub 1) (tau), (K sub 2) (tau), (M sub 1) (tau) and (M sub 2) (tau) for Doppler and Lorentz profiles have been obtained from their series and asymptotic expressions by the techniques of Pade approximants with a maximum relative error or less than 0.0001.

400,385

PB85-110153 Not available NTIS
National Bureau of Standards, Washington, DC.
Nature of Solution Spectra: Inhomogeneous Broadening and Phonon Effects In Frozen Solutions.
Final rept.,
W. C. McColgin, A. P. Marchetti, and J. H. Eberly. 1978, 5p
Pub. in Jnl. of the American Chemical Society 100, n18 p5622-5626, 30 Aug 78.

Keywords: *Organic compounds, *Optical spectra, *Phonons, Excitation, Fluorescence, Comparison, Stokes law(Fluid mechanics), Reprints, *Laser induced fluorescence.

The optical spectra of a number of organic compounds have been examined in low temperature, glassy solutions. According to the experimental conditions of excitation, a given sample can yield either the usual broad bands complete with Stokes shift or a set of very narrow fluorescence lines (about 1/cm). The comparisons of these two distinct types of spectra from the same sample make it possible to explain such features of the conventional spectra as their broad bandwidths, peak positions, and Stokes shifts.

400,386

PB85-110161 Not available NTIS
National Bureau of Standards, Washington, DC.
Synthesis and Structure of a Tetrahydro-tetra-thiafulvalene-Mercuric Chloride Complex, (H₄TTF)(HgCl₂)₃.
Final rept.,
M. D. Glick, W. H. Ilsley, and A. R. Siedle. 1981, 4p
Sponsored in part by Minnesota Mining and Mfg. Co., St. Paul. Central Research Labs.
Pub. in Inorganic Chemistry 20, n11 p3819-3822 1981.

Keywords: *Synthesis(Chemistry), *Molecular structure, *Raman spectroscopy, *Complex compounds, *Infrared spectroscopy, Crystal structure, X ray analysis, Reprints, *Fulvalene/tetrahydro-tetra-thia, *Mercury chlorides.

The solid state structure and infrared and Raman spectra of a mercuric chloride complex of tetrahydro-tetra-thiafulvalene are reported. There are two crystallographically independent mercury atoms. One, Hg(1), sits at an inversion center and the other, Hg(2), occupies a general position within the unit cell.

400,387

PB85-110187 Not available NTIS
National Bureau of Standards, Washington, DC.
Role of the Criegee Intermediate in the Matrix Thermoluminescence Study of the CH₂ + O₂ Reaction.
Final rept.,
R. I. Martinez, R. E. Huie, and J. T. Herron. 1981, 7p
Pub. in Jnl. of Chemical Physics 75, n12 p5975-5977 1981.

Keywords: *Thermoluminescence, *Formic acid, Chemical reactions, Reprints, *Chemical reaction mechanisms, *Criegee intermediate.

The identification by Lee and Pimentel (J. Chem. Phys. 74, 4851 (1981)) of two new progressions of formic acid arising from the reaction of CH₂ with O₂ in an argon matrix is interpreted in terms of the formation and isomerization of a Criegee intermediate. This is the first unambiguous identification of formic acid as a product of this process.

400,388

PB85-110211 Not available NTIS
National Bureau of Standards, Washington, DC.
Kinetics of the Reaction between Polyester Acid and Carbodiimide in Dry Polyester Diols and in a Polyester Polyurethane.
Final rept.,
D. W. Brown, R. E. Lowry, and L. E. Smith. 1981, 5p
Pub. in Macromolecules 14, n3 p659-663 1981.

Keywords: *Reaction kinetics, *Polyurethane resins, Chemical reactions, Elastomers, Viscosity, Activation energy, Polyesters, Reprints.

The kinetics of reaction between mono- or polycarbodiimide and organic acid attached to polyester have been studied in dry polyester diols, in a polyester based polyurethane elastomer, and in solution in tetrahydrofuran. Thus rate constants are much the same in a mobile liquid, polyesters of several viscosities, and in an elastomer.

400,389

PB85-111839 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermogravimetric Analysis Kinetics.
Final rept.,
J. H. Flynn. 1981, 3p
Pub. in Polymer Preprints 22, n1 p310-312 1981.

Keywords: *Reaction kinetics, *Thermogravimetry, Oxidation, Polymethyl methacrylate, Polystyrene, Polyurethane resins, Thermal analysis, Degradation reactions, Reprints.

Techniques for analyzing thermogravimetric data from experiments covering a broad range of heating rates from .1 to .0001/Ks are described. These techniques are used both to test the constancy of kinetic parameters and to interpret changes in kinetic mechanism. The methods are illustrated with examples from the degradation and oxidation of polystyrene, poly(methyl methacrylate) and polyurethane.

400,390

PB85-111854 Not available NTIS
National Bureau of Standards, Washington, DC.
Collection of Kinetic Data for the Diffusion of Organic-Compounds in Polyolefins.
Final rept.,
J. H. Flynn. 1982, 20p
Pub. in Polymer 23, n9 p1325-1344 1982.

Keywords: *Reaction kinetics, *Organic compounds, *Diffusion, *Olefin resins, Polyethylene, Tables(Data), Polyisobutylene, Polypropylene, Polybutadiene, Copolymers, Reprints, Low density polyethylene, High density polyethylene, Poly(pentene/methyl).

A comprehensive collection of kinetic data on the diffusion of organic compounds in polyolefins is contained in tables for low density polyethylene, high density polyethylene, polyisobutylene, polypropylene, hydrogenated polybutadiene, poly(4-methylpentene-1), ethylene-propylene copolymers, and self-diffusion of polyolefins. Diffusion constants for over 250 polymer-migrant entries at temperatures from -30 to 190C, activation energies and preexponential factors for the diffusion process and parameters for the concentration dependence of the diffusion constant are included. A special feature of this compilation is an extensive sec-

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tion of annotated references. This includes: (1) as complete a characterization of each polymer and migrant as is possible. (2) a description of the experimental methods used to determine the diffusion constants, and (3) the assumptions made, equations utilized and calculations performed to obtain the data in the tables. The tables exhibit remarkable consistencies considering the great variations in diffusion constants which can be brought about by thermal, mechanical, and solvent action. These consistencies lend hope that useful correlations may be developed from these data.

400,391
PB85-112886 PC A06/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Fine-Grained, Isotropic Graphite for Use as NBS (National Bureau of Standards) Thermophysical Property RM's from 5 to 2500 K.
Final rept.,
J. G. Hust. Sep 84, 120p NBS/SP-260/89
Library of Congress catalog card no. 84-601106. Also available from Supt. of Docs as SN003-003-02608-5.

Keywords: *Graphite, *Thermophysical properties, *Research projects, Standards, Electrical resistivity, Fines, *Standard reference materials.

The Chemical Engineering Science Division (Boulder, Colorado) in conjunction with the Office of Standard Reference Materials (Gaithersburg, Maryland) of the National Bureau of Standards, and the CODATA Task Group on Thermal Transport Properties have investigated graphite as a potential, extended temperature range, Research Material (RM). A large number of isotropic, fine-grained graphite rods in various diameters were obtained for these investigations. In Phase I, electrical resistivity and density measurements were performed on numerous rods at temperatures from 4 to 300 K. In Phase II, thermal conductivity measurements were performed on thirteen specimens at about 20C. In Phase III, a large number of specimens were characterized for room temperature electrical resistivity and density. These measurements were in preparation for the world-wide distribution of specimens to participants that agreed to make thermal and electrical property measurements. Phase IV describes the results of the measurements from the various participants. Phase V describes the analysis of these data.

400,392
PB85-115483 Not available NTIS
National Bureau of Standards, Washington, DC.
Finger-Printing and Partial Quantification of Complex Hydrocarbon Mixtures by Chemical Ionization Mass-Spectrometry.
Final rept.,
L. W. Sieck. 1979, 5p
Pub. in Analytical Chemistry, v51 n1 p128-132 1979.

Keywords: *Mass spectroscopy, *Hydrocarbons, *Chemical analysis, Revisions, Cyclohexane, Aromatic compounds, Complex compounds, Separation, Mixtures, Distillation, Reprints, *Ion molecule interactions, *Chemical ionization mass spectroscopy, *Finger printing.

A modification of chemical ionization mass spectrometry, which involves photoionization and cyclohexane as the source of the reagent ion, has been used to develop a technique for discriminatory 'finger-printing' of neat fossil fuels. The method provides a two minute turn-around time between samples and batch introduction, with no requirements for prior separation or fractionation. Depending upon the conditions chosen, the technique may also be extended to the quantification of aromatic and olefinic sample components.

400,393
PB85-115525 Not available NTIS.
National Bureau of Standards, Washington, DC.
Photodissociation of HgBr, X-Sigma-1/2.
Final rept.,
M. Krauss, and W. J. Stevens. 1981, 3p
Pub. in Applied Physics Letters 39, n9 p686-688 1981.

Keywords: *Photochemical reactions, *Dissociation, Mercury halides, Ions, Molecular energy levels, Reprints, *Laser spectroscopy, *Mercury bromide.

Transition moments and energies have been calculated for the X-A, bound to continuum, transition in HgBr. Absorption at the laser wavelength of 502 nm has been examined for two cases: (1) A thermal distribution of vibrational levels at 500K and (2) The terminus vibrational level of the B-X laser transition. In the first

case a cross section of 7×10 to the -20th power sq cm is calculated. Electron dissociative attachment of the X state is also shown to be improbable as a means of fast removal. Energy curves of the ground states of both the neutral and negative ion of HgBr are shown not to cross in any accessible region.

400,394
PB85-115582 Not available NTIS
National Bureau of Standards, Washington, DC.
Quality of Analytical Results, with Special Reference to Trace Analysis and Sociochemical Problems.
Final rept.,
L. A. Currie. 1982, 40p
Pub. in Jnl. of Pure Applied Chemistry 54, n4 p715-754 1982.

Keywords: *Trace elements, *Chemical analysis, *Industrial wastes, *Environmental surveys, *Laboratory design, Technology, Laboratories, Reprints.

High quality trace analysis is becoming increasingly important for technological development, both with regard to the production and monitoring of high-purity technological materials and processes, and with respect to monitoring and understanding the environmental and societal impacts of industrial waste products. The analytical scientist faces an enormous challenge in meeting these requirements because of the range of concentrations (to less than 10 to the -12th power g/g) and complexity of matrices, as well as the importance of the results to the future of mankind. The quest for accuracy in trace analysis is best viewed in the framework of a structured Chemical Measurement Process (CMP), in which high quality is assured by (a) performing regular assays of known (Standard Reference Materials) and interlaboratory comparison samples, and (b) examining and bringing into control each constituent step. Illustrations are presented of assumptions and common pitfalls which are characteristic of each of the CMP steps, with special emphasis on contamination, losses and interference, calibration and model errors, and inadequate reporting of results and uncertainties. The question of hypothesis testing and detection limits is given special focus.

400,395
PB85-115707 Not available NTIS
National Bureau of Standards, Washington, DC.
Chemisorption and Reactivity Studies of Hydrogen and Carbon Monoxide of Sulfided Nickel (100).
Final rept.,
D. W. Goodman, and M. Kiskinova. 1981, 6p
Pub. in Surf Science 105, n2-3 p265-270 1981.

Keywords: *Nickel, *Surface chemistry, *Chemisorption, *Sulfur, *Reaction kinetics, Hydrogen, Carbon monoxide, Catalysis, Methanation, Reprints.

Ultrahigh vacuum techniques have been used to study both the chemisorption and reaction kinetics of H₂ and CO over a sulfided Ni(100) catalyst. Sulfur at low coverages (O sub S 0.2) very effectively poisons the Ni(100) surface for catalytic methanation, CO absorption, as well as hydrogen chemisorption. This poisoning effect is nonlinear - one sulfur atom reactivates approximately ten nickel atom sites. The results of chemisorption studies suggest that the attenuation of H₂ and CO(B₂) chemisorption is responsible for the reduction of catalytic activity. These data are consistent with electronic effects playing a major role at low sulfur coverages in reducing the reaction rate.

400,396
PB85-115715 Not available NTIS
National Bureau of Standards, Washington, DC.
Catalyzed Graphite-Water Vapor Reaction - Isotopic Studies Using Barium Carbonate (Carbon-13).
Final rept.,
D. W. McKee, and J. T. Yates, Jr. 1981, 8p
Pub. in Jnl. of Catalysis, v71 n2 p308-315 1981.

Keywords: *Catalysis, *Barium carbonate, *Graphite, *Water vapor, *Gasification, Graphite, Chemical reactions, Reaction kinetics, Isotopic labeling, Carbon 13, Dissociation, Reprints, *Chemical reaction mechanisms.

The mechanism of the catalytic effect of barium carbonate on the steam gasification of carbon was investigated by adding BaC(13)03 to pure graphite and measuring the kinetics and products of the reaction with water vapor as functions of temperature. The onset of the catalyzed reaction at around 800 C was

accompanied by the appearance of C(13)0 and C(13)02 in the gas phase. When BaC(13)03 and graphite were heated together in an inert atmosphere, small amounts of C(13)02 were evolved above 600C and copious amount of C(13)0 and C(13)02 above 900C. Graphite catalyzed the decomposition of the BaCO₃ at low temperatures as the dissociation of pure BaCO₃ was very slow below 1000C. The catalytic effect of the salt in the gasification reaction could be interpreted in terms of a sequential series of reaction steps involving decomposition of the carbonate to oxide, followed by regeneration of the carbonate phase by reaction with the gaseous environment.

400,397
PB85-115731 Not available NTIS
National Bureau of Standards, Washington, DC.
Photoabsorption Cross Section of O₂ from 55-350 A.
Final rept.,
G. Mehlman, D. L. Ederer, and E. B. Saloman. 1978, 33p
Pub. in Jnl. of Chemical Physics 68, n4 p1862-1864, 15 Feb 78.

Keywords: *Oxygen, *Absorption, Photons, Ionization, Synchrotron radiation, Molecular structure.

The photoabsorption cross section of O₂ was measured photoelectrically in the wavelength range 55-350A. The 250 MeV storage ring at the National Bureau of Standards provided the background continuum. The absolute accuracy of the measurements is + or - 3% between 55-140 A and 170-300 A + or - 5% in the wavelength range 140-170 A and 300-350A. The cross section decreased monotonically with increasing photon energy. No thresholds or new structure was observed in the total cross section.

400,398
PB85-115756 Not available NTIS
National Bureau of Standards, Washington, DC.
Far Infrared Laser Magnetic Resonance Spectrum of CH₂F.
Final rept.,
J. A. Mucha, D. A. Jennings, K. M. Evenson, and J. T. Hougen. 1977, 3p
Pub. in Jnl. of Molecular Spectroscopy 68, n1 p122-124 Oct 77.

Keywords: *Infrared spectroscopy, Free radicals, Molecular rotation, Fluorine organic compounds, Molecular structure, Reprints, *Laser magnetic resonance spectroscopy, *Methane/fluoro, *Methane/diazo, *Far infrared spectroscopy.

Laser magnetic resonance rotational spectra of the free radical CH₂F have been obtained using far-infrared laser lines at 301.3, 393.6, 513.0 and 567.9 pm. The radical was prepared under fast-flow conditions by fluorine atom abstraction of a hydrogen from methyl fluoride and by fluorine atom addition to diazomethane.

400,399
PB85-115814 PC A04/MF A01
National Bureau of Standards (NEL), Boulder, CO. Center for Chemical Engineering.
Update of Thermal Conductivity and Electrical Resistivity of Electrolytic Iron, Tungsten, and Stainless Steel.
Final rept.,
J. G. Hust, and A. B. Lankford. Sep 84, 75p NBS/SP-260/90, LCCCN-84-601107
Also available from Supt. of Docs as SN003-003-02609-3. Library of Congress catalog card no. 84-601107.

Keywords: *Iron, *Tungsten, *Stainless steel, *Thermal conductivity, *Electrical resistivity, Tables(Data), Graphs(Charts), Temperature, Standards, *Standard reference material, Numerical solution.

An update is given of the thermal conductivity and electrical resistivity of the metals: electrolytic iron, tungsten, and stainless steel. This document describes the measurement effort that has occurred since the establishment of these SRM's. New data are presented and, based on these, changes in the recommended values are described. The new recommended values are presented in the form of equations, graphs, and tables. The temperature ranges included are: 2 to 1000 K for electrolytic iron, 2 to 3000 K for tungsten, and 2 to 1200 K for stainless steel.

400,400

PB85-116200

Not available NTIS

American Chemical Society, Washington, DC.

Journal of Physical and Chemical Reference Data, Volume 13, Number 2, 1984.Quarterly rept.
c1984, 306p

See also PB85-116218 through PB85-116259 and PB84-238427. Sponsored by National Bureau of Standards, Gaithersburg, MD. Prepared in cooperation with American Inst. of Physics, New York.

Keywords: *Physical properties, *Chemical properties, *Standards, Tables(Data), Reaction kinetics, Photochemistry, Smog, Heavy water, Thermodynamic properties, Nitrogen, Aromatic polycyclic hydrocarbons, Solubility, Halogen organic compound, Nitrogen oxides, Sulfur oxides, Inelastic scattering, Diatomic molecules, Air pollution, Chemical reaction mechanisms, Atmospheric chemistry.

Contents: Evaluation of kinetic and mechanistic data for modeling of photochemical smog; Rate data for inelastic collision processes in the diatomic halogen molecules; Water solubilities of polynuclear aromatic and heteroaromatic compounds; The solubility of nitrogen and air in liquids; Thermophysical properties of fluid D₂O.

400,401

PB85-116226

Not available NTIS

Joint Inst. for Lab. Astrophysics, Boulder, CO.

Rate Data for Inelastic Collision Processes in the Diatomic Halogen Molecules,

J. I. Steinfeld. c1984, 109p

Included in Jnl. of Physical and Chemical Reference Data, v13 n2 p445-553 1984.

Keywords: *Reaction kinetics, *Diatomic molecules, *Halogen inorganic compounds, *Inelastic scattering, Tables(Data), Molecular relaxation.

A detailed compilation of rate data for inelastic collision processes involving the homonuclear and heteronuclear diatomic halogen molecules is presented. The literature has been surveyed through April 1983. Processes that are considered include exchange of energy between electronic, vibrational, rotational and translational degrees of freedom, electronic quenching, dephasing, depolarization, pressure broadening, and spontaneous radiation. Collision partners include rare-gas atoms, halogen and other diatomic molecules, and polyatomic species; a few measurements in liquids and cryogenic matrices are also included. Each data entry includes collision partner, temperature, method of measurement, and an error estimate where available. While a large mass of data is available for these systems, there still exist sizable gaps in our knowledge concerning these processes, particularly for the interhalogen species.

400,402

PB85-116234

Not available NTIS

Texas Univ. at Austin.

Water Solubilities of Polynuclear Aromatic and Heteroaromatic Compounds,

R. S. Pearlman, S. H. Yalkowsky, and S. Banerjee.

c1984, 8p

Prepared in cooperation with Arizona Univ., Tucson. Coll. of Pharmacy and Syracuse Research Corp., NY. Life and Environmental Sciences Div.

Included in Jnl. of Physical and Chemical Reference Data, v13 n2 p555-562 1984.

Keywords: *Aromatic polycyclic hydrocarbons, *Solubility, *Water, *Environmental surveys, Surfaces, Boiling points, Assessments, Adsorption, Physical properties.

With the projected increased use of coal derived energy sources, the health and environmental impact of compounds associated with coal will receive progressively greater attention. Some of these compounds such as the polynuclear aromatic hydrocarbons are potent mutagens or carcinogens, and reliable data on the physical properties of these compounds must be available for meaningful health and environmental assessment to be made. Possibly the most important property from this viewpoint is water solubility, since apart from its importance in its own right, several other parameters such as lipophilicity, adsorption, and bioconcentration can be related to it. We have compiled and reviewed values for several polynuclear compounds, tested them against available models, and reduced them to a set of validated data.

400,403

PB85-116242

Not available NTIS

Wright State Univ., Dayton, OH. Dept. of Chemistry.

Solubility of Nitrogen and Air in Liquids,

R. Battino, T. R. Rettich, and T. Tominaga. c1984,

38p

Included in Jnl. of Physical and Chemical Reference Data, v13 n2 p563-600 1984.

Keywords: *Nitrogen, *Air, *Solubility, Temperature, Pressure, Water, Heavy water, Air water interfaces, Sea water, Solvents, Hydrocarbons, Tables(Data), Virial coefficients, Biological processes.

This review covers the solubility of nitrogen and air in liquids as a function of temperature and pressure. Solubility data for individual systems were critically evaluated. Recommended or tentative values are presented as smoothing equations and/or in tabular form. Trends in homologous series or related solvents are discussed. Data for the n-alkanes were water; heavy water; seawater; aqueous salt solutions; mixed solvents; hydrocarbons; organic compounds containing oxygen, halogen, sulfur, nitrogen, or silicon; olive oil; various biological fluids; H₂S; SO₂; NH₃; CO₂; nitrogen oxides; and several halogen and boron containing inorganic solvents.

400,404

PB85-116259

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Thermophysical Properties of Fluid H₂O,

J. Kestin, J. V. Sengers, B. Kamgar-Parsi, and J. M.

H. Levelt Sengers. c1984, 9p

Prepared in cooperation with Maryland Univ., College Park. Inst. for Physical Science and Technology.

Included in Jnl. of Physical and Chemical Reference Data, v13 n2 p601-609 1984.

Keywords: *Thermophysical properties, *Heavy water, Water, Equations of state, Thermal conductivity, Viscosity, Critical point, Computer applications.

The present publication contains data on the thermophysical properties of deuterium oxide (heavy water). It is a companion to the paper on the thermophysical properties of fluid H₂O published earlier in this journal by the same authors. The properties are represented by equations which can be readily programmed on a computer and incorporated in data banks. All data have been carefully and critically analyzed. The compendium represents the best available data for fluid D₂O.

400,405

PB85-118008

Not available NTIS

National Bureau of Standards, Washington, DC.

Laser Deceleration of an Atomic Beam.

Final rept.,

W. D. Phillips, and H. J. Metcalf. 1982, 34p

Sponsored in part by Office of Naval Research, Washington, DC.

Pub. in Physical Review Letters 48, n9 p596-599, 1 Mar 82.

Keywords: *Laser beams, *Atomic beams, *Deceleration, Zeeman effect, Doppler effect, Absorptions, Atoms, Reprints, *Sodium atoms, *Laser applications.

The authors have observed deceleration of Na atoms in an atomic beam from absorption of resonant laser light. The deceleration amounts to 40% of the initial thermal velocity corresponding to about 15000 absorptions. Atoms were kept in resonance with the laser by using a spatially varying magnetic field to provide a changing Zeeman shift to compensate for the changing Doppler shift as the atoms decelerated.

400,406

PB85-118248

Not available NTIS

National Bureau of Standards, Washington, DC.

Photoemission Studies of H₂S, H₂, and S Adsorbed on Ru(110): Evidence for an Adsorbed SH Species.

Final rept.,

G. B. Fisher. 1979, 13p

See also AD-A070054.

Pub. in Surface Science 67, n1 p215-227 Aug 79.

Keywords: *Hydrogen sulfide, *Hydrogen, *Sulfur, *Photoelectric emission, Chemisorption, Adsorption, Surface chemistry, Reprints.

H₂S, H₂ and S adsorbed on Ru(110) have been studied by angle-integrated ultraviolet photoemission

(UPS) as part of a study of the effect of adsorbed sulfur, a common catalytic poison, on this Ru surface. For low exposures of H₂S at 80 K, the work function rises to a value 0.15 eV above that of clean Ru(110) while the associated UPS spectra $h(\nu) = 21.2$ eV exhibit features similar to those of H(ads) and S(ads) and different from those of molecular H₂S. We conclude that H₂S dissociates completely at low coverages on Ru(110) at 80 K. At intermediate exposures the work function drops and the UPS spectra show new features which are attributed to the presence of an adsorbed SH species. This appears to be the first direct observation of this surface complex. At higher exposures the work function saturates at a value 0.35 eV below the clean value; the UPS spectra change markedly and indicate the adsorption of molecular H₂S. Thermal desorption from an H₂S layer shows that the H₂ desorption peak appears at about 180 K, below the desorption peaks for an H₂ monolayer on the same surface. Heating adsorbed H₂S leaves a stable layer of S(ads) on Ru(110). The surface with adsorbed sulfur strongly modifies the adsorption at 80 K of a number of molecules relative to the clean Ru(110) surface.

400,407

PB85-118255

Not available NTIS

National Bureau of Standards, Washington, DC.

Nuclear Safeguards and NBS (National Bureau of Standards) Standard Reference Materials Program.

Final rept.,

W. P. Reed, and H. T. Yolken. 1978, 7p

Pub. in ACS (American Chemical Society) Symposium Series 1978, n79 p27-33 1978.

Keywords: *Chemical analysis, *Calibrating, *Nuclear material management, Standards, Reprints, *Standard reference materials.

The use of accounting type procedures to provide safeguards on the diversion of Special Nuclear Material puts a heavy demand on the use of analytical calibration materials. This demand, in part, is generated by regulations that require nuclear materials inventories to be determined to a specified level of accuracy. These regulations also require that measurement uncertainty be determined relative to national standards which in some cases, in turn, require that analytical measurements be traceable to NBS Standard Reference Materials. These requirements for a specific level of accuracy with demonstrated traceability are well defined in some cases, but in other cases no guidelines or only general guidelines are provided. Since the kind and quantities of Standard Reference Materials available are very limited, knowledge of the rational behind the correct uses of Standard Reference Materials and the concept of traceability are important factors. The NBS Standard Reference Materials program is currently issuing a limited number of 'primary' standards for use in nuclear safeguards measurement. In conjunction with the NBS Office of Measurement for Nuclear Safeguards this work is being expanded (with support from NRC and DOE) to include other areas of nuclear measurement where SRM's are not currently available.

400,408

PB85-118263

Not available NTIS

National Bureau of Standards, Washington, DC.

Spectrum of Benzene in the 3-Mu-M Region: The Nu-12 Fundamental Band.

Final rept.,

J. Pliva, and A. S. Pine. 1982, 28p

Pub. in Jnl. of Molecular Spectroscopy 93, n1 p209-236 1982.

Keywords: *Absorption spectra, Doppler effect, Blends, Benzenes, Reprints, *Benzene.

The absorption spectrum of benzene vapor between 3020 and 3125/cm has been recorded at 297 and 204 K with Doppler-limited resolution using a difference-frequency laser spectrometer. Since in this highly complex spectrum much of the observed structure results from blends of two or more transitions, deconvolution was used to reduce the line width by a factor of about 3 down to 0.0010 - 0.0015/cm. This made it possible to resolve and analyze the spectrum in detail.

400,409

PB85-118271

Not available NTIS

National Bureau of Standards, Washington, DC.
Intercomparison of Selected Semi-Empirical and Fundamental Parameter Inter-element Correction Methods in X-Ray Spectrometry.

Final rept.,

P. A. Pella, and J. R. Sieber. 1982, 3p

Pub. in X-Ray Spectrometry 11, n4 p167-169 1982.

Keywords: *X ray spectroscopy, *Alloys, Comparison, Performance evaluation, Research project, Reprints.

Fundamental parameter interelement correction methods such as NRLXRF are finding increased use in quantitative x-ray spectrometry. The purpose of this work was to compare the results obtained with each of the three options in NRLXRF, namely Empirical, Full, and Theoretical, with a semiempirical model such as Rasberry-Heinrich and an NBS fundamental parameter method to check for consistency. Well characterized alloys were chosen for making the intercomparison.

400,410

PB85-118289

Not available NTIS

National Bureau of Standards, Washington, DC.

Overview of EXFNBS: A Data Reduction Procedure for Energy-Dispersive XRF with Secondary Target Excitation.

Final rept.,

R. L. Myklebust, P. A. Pella, and B. B. Thorne. 1982, 3p

Pub. in X-Ray Spectrometry 11, n4 p170-172 1982.

Keywords: *X ray absorption, *X ray spectroscopy, *Data processing, Excitation, Reprints, *Energy dispersive x ray spectroscopy, Computer applications.

An overview of a fundamental parameter data reduction procedure for processing energy-dispersive x-ray spectrometric data obtained with monochromatic excitation is described. The program called EXFNBS and NBSROI are written in FORTRAN and correct for interfering x-ray peaks, scope peaks, background, and x-ray absorption/enhancement due to interelement effects in a specimen. This procedure is designed to operate in an interactive mode with a minicomputer in real time.

400,411

PB85-118305

Not available NTIS

National Bureau of Standards, Washington, DC.

New FIR Laser Lines and Frequency Measurements in CD3OD.

Final rept.,

E. C. C. Vasconcellos, A. Scalabrin, F. R. Petersen, and K. M. Evenson. 1981, 7p

Pub. in International Jnl. of Infrared Millimeter Waves 2, n3 p533-539 1981.

Keywords: *Methyl alcohol, *Deuterium compounds, Optical pumping, Line spectra, Polarization(Waves), Reprints, *Laser spectroscopy, *Far infrared spectroscopy.

Nineteen new submillimeter laser lines in fully deuterated methyl alcohol (CD3OD) in the wavelength range from 42 to 419 micrometers have been obtained in a Fabry-Perot FIR resonator by optically pumping the methanol with a cw CO2 laser. The authors have made accurate wavelength measurements and have determined the relative polarization of most of the known CD3OD laser lines. The frequencies of 13 of the strongest lines were also measured.

400,412

PB85-118313

Not available NTIS

National Bureau of Standards, Washington, DC.

Ionization of Normal Alkanes: Enthalpy, Entropy, Structural and Isotope Effects.

Final rept.,

M. Meot-Ner, L. W. Sieck, and P. Ausloos. 1981, 7p

Pub. in Jnl. of the American Chemical Society 103, n18 p5342-5348 1981.

Keywords: *Alkanes, *Ionization, Photochemical reactions, High pressure tests, Mass spectroscopy, Reprints.

Charge transfer equilibria involving n-alkanes, cyclohexane and some 2-Methyl-alkanes were measured between 300 and 420 K by high-pressure photoionization mass spectrometry.

400,413

PB85-118347

Not available NTIS

National Bureau of Standards, Washington, DC.

Reliability of Partial Structure Factors Determined By Anomalous Dispersion of X-Rays.

Final rept.,

R. G. Munro. 1982, 9p

Pub. in Physical Review B 25, n8 p5037-5045 Apr 82.

Keywords: *X rays, *Dispersions, Reprints, *Partial structure factors.

The reliability of the partial structure factors determined by either of two X-ray scattering techniques using the effects of anomalous dispersion is considered. A comparison of the two experimental techniques is given for both binary and ternary systems. The recently proposed X-ray frequency modulation technique is found to be about an order of magnitude better than the direct X-ray anomalous scattering method, and it is also found to be suitable for ternary systems. Experimental error is simulated by a pseudo-random number generator which produces normally distributed numbers with a specified mean and standard deviation. Conditions corresponding to about 1 percent experimental error from data acquisition and processing are assumed.

400,414

PB85-118354

Not available NTIS

National Bureau of Standards, Washington, DC.

Microwave Optical Double Resonance of NO2 with a Tunable CW Laser.

Final rept.,

T. Tanaka, A. D. English, R. W. Field, D. A. Jennings, and D. O. Harris. 1973, 2p

Pub. in Jnl. of Chemical Physics 59, n9 p5217-5218, 1 Nov 73.

Keywords: *Nitrogen dioxide, *Optical spectra, Reprints, *Laser spectroscopy, *Microwave double resonance.

A tunable CW dye laser has been used, using MODR techniques to give a complete rotational assignment of four NO2 absorption lines at 593.6 nm. The usefulness of this method of investigating complex optical spectra is shown and the details of the rotational assignment are discussed.

400,415

PB85-118362

Not available NTIS

National Bureau of Standards, Washington, DC.

Investigation of Laser Temporal Pulse Duration on Rayleigh Scattering.

Final rept.,

T. A. Nee, and J. R. Roberts. 1982, 4p

Pub. in Physical Review A 25, n2 p1000-1003 Feb 82.

Keywords: *Rayleigh scattering, *Cross sections, Pulse duration modulation, Reprints, *Laser applications.

Relative Rayleigh scattering cross sections from nitrogen have been measured for various pulse durations and various wavelengths of incident laser radiation. No pulse duration dependence has been observed for laser pulses as short as 5 ns, and classical theory is believed to be still valid for pulses shorter than 50 ns.

400,416

PB85-118396

Not available NTIS

National Bureau of Standards, Washington, DC.

Phase Diagram of Water Based on a Lattice Model.

Final rept.,

P. H. E. Meijer, R. Kikuchi, and P. Papon. 1981, 17p

Pub. in Physica A 109, n3 p365-381 Dec 81.

Keywords: *Phase diagrams, *Water, *Lattice parameters, Chemical bonds, Entropy, Ice, Equations of state, Reprints.

In order to calculate the phase diagram of water the authors introduce a lattice model that has the following features for its potential. A nearest neighbor attraction, which due to hydrogen bonding, is strongly dependent on the relative orientation of water molecules, and a next-nearest neighbor or a three-body repulsion. The hydrogen bonding is introduced in the model by means of a set of weight factors that are in accordance with Pauling's ice rules. The entropy is calculated using the cluster variation method for tetrahedrons. The isotherms show a maximum in the density and we obtain phase separations between the vapor, the open ice state and a state which is densely packed.

400,417

PB85-120582

Not available NTIS

National Bureau of Standards, Washington, DC.

Study of Corresponding States for the Liquid Alkali Metals.

Final rept.,

R. D. Mountain. 1976, 10p

Sponsored in part by Energy Research and Development Administration, Washington, DC.

Pub. in Proc. Int. Conf. on Liquid Metals (3rd), Bristol, England, July 12-15 1976, p62-71.

Keywords: *Alkali metals, *Equations of state, X ray diffraction, Thermodynamic properties, Pseudopotentials, Liquid potassium, Liquid sodium, Liquid rubidium.

The pseudopotential pair potentials developed by Price, et al. and by Dagens, Rasolt and Taylor are used to investigate the microscopic basis for a law of corresponding states for the liquid alkali metals. Both sets of potential functions show small departures from corresponding states. Monte Carlo simulation is used to show that the temperature dependent part of the pressure scales for Na and K with an error on the order of 10%. The pair distribution functions for Na are in good agreement with the results of X-ray diffraction measurements. These studies suggest that corresponding states is a reasonable, but not completely accurate, way of describing the thermodynamic properties of the liquid alkali metals.

400,418

PB85-120624

Not available NTIS

National Bureau of Standards, Washington, DC.

Ion Fragmentation of Benzene and Linear Benzene Isomers.

Final rept.,

H. M. Rosenstock, K. E. McCulloh, and F. P.

Lossing. 1978, 6p

Pub. in Advances in Mass Spectrometry 7B, p1260-1265 1978.

Keywords: *Ionization, *Photochemical reactions, *Fragmentation, Benzenes, Ionization potentials, Reprints, *Benzene, *Hexadiyne, Chemical reaction mechanisms, Autoionization, Rydberg series.

Photoionization and electron monochromator studies have been carried out on the ionization and fragmentation of benzene, 1,5-hexadiyne and some other pertinent molecules to further our understanding of the mechanism of benzene ion fragmentation. Evidence is presented for the formation of a new C4H4(+1) species with a heat of formation of about 286 kcal/mol, significantly lower than the species formed from vinylacetylene or butatriene. Heats of formation of a number of isomeric ions have been estimated. A number of these are nearly equivalent in energy to the first excited state of benzene ion and could serve as intermediates in the skeletal fragmentation reactions which occur with a significant kinetics shift. Autoionizing Rydberg states converging to the 16.84 eV ionization potential are observed in the photoionization yield curves of the benzene parent ion and all four major primary fragments. Evidence is presented which suggests that 1,5-Hexadiyne may also decompose via independent sets of fragmentation reactions.

400,419

PB85-120632

Not available NTIS

National Bureau of Standards, Washington, DC.

Scaled Fundamental Equation for the Critical Region of Steam.

Final rept.,

J. M. H. Levelt Sengers. 1977, 12p

Pub. in Proc. Symp. Thermophysical Properties (7th), Gaithersburg, Maryland, May 10-12 1977, p774-785.

Keywords: *Thermophysical properties, *Critical point, *Steam, *Mathematical models, Equations of state, Comparison, Enthalpy, Entropy, Specific heat.

The Linear Model scaled equation-of-state previously formulated for steam by Murphy et al. has been generalized to a fundamental equation. Intercomparisons are made with experimental data for pressure, energy and specific heats Cp and Cv. A tabulation is given of the thermodynamic functions volume, energy, entropy, enthalpy and specific heats, with pressure and temperature as entries. The range covered is 356-420C in temperature, 2.5-4.0 cu cm/g in volume.

400,420
PB85-120764 Not available NTIS
 National Bureau of Standards, Washington, DC.
Trends in Structure and Vibrational Frequencies of MX₂ and MX₃ High Temperature Halide Vapors.
 Final rept.,
 M. C. Drake. 1979, 10p
 Pub. in Jnl. of Electrochem. Soc. 126, n8 p1387-1396 Aug 79.

Keywords: *High temperature tests, *Molecular structure, *Molecular vibration, *Transition metals, *Halogen inorganic compounds, Thermodynamics, Trends, Reprints.

Trends in the structures and vibrational frequencies of gaseous MX₂ and MX₃ halides are summarized. Both molecular orbital and ion polarizability models are consistent with planar symmetry for all Group III A trihalides in accord with recent experiments. Both models yield the same qualitative predictions for the structures of other MX₃ species. Correlations of stretching frequencies and internuclear distances in MX, MX₂, and MX₃ molecules can be used to estimate shapes and unobserved vibrations. The implications of the results for the thermodynamic functions of gaseous halides are discussed.

400,421
PB85-120780 Not available NTIS
 National Bureau of Standards, Washington, DC.
Universality of Thermophysical Properties Near Critical Points.
 Final rept.,
 J. M. H. Levelt Sengers. 1977, 8p
 Pub. in Proc. Symp. Thermophysical Properties (7th), Gaithersburg, Maryland, May 10-12 1977, p766-773.

Keywords: *Thermophysical properties, *Critical point, Mathematical models, Scaling, Reprints, Ising model.

It is expected that critical behavior in a large variety of physical systems is the same. Reasons for the similarity are given. The principle of universality of critical behavior is first defined for magnetic systems and then extended to fluids. The factors that determine to which universality class a system belongs are given. Tests of the validity of the principle of universality in model systems and magnets are discussed. In fluids, three recent experiments have confirmed that these systems belong in the same universality class as the Ising model. Correction terms to asymptotic scaling will be important in fluids in regions of interest to engineers.

400,422
PB85-120830 Not available NTIS
 National Bureau of Standards, Washington, DC.
Triplet Correlations.
 Final rept.,
 H. J. Raveche, and R. D. Mountain. 1978, 33p
 Pub. in Paper in Progress in Liquid Physics, p469-501 1978.

Keywords: *Liquids, *Thermodynamic properties, Laboratory design, Neutron scattering, Reprints, *Triplet correlation, Computer applications.

The phenomenon of the correlation between three arbitrary molecules in a liquid is analyzed. The contribution of this correlation to the microscopic and thermodynamic properties of liquids and dense fluids is considered. Results from both laboratory measurements and computer simulations are included. The theory of triplet correlation is discussed and all the most widely used integral equations are analyzed.

400,423
PB85-121564 PC A06/MF A01
 National Bureau of Standards, Gaithersburg, MD.
 Center for Materials Science.
Phase Equilibria of Stored Chemical Energy Reactants.
 Annual rept.,
 L. P. Cook, E. R. Plante, R. S. Roth, and J. W. Hastie. Sep 84, 113p NBSIR-84/2940
 Grant N00014-83-F-0117

Keywords: *Phase diagrams, *Chemical equilibrium, *Crystallography, *Lithium aluminum hydride, Chemical reactions, X ray analysis, Thermodynamics, Mass spectroscopy, Mathematical models, Lithium oxides, Aluminum oxides, Mixtures.

The reaction of lithium aluminum alloy with water at high temperature is discussed in terms of phase equi-

libria in the system Li-Al-O-H. A thermodynamic analysis of the system reveals the potential importance of lithium hydride as a reaction product. Major needs for experimental phase equilibria data are outlined, and a determination of the Li₂O-Al₂O₃ phase diagram is given top priority. Appendices are given for the modeling of viscosities in multiphase mixtures, and describing results of a computerized literature search on the system Li-Al-O-H.

400,424
PB85-123321 Not available NTIS
 National Bureau of Standards, Washington, DC.
Small Angle Neutron Scattering (SANS) Measurements of Block Chains at National Bureau of Standards.
 Final rept.,
 E. J. Amis, C. J. Glinka, C. C. Han, H. Hasegawa, and T. Hashimoto. 1983, 3p
 Pub. in Polymer Preprints 24, n2 p215-217 1983.

Keywords: *Neutron scattering, *Polymers, Polystyrene, Copolymers, Reprints, *Small angle scattering, *Molecular conformation, *Polymer chains.

Deuterium labelling technique is used in the Small Angle Neutron Scattering experiments to determine the conformation of portion of polymer chain. Two such studies are presented in this paper. In the first experiment, the chain length and contour position dependence of the excluded volume effect is studied. In the second experiment, the dimensions of a polystyrene block chain in a microphase separated lamellar domain are studied. Also, the characteristics and capabilities of the NBS-SANS facility are described and illustrated.

400,425
PB85-123339 Not available NTIS
 National Bureau of Standards, Washington, DC.
Structure of C₄H₄(+) Produced in the Unimolecular Fragmentation of C₆H₆(+) and C₅H₅N(+).
 Final rept.,
 P. Ausloos. 1981, 2p
 Pub. in Jnl. of the American Chemical Society 103, n13 p3931-3932 1981.

Keywords: *Fragmentation, *Molecular structure, *Reaction kinetic, Pyridine, Ions, Reprints, *Ion molecule interactions, Benzene, Hexadiyne.

Ion cyclotron resonance experiments indicate that fragmentation of benzene, 1,5-hexadiyne, 2,4-hexadiyne, and pyridine ions lead to the formation of two isomeric C₄H₄(+) fragment ions, one linear (the but-1-yne-3-ene structure) and one cyclic (the methylene-cyclopropene structure). At the threshold energy for formation of C₄H₄(+) in benzene, only the cyclic ion is produced, while the linear C₄H₄(+) predominates at energies about 2 eV above the onset of this fragmentation process. It is suggested that the striking change in branching ratios for formation of C₃H₃(+) and C₄H₄(+) at a total energy of about 15.6 eV can be explained in terms of the existence of two channels leading to the formation of C₄H₄(+) species.

400,426
PB85-123347 Not available NTIS
 National Bureau of Standards, Washington, DC.
Structure and Isomerization of C₇H₇(+) Ions Formed in the Charge Transfer-Induced Fragmentation of Ethylbenzene, Toluene, and Norbornadiene.
 Final rept.,
 P. Ausloos. 1982, 7p
 Pub. in Jnl. of the American Chemical Society 104, n20 p5259-5265 1982.

Keywords: *Molecular structure, *Isomerization, *Benzenes, *Toluene, Ions, Deuterium compounds, Reaction kinetics, Reprints, *Benzene ions, *Benzene/ethyl, *Norbornadiene, Charge transfer.

C₇H₇(+) ions with internal energies varying from about 0.5 eV to 6.5 eV above their ground state energy have been prepared in an ion cyclotron resonance spectrometer (ICR) by charge transfer-induced fragmentation of ethyl benzene, toluene, and norbornadiene. It is shown that in the case of ethyl alpha, alpha-d₂ benzene and toluene -alpha, alpha, alpha-d₃ the abundance of unscrambled C₆H₅CD₂(+) ions produced by direct bond cleavage increases with energy to reach respectively 60 and 10 percent of the total C₇(H,D)(+) population at 3 eV above the appearance energy. C₇H₅D₂(+) ions are also produced after the occurrence of ring expansion and contraction

in the parent ion. However, because these ions produced from ethyl -alpha, alpha-d₂ benzene are not statistically scrambled, especially at high internal energies, it is suggested that only a few passages over the energy barrier separating the six-membered ring from the seven-membered ring structure occur during the dissociative lifetime of the ethylbenzene ion. In contrast, the hydrogens in benzyl-d₂ and benzyl-d₃ ions produced from toluene -alpha, alpha, alpha-d₃ after ring expansion are statistically scrambled.

400,427
PB85-123362 Not available NTIS
 National Bureau of Standards, Washington, DC.
Total and Partial Cross Sections for Electron Capture in Collisions of Hydrogen Atoms with Completely Stripped Ions.
 Final rept.,
 D. S. Belic, B. H. Bransden, and R. K. Janev. 1983, 10p
 Pub. in Physical Review A 28, n3 p1293-1302 Sep 83.

Keywords: *Exchange reactions, *Absorption cross sections, *Electron capture, Atoms, Ions, Electron scattering, Reprints, *Atom ion interactions, *Hydrogen atoms, Numerical solution.

Total and partial cross sections for the charge exchange reaction H(ls) + A(+Z) yields H(+1) + A(+Z-1) (n) A(+Z) being a fully stripped ion) are calculated in the energy range .01-100 keV/amu by using the multichannel Landau-Zener theory with rotational coupling included. The calculations are performed for Z between 5 and 74 and include species with highest priority for fusion research.

400,428
PB85-123388 Not available NTIS
 National Bureau of Standards, Washington, DC.
Silane Pyrolysis.
 Final rept.,
 R. Robertson, D. Hils, and A. Gallagher. Jan 84, 8p
 Sponsored in part by Solar Energy Research Inst., Golden, CO.
 Pub. in Chemical Physics Letters 103, n5 p397-404 Jan 84.

Keywords: *Silane, *Pyrolysis, *Surface chemistry, Chemical reactions, Decomposition reactions, Mathematical models, Reprints, Homogeneous reactions.

The authors show that silane pyrolysis is initiated by decomposition on the amorphous silicon surface, with an activation energy E_{sub a} of 56 kcal/mole. The observed surface decomposition rate is only weakly dependent on silane pressure. Much faster delayed decomposition rates, approximately independent of surface area and proportional to pressure, are shown to be initiated by surface reactions. A model for surface decomposition is given. Also a model for gas reactions is suggested based on H atom or SiH₃ release by surface decomposition, causing chain reactions that process the gas to high silanes that decompose rapidly. This model can explain the previous observations that the initial disilane formation rate and the delayed decomposition rate were independent of the surface area to volume ratio A/V, which had misled previous investigators to suggest homogeneous initiation processes.

400,429
PB85-123412 Not available NTIS
 National Bureau of Standards, Washington, DC.
2-Amino-6,7-Dihydroxytetralin Hydrobromide, C₁₀H₁₃NO₂.HBr.
 Final rept.,
 J. K. Stalick, C. R. Hubbard, A. D. Mighell, J. R. Rodgers, and A. S. Horn. 1984, 4p
 Contract FDA-224-80-3009
 Pub. in Acta Crystallographica. Section C 40, p317-320 1984.

Keywords: *Crystal structure, *X ray analysis, Molecular structure, Stereochemistry, Nitrogen organic compounds, Reprints, *Tetralin hydrobromide/amino-dihydroxy.

There are two independent molecules in the unit cell. Molecule A is essentially planar, except for two C atoms of the aliphatic ring which are displaced equally 0.33 Å above and below the plane of the molecule; the N atom also lies in the molecular plane defined by the aromatic ring. Molecule B exhibits partial disorder of the (+) and (-) enantiomers.

400,430

PB85-123438

Not available NTIS

National Bureau of Standards, Washington, DC.

High Resolution Spectrum of the HC1 Dimer.

Final rept.,

N. Ohashi, and A. S. Pine. 1 Jul 84, 12p

Pub. in Jnl. of Chemical Physics 81, n1 p73-84, 1 Jul 84.

Keywords: *Hydrogen chloride, *Infrared spectroscopy, *Molecular rotation, *Molecular vibration, Chemical bonds, Dimerization, Isotopic labeling, Electron tunneling, Reprints, *Laser spectroscopy, *High resolution infrared spectroscopy, Chlorine 35, Chlorine 37.

Rotational structure in the spectrum of the HCl stretching bands of the HCl dimer has been fully resolved using a tunable difference-frequency laser. The spectrum of a natural isotopic sample was recorded under thermal equilibrium conditions near the condensation point (T about 130 K) of HCl at low pressures (3-4 Torr) and long pathlengths (64-80 m). The spectra suggest an extremely rapid tunneling motion between equivalent forms of nearly orthogonally oriented monomer units.

400,431

PB85-123636

Not available NTIS

National Bureau of Standards, Washington, DC.

Assessment of the Effective Gaunt Factor Approximation.

Final rept.,

S. M. Younger, and W. L. Wiese. 1979, 10p

Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 22, n2 p161-170 1979.

Keywords: *Ions, *Electron scattering, Assessments, Comparison, Excitation, Performance evaluation, Reprints, *Gaunt factor.

Based on comparisons with recent theoretical data, it is shown that the effective Gaunt factor for delta $n = 0$ transitions in alkali-like ions is within 25% of unity in most cases and is a slowly varying function of energy.

400,432

PB85-123669

Not available NTIS

National Bureau of Standards, Washington, DC.

Reduction Parameters in a Phenomenological 3-Parameter Corresponding States Theory for N-Alkanes.

Final rept.,

F. Dowell. 1979, 3p

Pub. in Jnl. of Physical Chemistry 83, n7 p802-804 1979.

Keywords: *Alkanes, *Critical point, *Scaling, Entropy, Molecular structure, Reprints, *Correspondence principle.

Reduction (scaling) parameters in a phenomenological three-parameter corresponding states theory for n-alkanes are determined at the gas-liquid critical point and compared with values previously determined away from the critical region. The relative reduction parameters for volume and temperature remain virtually constant, but the relative reduction parameters for energy and entropy change; the trend in the relative entropy reduction parameter as a function of the number of carbon atoms changes. From these results, certain implications are observed regarding the parameters for corresponding states models for chain molecules.

400,433

PB85-123677

Not available NTIS

National Bureau of Standards, Washington, DC.

High-Resolution, Magic Angle Sample Spinning ¹³C NMR of Solid Cellulose - 1.

Final rept.,

W. L. Earl, and D. L. Vanderhart. 1980, 2p

Pub. in Jnl. of the American Chemical Society 102, n9 p3251-3252 1980.

Keywords: *Nuclear magnetic resonance, *Cellulose, Isotopic labeling, Chemical analysis, Reprints, Carbon 13.

The peaks for carbons 1, 4, and 6 in the solid state, magic angle sampling spinning (¹³C) NMR spectrum of cellulose have been assigned. The transverse and longitudinal relaxation times have been investigated for a carefully dried sample of cellulose I. These relaxation times are interpreted to indicate that the mobility of the backbone carbons in cellulose is intermediate between a crystalline solid and glassy polymer, provid-

ed that there is no water remaining in the sample to cause relaxation by its own motion. Anomalies in the spectrum can be interpreted as arising from two possible environments for the glucose monomers, one of which exhibits a more rapid relaxation for carbon 6 than the other.

400,434

PB85-123685

Not available NTIS

National Bureau of Standards, Washington, DC.

Electron Collisions with Highly Polar-Molecules: Integrated and Momentum-Transfer Cross-Sections and Conductivity Integrals for KOH and C5OH.

Final rept.,

L. A. Collins, D. W. Norcross, and G. B. Schmid.

1979, 13p

Sponsored in part by Department of Energy, Washington, DC. and Department of the Air Force, Washington, DC.

Pub. in Jnl. of Physics B: Atomic and Molecular Physics 12, n6 p1019-1030 1979.

Keywords: *Electron scattering, *Potassium hydroxides, Dipole moments, Cross sections, Reprints, *Electron molecule interactions, *Cesium hydroxide.

The authors report close-coupling calculations of the total integrated and momentum transfer cross sections for the scattering of electrons from KOH and CsOH in the energy range 0.01 eV to 10 eV. A cut-off dipole potential is used to account for the long-range interaction. We nominally chose the cut-off radius, R sub c , such that the potential has a minimum in the vicinity of the nucleus nearest to the center-of-mass (COM) of the molecule. No explicit account is taken of the short-range interactions. The results exhibit oscillations about a mean value, with an amplitude of approximately 1% and 10%, respectively, of the mean value for the two cross sections.

400,435

PB85-124048

Not available NTIS

National Bureau of Standards, Washington, DC.

Simulated Precipitation Reference Materials: Measurement of pH and Acidity.

Final rept.,

W. F. Koch, and G. Marinenko. 1983, 8p

See also PB80-227044.

Pub. in American Society for Testing and Materials, Special Technical Publication 823, p10-17 1983.

Keywords: *pH, *Acidity, Air pollution, Reprints, *Reference materials, Acid rain, Atmospheric chemistry.

The Center for Analytical Chemistry of the National Bureau of Standards has prepared and analyzed several series of simulated precipitation reference materials to be used as a means of intercalibrating atmospheric monitoring stations. In addition, research has shown serious errors in the measurement of pH and acidity determined in solutions of low-acidity and low-ionic strength. Contingent on further research pH measurements of acid rain should not be reported with greater confidence than 0.1 pH number. Titrations for total acidity should be performed to an inflection point or Gran plot endpoint and not to a fixed pH endpoint. Improved measurement protocols and reference standards are necessary to assure measurement comparability and consistency throughout the nation.

400,436

PB85-124055

Not available NTIS

National Bureau of Standards, Washington, DC.

Correcting Emission and Excitation Spectra: A Review of Past Procedures and New Possibilities Using Silicon Photodiodes.

Final rept.,

E. F. Zalewski, J. Geist, and R. A. Velapoldi. Dec 83, 9p

Pub. in Proceedings of Symposium New Directions in Molecular Luminescence, Atlantic City, NJ., March 10, 1982, American Society for Testing and Materials, Special Technical Publication 882, p103-111, Dec 83.

Keywords: *Emission spectra, *Photodiodes, Silicon, Excitation, Fluorescence, Reviews, Standards, Spectroradiometers, Fluorometric analysis.

A brief review of procedures used to produce corrected excitation and emission spectra is given. Recent advances in silicon photodiodes as detector standards and the possibility of their use to produce both corrected excitation and emission spectra are discussed in more detail. The advantages in the use of the photodiodes based on accuracy, stability, simplicity of use, and extensive linear dynamic range will be reviewed.

400,437

PB85-124063

Not available NTIS

National Bureau of Standards, Washington, DC.

Improved Flexibility in MODR (Microwave-Optical Double Resonance) Using a Supersonic Jet Source: Applications to CO+ and CN.

Final rept.,

M. A. Johnson, M. L. Alexander, I. Hertel, and W. C. Lineberger. Mar 84, 6p

Sponsored in part by National Science Foundation, Washington, DC.

Pub. in Chemical Physics Letters 105, n4 p374-379 Mar 84.

Keywords: *Carbon monoxide, *Cyanides, Hyperfine structure, Microwave spectroscopy, Ions, Free radicals, Reprints, *Carbon 12, *Nitrogen 14, Microwave double resonance.

Microwave-optical double resonance (MODR) is carried out on the $N=0$ to 1 transitions of CN and $CO(+1)$, which are rotationally cooled in a supersonic jet. Large modulations in the probe LIF (100%) are observed without optical saturation, demonstrating that short pulse dye lasers may be used in MODR.

400,438

PB85-124261

Not available NTIS

National Bureau of Standards, Washington, DC.

Electron-Detachment Progress in keV H-, Li-, Na-, K- - Rare Gas Collisions.

Final rept.,

N. Andersen, T. Andersen, L. Jepsen, and J. Macek. Jun 84, 14p

Pub. in Jnl. of Physics B: Atomic and Molecular Physics 17, n2 p2281-2294 Jun 84.

Keywords: *Rare gases, Ions, Helium, Neon, Argon, Excitation, Reprints, *Ion molecule interactions.

Electron detachment processes have been measured for the (quasi-) two-electron negative ions with n (square sec) structures ($n=1,2,3,4$), namely $H(-1)$, $Li(-1)$, $Na(-1)$, $K(-1)$ in collisions with He, Ne, and Ar at energies of 0.5-100 keV/amu. Total detachment cross sections have been determined for $n = 1-4$. Detachment with simultaneous ns-np excitation has been measured for $n = 2$ and 3. Finally, cross sections for target excitation and/or ionization have been estimated for 50 keV. For energies above 1 keV/amu, the total detachment cross sections are found to scale with the cross section for $H(-1)$ at the same velocity as the inverse square of the detachment energies. Simultaneous ns-np excitation is found to be important (about 30%) and exhibits a considerable alignment. Target excitation at these energies is relatively small in all cases except for $Na(-1)$ -Ne due to strong quasi-molecular effects in this system.

400,439

PB85-124287

Not available NTIS

National Bureau of Standards, Washington, DC.

Compression of CCl4 at High Pressures.

Final rept.,

S. D. Wood, and V. E. Bean. 1984, 4p

Pub. in Proceedings of AIRAPT Interactive High Pressure Conference (9th), Albany, NY., July 24-29, 1983, pt. 2, p29-32 1984.

Keywords: *Carbon tetrachloride, *Compressibility, Equations of state, High pressure tests, Isotherms, Critical point.

The compression of carbon tetrachloride has been measured along twelve isotherms covering a pressure range of 0.1 to 200 MPa and a temperature range of 254 to 298 K. Volume changes were measured with an automated capacitance bridge—one side of the bellows containing the sample serving as one plate of the capacitor. Data were obtained in the liquid, face-centered cubic (fcc), and rhombohedral phases; during melting, during freezing into the fcc phase and during the fcc to rhombohedral phase change. Premelting behavior was observed for both solids. The disappearance of the fcc phase at approximately 273 K and the existence of dual melting curves for the fcc and rhombohedral phases were reaffirmed.

400,440
PB85-124337 Not available NTIS
 National Bureau of Standards, Washington, DC.
Cure Kinetics Measurements on Polymer Composite Matrix Materials.

Final rept.,
 G. A. Senich, J. H. Flynn, J. C. Phillips, and H. Weisshaus. Aug 84, 2p
 Pub. in Polymer Preprints 25, n2 p211-212 Aug 84.

Keywords: *Reaction kinetics, *Polymers, *Composite materials, Nondestructive tests, Curing, Exothermic reactions, Heat measurement, Thermosetting resins, Mechanical properties, Infrared spectroscopy, Comparison, Acrylates, Reprints, Fourier transform spectroscopy.

Nondestructive techniques are being used during cure of identical samples for analysis of the rate and reaction kinetics of polymer composite matrix formation. Curing of acrylates and other unsaturated oligomers is initiated by ultra-violet light or by thermal means. Fourier transform infrared spectroscopy is used to determine the extent and rate of reaction of participating chemical functional groups. Differential scanning calorimetry is used to monitor thermally the kinetics of these exothermic cure process. Ultrasonic shear wave propagation in a quartz substrate coated with the curing sample gives information on the changes in mechanical properties occurring with time. By comparing the results for the same material it is possible to obtain a more thorough understanding of the cure chemistry kinetics occurring during processing of thermoset polymer matrix materials.

400,441
PB85-124352 Not available NTIS
 National Bureau of Standards, Washington, DC.
Application of Laser-Induced Rayleigh Light Scattering to the Study of Turbulent Mixing.

Final rept.,
 W. M. Pitts, and T. Kashiwagi. 1984, 39p
 Pub. in Jnl. of Fluid Mechanics 141, p391-429 1984.

Keywords: *Light scattering, *Rayleigh scattering, Raman spectroscopy, Turbulence, Turbulent flow, Methane, *Laser applications.

This work describes the development and characterization of an experimental system employing laser-induced Rayleigh light scattering with digital data acquisition as a time-resolved, quantitative concentration probe in the turbulent flow field of a binary gas mixture. Equations for the expected signal and noise levels are given. Estimates of these parameters for the experimental system used here are in satisfactory agreement with experiment. It is demonstrated that the laser Rayleigh light scattering technique provides measurements having high spatial and temporal resolution for various locations within the concentration flow field. Measurements at various positions in the flow field of an axisymmetric methane jet issuing into a slow flow of air are reported and, where possible, compared with appropriate literature results. The statistical properties of the turbulent concentration fluctuations are found to be in good agreement with other independent measurements. Conditionally sampled measurements are also reported and shown to behave in the same manner as the limited number of similar measurements in the literature. The capability of calculating power spectra and correlation functions for the time behavior of the methane concentration is also demonstrated. Raman and Rayleigh scattering techniques are compared as measurement techniques of scalar values in turbulent flow fields.

400,442
PB85-124378 Not available NTIS
 National Bureau of Standards, Washington, DC.
Photoacoustic Measurements of Multiple Photon Infrared Absorption by Alkyl Chlorides and Hexadienes.

Final rept.,
 T. A. Seder, and E. Weitz. Feb 84, 7p
 Pub. in Chemical Physics Letters 104, n6 p545-551 Feb 84.

Keywords: *Chlorides, Infrared spectroscopy, Absorption, Reprints, *Photoacoustic spectroscopy, *Hexadienes.

The multiple-photon absorption behavior of a series of alkyl chlorides and a number of hexadiene isomers has been examined in order to elucidate the dependence of absorption cross section on fluence. Measurements

of absorbed energy via a photoacoustic technique show that, while a high density of states is necessary for an absorption cross section linear influence, other factors are also important. A photoacoustic technique for measuring absorbed energy by weakly absorbing molecules at low pressure is described.

400,443
PB85-124386 Not available NTIS
 National Bureau of Standards, Washington, DC.
Porosity Study of Sintered and Green Compact YCrO₃ Using Small Angle Neutron Scattering Techniques.

Final rept.,
 K. Hardman-Rhyne, N. F. Berk, and E. D. Case. 1984, 6p
 Pub. in Proceedings of Symposium Nondestructive Evaluation Application and Materials Processing, Philadelphia, PA., October 3-4, 1983, p103-108 1984.

Keywords: *Neutron scattering, Nondestructive testing, *Small angle scattering, *Yttrium chromates.

A sintered and 'green' compact of YCrO₃ are studied to determine the void sizes and density using small angle neutron scattering techniques which have been extended to the beam broadening regime to detect sizes larger than 0.15 micrometers. This approach can be used with other on-line processing NDE techniques such as ultrasonics to standardize their results. Although the density ratio of the voids in the 'green' compact and sintered material of YCrO₃ are very different (0.42 and 0.03 respectively), the average void radius is very similar (0.17 and 0.18 micrometers respectively).

400,444
PB85-124394 Not available NTIS
 National Bureau of Standards, Washington, DC.

Collision Dynamics of Three Interacting Atoms: The Faddeev Equations in a Diabatic Electronic Basis.

Final rept.,
 Z. C. Kuruoglu, and D. A. Micha. Dec 83, 15p
 Pub. in Jnl. of Chemical Physics 79, n12 p6115-6129 Dec 83.

Keywords: *Diatomic molecules, Hydrogen, Hydrogen fluoride, Reprints, *Atom atom interactions, Faddeev equations.

Starting with all the electrons and nuclei making up a system of three atoms, the authors introduce a basis of antisymmetrized products of atomic states to define a matrix hamiltonian partition applicable to atom-diatom collisions. They derive a three-atom generalization of the Faddeev equations, in terms of diatomic transition operators. Equations are obtained for three-atom rearrangement transition operators, that are then reduced to sets of effective two-body (atom-diatom) equations by introducing separable expansions of the diatomic transition operators. They also discuss the permutational symmetry of identical nuclei, and briefly describe how the formalism applies to the H₃ and FH₂ systems.

400,445
PB85-124410 Not available NTIS
 National Bureau of Standards, Washington, DC.
Isomerization of Carbonium Ions in Collision Complexes.

Final rept.,
 P. Ausloos, and S. G. Lias. 1984, 32p
 Pub. in International Jnl. of Mass Spectrometry and Ion Processing 58, p165-180 1984.

Keywords: *Reaction kinetics, Ions, Isotope exchange, Isomerization, Reprints, *Butene, *Cyclopropane/methyl, *Ion molecule interactions.

Rate constants for proton transfer to the C₄H₈ isomers, cis- and trans-2-butene, 1-butene, and methylcyclopropane from various proton donors (such as CH₃CNH(+1), CH₃CHOH(+1), AsH₄(+1), H₃S(+1), and H₃O(+1)) are reported, and the structures of the product C₄H₉(+1) ions have been determined. In some mixtures, on the other hand, both sec-butyl and tert-butyl ions are formed as products. The probability of rearrangement in the complex is greater, the greater the dipole moment of the M species, since a larger dipole moment is associated with a deeper well-depth for the ion-molecule complex, and hence, a lower energy for the 'transition state-complex'. When proton transfer to form an unrearranged sec-butyl product ion is highly exothermic (> 10 kcal/mol), that channel will predominate over the rearrangement channel, even if the transition state for the isomerization is energetically favorable. Results on the protonation of 2-pentene

indicate that rearrangement of sec-C₅H₁₁(+1) to tert-C₅H₁₁(+1) occurs in the ion-molecule complex.

400,446
PB85-124428 Not available NTIS
 National Bureau of Standards, Washington, DC.
Collisional Narrowing Effects in the Raman Q-Branch Spectral Profiles of N₂, CO, and NO.

Final rept.,
 W. S. Hurst, G. J. Rosasco, and W. Lempert. Jun 84, 8p
 Pub. in Society of Photo-Optical Instrumentation Engineers 482, p23-30 1984.

Keywords: *Raman spectroscopy, *Nitrogen, *Carbon monoxide, *Nitrogen oxide(NO), Inelastic scattering, Molecular rotation, Line spectra, Reprints.

High resolution (10 MHz) stimulated Raman Q-branch spectra of molecules important in combustion are reported. In addition to the normal linear pressure broadening, line interference which leads to collisional narrowing is demonstrated. If proper account is not taken of this latter effect, large errors in the temperature and/or pressure as extracted from the spectral profile can result. The formalism which describes the spectrum and accounts for both line broadening and line interference effects is reviewed. The resulting ('relaxation') matrix equation (N_xN for an N-line spectrum) can be reduced by means of a perturbation solution to a spectral distribution involving a line broadening coefficient and a line interference coefficient for each line. This approach is applied successfully for the spectra of N₂ and CO. Further, it is shown that for the simple diatomics the J-dependent line broadening/interference coefficients can be expressed in terms of simple scale/fitting laws for the rates of rotationally inelastic collisions. This approach, in terms of the rate laws, leads to a simple parameterization of all the elements of the relaxation matrix and therefore allows a determination of the spectrum. The latter approach is used in the analysis of the Q-branch spectrum of NO, for which the perturbation solution cannot be applied because of the nearly degenerate Q-branch lines arising from its two ground state electronic configurations. It is shown that collisional narrowing in the NO Q-branch spectrum is reproduced reasonably well by a rate low model fit to literature data on specific state-to-state rates for rotational energy transfer.

400,447
PB85-128825 Not available NTIS
 National Bureau of Standards, Washington, DC.
Considerations in the Preparation and Certification of 'Pure Analyte' Reference Materials.

Final rept.,
 R. Schaffer, S. A. Margolis, and P. K. Longenbach. 1981, 6p
 Pub. in Quality Control in Clinical Endocrinology, p37-42 1981.

Keywords: *Chemical analysis, *Chemical compounds, Reprints, *Reference materials.

The development of reference methods of the kind that consist nominally of a single chemical compound requires the development of criteria defining the properties of the pure compound, specifications appropriate for a reference material, and the selection of appropriate analytical tests. Some special problems that may be found with the development of reference materials where only small quantities of material are available are considered.

400,448
PB85-128874 Not available NTIS
 National Bureau of Standards, Washington, DC.
Basic Research Needs and Opportunities for Characterizing the Microstructure and Microchemistry of Interfaces.

Final rept.,
 P. H. Holloway, K. R. Lawless, D. Lichtman, R. G. Meisenheimer, and L. E. Murr. 1982, 14p
 Pub. in Material Science and Engineering 53, n1 p149-162 Apr 82.

Keywords: *Research projects, *Molecular structure, *Interfaces, Electron microscopy, Performance evaluation, Solids, Gases, Liquids, Comparison, Reprints, *Solar equipment.

This article is a chapter in the report of a Workshop on Basic Research Needs and Opportunities on Interfaces in Solar Materials sponsored by the Department of Energy Division of Materials Sciences in July 1980.

Interfaces of many types (solid/solid, solid/gas, solid/liquid) occur in the materials configurations of most solar devices, often with several in close proximity. To secure satisfactory performance of devices, interfaces have to be adequately characterized, particularly the local microstructure and microchemistry. Needs were identified for microcharacterization on spatial scales ranging from the macroscopic to the microscopic giving structural, chemical or electronic configurations. Comparison of available techniques with these needs revealed major inadequacies. Much greater effort needs to be invested in 'in-situ' techniques. Efforts to extend the capabilities of surface analytical techniques to meet the identified needs are necessary. Recent developments in analytical electron microscopy show promise of complementing the surface technologies and should be developed. Wide use of these techniques in concert is encouraged and wider use of electron microscopy in general is necessary. Much deeper understanding of existing techniques is necessary and totally novel characterization approaches should be encouraged, particularly for 'in-situ' characterization of S/L, S/G interfaces.

400,449
PB85-128882 Not available NTIS
 National Bureau of Standards, Washington, DC.
Line Frequency Expressions for Triply Degenerate Fundamentals of Spherical Top Molecules Appropriate for Large Angular Momentum.
 Final rept.,
 H. W. Galbraith, C. W. Patterson, B. J. Krohn, and W. G. Harter. 1978, 19p
 Pub. in Jnl. of Molecular Spectroscopy 73, n3 p475-493 1978.

Keywords: *Molecular rotation, *Angular momentum, *Molecules, *Fundamental constants, Molecular vibration, Absorption spectra, Reprints, Numerical solution.

The authors obtain spectroscopically accurate expressions for the transition frequencies in the triply degenerate fundamental of a 'heavy' spherical top, without tedious calculation of octahedral vector coupling coefficients or diagonalization of matrices. Their calculations are based upon the physical assumption that as the molecule rotates with large angular momentum it behaves as a symmetric top with the coupled pure rotational angular momentum quantized along either the four- or three-fold body fixed axes. They found that a second order calculation which involves only 3-J symbols significantly exceeds the corresponding calculation in terms of non-diagonal octahedral vector coupling coefficients, so that for all but the most accurate saturated absorption spectra theoretical analysis may be carried out without reference to the octahedral subgroup of the rotation group.

400,450
PB85-128890 Not available NTIS
 National Bureau of Standards, Washington, DC.
Role of Tin in Bacterial Methylation of Mercury.
 Final rept.,
 C. Huey, F. E. Brinckman, S. Grim, and W. P. Iverson. 1974, 6p
 Pub. in Proceedings of International Conference on Transport of Persistent Chemistry in Aquatic Ecosystems, College Park, MD, April 30-May 4, 1974, p73-78.

Keywords: *Bacteria, *Methylation, *Water pollution, Sediments, Gas chromatography, Mass spectroscopy, Atomic spectroscopy, Pseudomonas, *Mercury/methyl, *Chemical reaction mechanisms, Tin/methyl, Fluorometric analysis, Atomic absorption spectrophotometry.

Evidence has been obtained for the methylation of Sn(IV) by a Sn and Hg tolerant strain of Pseudomonas isolated from the Chesapeake Bay. Growth of this organism in the presence of both Hg(II) and Sn(IV) results in the formation of methylmercury. A postulated mechanism to account for this formation is: Sn(IV) yields Methyltin species (Biological pathway), Methyltin species + Hg(+2) yields MeHg+ (Abiotic reaction).

400,451
PB85-128973 Not available NTIS
 National Bureau of Standards, Washington, DC.
Transport Properties of a Moderately Dense Gas.
 Final rept.,
 D. G. Friend, and J. C. Rainwater. 15 Jun 84, 5p
 Pub. in Chemical Physics Letters 107, n6 p590-594, 15 Jun 84.

Keywords: *Transport properties, *Density(Mass/volume), *Gases, Kinetic theory, Viscosity, Thermal

conductivity, Comparison, Reprints, *Dimer monomer interactions.

The initial density dependences of both viscosity and thermal conductivity are calculated according to a microscopically based theory which includes effects due to collisional transfer (from only free two-body phase space), three monomer collisions, and monomer-dimer collisions. A Lennard-Jones potential is used to model the interactions. Comparison of the calculated results with experiment (in reduced form) shows very good agreement for both viscosity and thermal conductivity over a wide temperature range.

400,452
PB85-128999 Not available NTIS
 National Bureau of Standards, Washington, DC.
Photodecomposition of Nitromethane Trapped in Solid Argon.
 Final rept.,
 M. E. Jacox. 19 Jul 84, 7p
 Pub. in Jnl. of Physical Chemistry 88, n15 p3373-3379 1984.

Keywords: *Nitromethane, *Photolysis, *Infrared spectroscopy, Chemical bonds, Absorptions, Vapor phases, Reprints, *Matrix isolation techniques, Chemical reaction mechanisms, Methanol/nitroso.

When nitromethane isolated in solid argon at 14 K is exposed to the full light of a medium pressure mercury arc, infrared absorptions of cis- and trans-CH₃ONO initially grow in intensity. On prolonged photolysis, these absorptions diminish in intensity, and there is continued growth in the infrared absorptions of the H₂CO...HNO hydrogen-bonded complex and in those of the cis- and trans- rotamers of the recently discovered species nitrosomethanol. Detailed isotopic substitution studies are consistent with these identifications. In the later stages of the photolysis, absorptions of CO, NO, and HNCO and of the H₂CO...HNCO hydrogen-bonded complex become increasingly prominent. The mechanism by which these products are formed is discussed. When the enhanced role of cage recombination is taken into account, this mechanism is compatible with that determined from gas-phase studies of the photolysis of nitromethane.

400,453
PB85-129005 Not available NTIS
 National Bureau of Standards, Washington, DC.
Electronic States of Al₂.
 Final rept.,
 H. Basch, W. J. Stevens, and M. Krauss. 10 Aug 84, 5p
 Pub. in Chemical Physics Letters 109, n2 p212-216, 10 Aug 84.

Keywords: *Aluminum, *Atomic energy levels, Electrons, Reprints, Multiconfiguration self consistent field.

Ab initio multi-configuration self-consistent field and first-order configuration interaction (FOCI) calculations in an extended basis set have been carried out for the lower energy electronic states of Al₂ in an attempt to assign its ground state. The ten core electrons of each Al atom were replaced by a compact effective core potential of a type which has been shown to give molecular results that agree with the corresponding all electron results to a high degree of accuracy.

400,454
PB85-129021 Not available NTIS
 National Bureau of Standards, Washington, DC.
Phase Space Subdivision of the Second Virial Coefficient and Its Consequences for Kinetic Theory.
 Final rept.,
 J. C. Rainwater. Jul 84, 6p
 Pub. in Jnl. of Chemical Physics 81, n1 p495-510 Jul 84.

Keywords: *Kinetic theory, *Metastable states, Reprints, *Virial coefficients, *Phase space, Curtiss theory, Numerical solution.

Two new methods of partitioning the second virial coefficient B into free, bound, and metastable parts, which differ from the well known partitioning of Stogryn and Hirschfelder, are presented. It is shown that the proper partitioning to use depends on the specific physical problem of interest. In particular, in the kinetic theory of moderately dense gases due to Curtiss, Snider and co-workers, certain collision integrals reduce unambiguously to linear sums of B and its temperature derivatives for repulsive potentials, but it has not been clear to what such integrals reduce for realis-

tic potentials. It is shown that such integrals reduce to the previously derived expressions with B replaced by one of our two new definitions of its free part. This contrasts with previous applications to real gases in which Curtiss and co-workers have used the full B and Kuznetsov has used the free part of B as defined by Stogryn and Hirschfelder. Also, original numerical calculations for the collision integrals are presented and the numerical consistency of the theory is verified.

400,455
PB85-129195 Not available NTIS
 National Bureau of Standards, Washington, DC.
Crystal Structure of Polytetrafluoroethylene Homopolymer and Copolymers in the High Pressure Phase.
 Final rept.,
 E. S. Clark, R. K. Eby, G. J. Piermarini, and S. Block. Aug 83, 2p
 Pub. in Polym. Prepr. 24, n2 p423-424 Aug 83.

Keywords: *Crystal structure, *X ray diffraction, Copolymers, High pressure tests, Fluorine organic compounds, Reprints, *Poly(ethylene/tetrafluoro).

Polytetrafluoroethylene is a linear polymer which has a helical conformation: at atmospheric pressure. Three distinct phases have been identified at one atmosphere (101 MPa)--Form (above 30C), Form IV (19-30C) and Form II (below 19C). Various investigators have identified a fourth phase (Form III) at pressures above about 700 MPa at room temperature. Studies of the crystal structure using x-ray diffraction by Nakafuku and Takemura (1) indicated a crystal structure similar to orthorhombic polyethylene whereas x-ray studies by Flack (2) indicated a monoclinic packing of planar zig-zag chains. We have undertaken a study of the crystal structure of the high pressure (Form III) of polytetrafluoroethylene homopolymer as well as several copolymers containing randomly distributed hexafluoropropylene units.

400,456
PB85-129203 Not available NTIS
 National Bureau of Standards, Washington, DC.
Viscosities and Glass Transitions in Liquids at High Pressures.
 Final rept.,
 R. G. Munro, G. J. Piermarini, and S. Block. 1980, 18p
 Pub. in Review of Physical Chemistry of Japan 50, p79-96 1980.

Keywords: *Viscosity, *Liquids, *Glass transition temperatures, *High pressure tests, Fluorescence, Reprints.

The study of the pressure dependence of the viscous properties of liquids, including glass transitions, is reviewed. An overview of the present status of both the theory of viscosity and the experimental techniques and results for high pressure viscometry is presented. Representative examples of several viscometers for high pressure applications are described briefly. A more detailed description of the diamond anvil pressure cell falling sphere viscometer is given. Viscosity data obtained by this method for several liquids are correlated with their glass transition pressures which are derived from ruby fluorescence line-broadening measurements.

400,457
PB85-129237 Not available NTIS
 National Bureau of Standards, Washington, DC.
Impedance Spectroscopy Model for Electron-Transfer Reactions at an Electrode Solid Electrolyte Interface.
 Final rept.,
 H. J. deBruin, and A. D. Franklin. 1981, 14p
 Pub. in Jnl. of Electroanalytical Chemistry and Interfacial Electrochemistry 118, p405-418 1981.

Keywords: *Mathematical models, *Electron transfer, *Electrodes, *Solid electrolytes, Electrochemistry, Reaction kinetics, Chemical reactions, Reprints, *Impedance spectroscopy, Numerical solution.

Numerical calculations have been performed for a model for the frequency-dependence of the impedance of a diffusion-limited electrode on a solid electrolyte. Three circuit elements are connected in series in the model. Bulk charge transport is represented by a simple parallel R-C circuit and the diffusion process itself by a Warburg impedance. The possibility of a multistep redox reaction at the electrode-electrolyte interface is modeled by a string, in series, of parallel R-

C networks, and the possibility of competing redox reactions by combining several of these series strings in parallel. The distributions of the elements in the series strings were represented by both Cole-Cole and normal distribution. Calculations were carried out for several such arrangements, varying the nature and width of the distributions and the number of parallel strings. It is found that these variations are reflected in subtle changes in the impedance data, and it is concluded that important kinetic information is contained in the sub-structure of the impedance spectra.

400,458
PB85-129245 Not available NTIS
 National Bureau of Standards, Washington, DC.
Rotational-State and Spin-State Distributions - NO Thermally Desorbed from Ru(001).
 Final rept.,
 R. R. Cavanagh, and D. S. King. 1981, 4p
 Pub. in Physical Review Letters 47, n25 p1829-1832 1981.

Keywords: *Surface chemistry, *Molecular rotational, *Nitrogen oxide(NO), Fluorescence, Desorption, Ruthenium, Boltzmann equation, Thermal environments, Reprints, *Laser excited fluorescence.

Rotational state distributions in both spin manifolds of the ground electronic state of NO desorbed from single crystal Ru(001) via thermal heating in ultra-high vacuum have been measured using laser excited fluorescence techniques. NO molecular desorption proceeds from singly coordinated (i.e., atop) sites of the Ru basal plane between 435 and 475 K. The nascent population distribution for those states with less than 400 /cm of rotational energy (including spin) can be represented by a single Boltzmann factor, $T_{\text{sub}}(\text{rot}) = 235 \pm 35$ K, significantly lower than the surface temperature.

400,459
PB85-129260 Not available NTIS
 National Bureau of Standards, Washington, DC.
Mechanical and Transport Properties of the Drawn Cross-Linked Low Density Polyethylene (CLPE).
 Final rept.,
 F. DeCandia, R. Russo, V. Vittoria, and A. Peterlin. 1982, 9p
 Pub. in Jnl. of Polymer Science, Polymer Physics Edition 20, n2 p269-277 1982.

Keywords: *Polyethylene, *Mechanical properties, *Transport properties, Crosslinking, Density(Mass/volume), Elastic modulus, Drawing, Diffusion coefficients, Elastomers, Reprints, *Low density polyethylene.

The draw ratio dependence of the density ρ and the elastic modulus E , and the maximum draw ratio λ of the CLPE are rather similar to the values obtained with the not crosslinked branched material with a similarly low density. Very much the same applies to the equilibrium concentration of the sorbed methylene chloride in the amorphous component, and the zero concentration diffusion coefficient $D_{\text{sub } 0}$. The exponential concentration coefficient $\gamma_{\text{sub } D}$, however, even at the maximum draw ratio does not show any indication of the rapid increase which is so characteristic for the completion of the transformation from the lamellar to the fibrous structure. On the basis of this finding, one could understand the small deviations in the dependence of the mechanical properties between the cross-linked and the not cross-linked branched material. The segments between the cross-links, much shorter than the free molecules, favor the formation of the intermicrofibrillar tie molecules which limit the drawability of the sample. But since they cannot be extended to the same length as the free molecules, they contribute less to the total fraction of tie molecules per amorphous layer and hence yield a smaller axial elastic modulus.

400,460
PB85-129302 Not available NTIS
 National Bureau of Standards, Washington, DC.
Measurement of ^{13}C Chemical Shifts in Solids.
 Final rept.,
 W. L. Earl, and D. L. Vanderhart. 1982, 20p
 Pub. in Jnl. of Magnetic Resonance 48, n1 p35-54 1982.

Keywords: *Solids, *Isotopic labeling, Plastics, Reprints, *Chemical shifts(Nuclear magnetic resonance), *Carbon 13, Reference materials, Poly(Silane/dimethyl).

A pulse sequence and sample geometry which allows the measurement of (^{13}C) chemical shifts of solid materials relative to liquid TMS are described. Using this technique, the chemical shifts of a series of common engineering plastics were measured and reported. A small number of candidate secondary shift reference materials have been considered and their chemical shifts measured. Most of these materials proved to be unsuitable for general (^{13}C) shift references for differing reasons. The most promising standard investigated was polydimethylsilane. The measurement of chemical shifts in solid materials is slightly complicated by anisotropic magnetic properties and sensitivity to magic angle missetting when the material exhibits macroscopic orientation. These complications are discussed in detail and examples of misleading spectra are shown.

400,461
PB85-129351 Not available NTIS
 National Bureau of Standards, Washington, DC.
Factor-Jump Thermogravimetry Applied to Polymer Degradations.
 Final rept.,
 B. Dickens. 1981, 2p
 Pub. in Polym. Prepr. 22, n1 p316-317 1981.

Keywords: *Polymers, *Degradation, *Thermogravimetry, Activation energy, Polystyrene, Polypropylene, Polyethylene, Plastics, Reprints.

The factor-jump method of thermogravimetry has been developed to study thermal degradations of polymers by continually measuring the activation energy of the degradation process. The method requires only one sample for these determinations and thus complicating effects arising from the use of two samples with differing thermal histories are avoided. Also, the effect of thermal history on the weight loss process can be studied. Preheating for longer than a few minutes at temperatures below the ultimate temperature of degradation produces small molecules which later volatilize to give apparent activation energies of greater than 110 kcal/mole. Use of a chemically significant quantity such as the activation energy allows the estimation of the importance of physical effects such as diffusion in the weight-loss processes. Average activation energies are estimated from individual values using trimmed means and probability plot-type calculations. The method has been applied to the study of the degradations of PS, PE, and PP in vacuum and in slowly flowing N_2 .

400,462
PB85-129369 Not available NTIS
 National Bureau of Standards, Washington, DC.
Specific Heat of Phenolic Resins.
 Final rept.,
 S. S. Chang. 1983, 2p
 Pub. in Polym. Prepr. 24, n2 p187-188 1983.

Keywords: *Phenols, *Specific heat, Polymers, Chemical reactions, Reviews, Reprints.

A review of specific heat investigations on phenolic resins and other crosslinked polymers are presented. The temperature range of investigations covered from cryogenic temperatures of 0.1 K through the normal useful range of about 500 K up to charred materials at 3000 K. Because of the variations in composition, as well as in the degree of crosslinking and curing, emphasis will be placed on the general characteristics of these materials. The thermal behavior of these cross-linked polymers at low temperatures is rather similar to that normally observed for glassy polymers. At high temperatures, thermal effects from chemical reactions may often interfere with the determination of the physical constants.

400,463
PB85-129393 Not available NTIS
 National Bureau of Standards, Washington, DC.
Molecular Packing in 15/7 Hexagonal Polytetrafluoroethylene.
 Final rept.,
 B. L. Farmer, and R. K. Eby. Aug 83, 2p
 Pub. in Polym. Prepr. 24, n2 p421-422 Aug 83.

Keywords: *Crystal structure, X ray diffraction, X ray analysis, Fluorine organic compounds, Reprints, *Poly(ethylene/tetrafluoro), *Molecular conformation, Numerical solution.

Semiempirical energy calculations were used extensively in the elucidation of the crystalline structure of the low temperature phase (II) of polytetrafluoroethy-

lene (PTFE) (1,2). The structure which emerged from x-ray diffraction analysis and energy minimization was a triclinic unit cell containing one left and one right-handed 54/25 helical PTFE molecule. The molecular packing could best be described as rows of like-handed molecules having setting angles (defined as the orientation of a specific CF_2 group in a reference plane) increasing progressively with a 40 deg increment. The setting angle progressions in adjacent, opposite-handed molecular rows run in opposite directions.

400,464
PB85-130268
 (Order as PB85-130078, PC A99/MF A01)
 Mainz Univ. (Germany, F.R.). Inst. fuer Physik.
High Resolution Microwave Spectroscopy on Trapped $\text{Ba}(+1)$ Ions,
 W. Becker, R. Blatt, and G. Werth. 1984, 3p
 Included in Precision Measurement and Fundamental Constants II, p99-101 1984.

Keywords: *Microwave spectroscopy, *Frequency standards, Ground state, Hyperfine structure, Time standards, Atomic energy levels, *Barium ions, *Ion traps, Barium 137, Barium 135, Double resonance methods.

The authors performed an optical double resonance experiment on the ground state of ($^{137}\text{Ba}(+1)$) and ($^{135}\text{Ba}(+1)$) ions. About 100,000 particles were confined in an rf quadrupole trap for many hours. Hfs state selection by pulsed laser optical pumping was followed by microwave transitions, which were observed via change in the ionic fluorescence intensity. Linewidths of the order of the laser repetition frequency (1-20 Hz) and a complicated line structure were observed in the 'field independent' $F = 1, m = 0$ yields $F = 2, m = 0$ transitions. The statistical uncertainty of the line center was below 0.1 Hz. The results for the hyperfine separations, including corrections to zero magnetic and electric field, are given.

400,465
PB85-130276
 (Order as PB85-130078, PC A99/MF A01)
 Texas A and M Univ., College Station. Dept. of Physics.
Observation of High Order Side Bands in the Spectrum of Stored ($\text{sup } 3$)He(+1) ions,
 H. A. Schuessler, and H. S. Lakkaraju. 1984, 5p
 Included in Precision Measurement and Fundamental Constants II, p103-107 1984.

Keywords: *Helium 3, *Microwave spectra, *Sidebands, Perturbation theory, Doppler effect, *Ion traps, *Helium ions.

The magnetic resonance spectrum of the 1 doublet S ($1/2$) ground state of ($^3\text{He}(+)$) ions was remeasured using a radio-frequency quadrupole ion trap and the ion storage exchange collision technique. In particular the line shape of the $\Delta F = +$ or $-1, \Delta m(F) = +$ or -1 hyperfine structure transition was studied. The spectrum was observed to consist not only of the component at the main transition frequency $\nu(0)$. A calculation of the spectrum based on the correlation function formalism reproduced the main features of the experimental spectrum although differences are discernible. The dependence of the side-band spectrum on the energy and energy distribution of stored ions in both standing and traveling wave fields was also investigated numerically. The present investigation has a strong bearing on side-band cooling techniques and on improving the precision of spectroscopic measurements.

400,466
PB85-130292
 (Order as PB85-130078, PC A99/MF A01)
 Stanford Univ., CA. Dept. of Physics.
Spectroscopy, Quantum Electrodynamics, and Elementary Particles: Precision Laser Spectroscopy,
 T. W. Haensch. 1984, 5p
 Included in Precision Measurement and Fundamental Constants II, p111-115 1984.

Keywords: *Quantum electrodynamics, *Fundamental constants, Doppler effect, *Laser spectroscopy, *Hydrogen atoms, *Deuterium atoms.

Precision laser spectroscopy of atomic hydrogen and deuterium will be reviewed. The Balmer-alpha line has been studied by Doppler-free saturated absorption spectroscopy, polarization spectroscopy, optical-ra-

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Group 7D—Physical Chemistry

diofrequency double quantum spectroscopy, and by laser-quenching of a beam of metastable atoms. These experiments have led to an eightyfold improvement in the accuracy of the Rydberg constant. Two-photon spectroscopy of the 1S-2S transition has made possible an accurate measurement of the ground state Lamb shift, and further advances in resolution promise new stringent tests of quantum electrodynamic theory.

400,467
PB85-130300

(Order as PB85-130078, PC A99/MF A01)
Yale Univ., New Haven, CT. Dept. of Physics.
Atomic Beam, Linear, Single-Photon Measurement of the Rydberg Constant,
S. R. Amin, C. D. Caldwell, and W. Lichten. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p117-122 1984.

Keywords: *Fundamental constants, Atomic energy levels, Atomic beams, *Rydberg series, *Laser spectroscopy, *Hydrogen atoms, *Deuterium atoms.

The Rydberg constant has been measured to a standard error of one part in 10 to the 9th power for the first time by atomic beam, laser spectroscopy. The results are consistent with recent, less precise measurements.

400,468
PB85-130318

(Order as PB85-130078, PC A99/MF A01)
Michigan Univ., Ann Arbor. Dept. of Physics.
Current Work on Two Photon Excitation in a Hydrogen Beam for the Measurement of the Rydberg Constant and $M(\text{sub } e)/M(\text{sub } p)$,
D. Shiner, and C. Wieman. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p123-125 1984.

Keywords: *Fundamental constants, Atomic energy levels, Excitation, Metastable state, *Rydberg series, *Hydrogen atoms, *Deuterium atoms, *Laser spectroscopy.

The authors have observed the two quantum 2S to 3S transition in a beam of hydrogen in the metastable 2S state. The transition was excited by 6563 Å laser light plus a 315 MHz radio frequency field and is much narrower than the 2S to 2P single photon transition. The transition is detected by observing the increase in the number of metastable atoms which survive passage through the region containing the two fields. Work is underway to precisely measure the transition energy and the shift between hydrogen and deuterium. These results will provide more precise values for the Rydberg constant and the electron to proton mass ratio.

400,469
PB85-130326

(Order as PB85-130078, PC A99/MF A01)
Harvard Univ., Cambridge, MA. Lyman Lab. of Physics.
Measurement of the 2 doublet P (3/2) - 2 doublet S (1/2) Fine-Structure Interval in Atomic Hydrogen,
K. A. Safinya, K. K. Chan, S. R. Lundeen, and F. M. Pipkin. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p127-130 1984.

Keywords: *Atomic beams, Atomic energy levels, *Hydrogen atoms, *Separated oscillatory fields, *Fine structure constant, Lamb shift.

A separated-microwave-oscillatory-field technique has been used in conjunction with a fast atomic-hydrogen beam to measure the 2 doublet P (3/2) - 2 doublet S (1/2) fine-structure interval in atomic hydrogen. The value obtained for the 2 doublet P (3/2) - 2 doublet S (1/2) fine-structure interval is 9911.117(41) MHz. This value is compared with other measurements of this fine structure interval and the potential precision obtainable in a more definitive measurement is discussed.

400,470
PB85-130334

(Order as PB85-130078, PC A99/MF A01)
Harvard Univ., Cambridge, MA. Lyman Lab. of Physics.
Measurement of the Lamb Shift in Hydrogen, $\eta = 2$,
S. R. Lundeen, and F. M. Pipkin. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p131-133 1984.

Keywords: *Hydrogen, *Atomic beams, Quantum electrodynamics, Line width, *Lamb shift, *Hydrogen ions, *Fine structure, Separated oscillatory fields.

A measurement based on the fast atomic beam separated oscillatory field method of sub-natural linewidth spectroscopy gives for the Lamb shift in hydrogen: $S(\eta = 2) = 1057.845(9)$ MHz. The result is not in good agreement with theory.

400,471
PB85-130342

(Order as PB85-130078, PC A99/MF A01)
Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Inst. Atomnoi Energii.
Atomic Interferometer Method Measurement of the Lamb Shift in Hydrogen ($\eta = 2$),
Y. L. Sokolov. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p135-139 1984.

Keywords: *Interferometers, *Lamb shift, *Hydrogen atoms, *Atomic interferometers.

The frequency of the (2S (1/2), F = 0) - (2P (1/2), F = 1) transition in the hydrogen atom has been measured by means of an atomic interferometer. The Lamb shift has been found to be $S = 1057.8583 \pm \text{or} - 0.0022$ MHz, where the uncertainty is the statistical standard deviation of a single observation.

400,472
PB85-130359

(Order as PB85-130078, PC A99/MF A01)
Harvard Univ., Cambridge, MA. Lyman Lab. of Physics.
Measurement of the 4 doublet S(1/2) - 4 doublet P(1/2) Lamb Shift in He(+1),
J. J. Bollinger, S. R. Lundeen, and F. M. Pipkin. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p141-144 1984.

Keywords: *Quantum electrodynamics, Ions, Atomic energy levels, Experimental design, *Lamb shift, *Helium ions, Separated oscillatory fields.

The separated oscillatory field technique is being used with a fast 120 keV He(+1) beam and a miniature microwave spectroscopy region to make a zero magnetic field measurement of the $n = 4$ Lamb shift interval in He(+1). The 4 doublet S(1/2) state population is monitored by observing its decay to the 2P state with a large solid angle VUV photoionization detector. With 10 minutes of counting time, the signal to noise ratio is sufficient to make a 100 ppm measurement of the line center. It is believed that with this signal to noise ratio the systematics can be well enough understood to determine the line center better than previous He(+1) Lamb shift measurements and test the Erickson and Mohr calculations of the Lamb shift.

400,473
PB85-130367

(Order as PB85-130078, PC A99/MF A01)
Bell Labs., Murray Hill, NJ.
Lamb Shift in the Hydrogenic Ion Cl(+16),
E. T. Nelson, O. R. Wood, C. K. N. Patel, M. Leventhal, and H. W. Kugel. 1984, 3p
Prepared in cooperation with Rutgers - The State Univ., Piscataway, NJ.
Included in Precision Measurement and Fundamental Constants II, p145-147 1984.

Keywords: Atomic energy levels, *Lamb shift, *Chlorine ions, *Laser spectroscopy.

The Cl(+16) $n = 2$ Lamb shift has been measured by resonant laser quenching of a fast (ν/c about 0.1) metastable beam. The result for the 2S(1/2) - 2P(1/2) splitting is 31.19(22) THz in agreement with the calculation of Mohr and with the series expansion in powers of (Z/α) .

400,474
PB85-130375

(Order as PB85-130078, PC A99/MF A01)
Yale Univ., New Haven, CT.
Helium Fine Structure and the Fine Structure Constant,
W. Frieze, E. A. Hinds, A. Kponou, V. W. Hughes, and F. M. J. Pichanick. 1984, 3p
Prepared in cooperation with Massachusetts Univ., Amherst.
Included in Precision Measurement and Fundamental Constants II, p149-151 1984.

Keywords: *Helium, *Fundamental constants, Quantum electrodynamics, Optical spectra, Microwave spectroscopy, Atomic energy levels, *Fine structure, *Fine structure constant.

A series of precision measurements have been made of the fine structure interval $\nu_{\text{sub}}(\text{JJ}')$ in the 2 triplet P state of helium. These results are self-consistent and in good agreement with theory. Experiment and theory can be combined to produce an independent value for the fine structure constant $1/\alpha = 137.036 13(11)$ (0.8 ppm), in good agreement with the more accurate value currently accepted $1/\alpha = 137.035 963(15)$ (0.11 ppm).

400,475
PB85-130383

(Order as PB85-130078, PC A99/MF A01)
State Univ. of New York at Stony Brook. Dept. of Physics.
Preliminary Measurement of the J = 0 to J = 2 Fine Structure Interval in the 3 triplet P State of Helium,
M. Feldman, T. Breeden, L. DiMauro, T. Dong, and H. Metcalf. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p153-157 1984.

Keywords: *Helium, Atomic energy levels, Zeeman effect, Excitation, Fundamental constants, Nuclear magnetic resonance, *Fine structure.

The authors have made time resolved measurements of the level crossing signal from the $J = M = 2$, and the $J = M = 0$ sublevels of the 3 triplet P state of He near 2277 gauss. A thermal beam of He 2 triplet S metastables is excited by a pulse of 3889 Å dye laser light and a temporal slice of the fluorescence at 90 degrees to the field is recorded by fast electronics as a function of field. This experiment has been carefully designed to minimize the effects of very many possible systematic errors. They have a S/N of about 15 in each of about 100 data sets (about 1 hour run time). The result has a statistical standard error of 1.4 ppm and a systematic uncertainty of about 1.4 ppm, resulting in a net uncertainty of 2 ppm. The distribution of the results is approximately a Gaussian of width 14 ppm and the average, corrected for field inhomogeneity, is 9695.013 kHz (NMR, H₂O).

400,476
PB85-130391

(Order as PB85-130078, PC A99/MF A01)
Heidelberg Univ. (Germany, F.R.). Physikalisches Inst. (II).
Laser Microwave Precision Measurements of 2 triplet S(1) and 2 triplet P Term Splittings in Helium-Like Li(+1),
U. Koetz, J. Kowalski, R. Neumann, S. Noehte, and H. Suhr. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p159-162 1984.

Keywords: *Hyperfine structure, Atomic energy levels, Ions, *Lithium ions, *Laser spectroscopy.

The hyperfine structure (hfs) splittings of the metastable 1s_{2s} triplet S(1) state of helium-like (6,7)Li(+1) have been measured with combined laser optical pumping and microwave resonance. A low energy Li(+1) ion beam, optically excited by an intersecting laser beam, passed through a waveguide where radio frequency transitions were induced. The resulting population transfer between the hfs levels of the triplet S(1) was detected via the change of fluorescence light intensity from a second crossing region of laser light and ion beam located behind the waveguide. The magnetic hfs constants A (6Li(+1), 2 triplet S(1)) and A (7Li(+1), 2 triplet S(1)) were extracted from the measurements and compared with theory. The hfs anomaly is in good agreement with the value obtained from the magnetic hfs constants of the atomic 2 doublet S1/2 ground states. In addition rf measurements of the 2 triplet P hfs have been performed.

400,477
PB85-130409

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Center for Absolute Physical Quantities.
Optically Pumped Metastable Hydrogen Beam,
K. C. Harvey. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p163-167 1984.

Keywords: *Optical pumping, *Fundamental constants, *Atomic beams, Atomic energy levels, Metastable state, *Hydrogen atoms.

A beam source of atomic hydrogen is described which produces metastable atoms in the $2S_{1/2}$ state by optical pumping. An effusive beam of atomic hydrogen is generated in the ground state. The atoms pass in front of a VUV lamp producing Lyman-beta (1026 Å) radiation. The atoms are excited to the 3p level and then cascade to the $2S_{1/2}$ state. The metastable atoms are measured by quenching them with an electric field and detecting the emitted Lyman-alpha radiation. Beams with a flux of 10 to the 6th power atoms/sec were obtained. A metastable-beam effective temperature of 100 K was measured. In addition preliminary measurements of the transition from $n = 9$ to $n = 20$ in hydrogen using a Woods discharge are presented and directions for improvement are indicated.

400,478

PB85-130417

(Order as PB85-130078, PC A99/MF A01)
Ecole Normale Supérieure, Paris (France).

Precise Determination of the S and P Quantum Defects in Sodium and Cesium by Millimeter and Submillimeter Spectroscopy between Rydberg States, P. Goy, J. M. Raimond, G. Vitrant, C. Fabre, and S. Haroche. 1984, 4p

Included in Precision Measurement and Fundamental Constants II, p169-172 1984.

Keywords: *Atomic beams, Quantum theory, Excitations, Millimeter waves, Submillimeter waves, *Fine structure, *Rydberg series, *Quantum defects, *Sodium atoms, *Cesium atoms.

Well-stabilized millimeter and submillimeter sources in the frequency range 50-500 GHz permit one to induce narrow transitions between Rydberg states of alkalis with the principal quantum numbers n in the range $23 < n < 41$. The levels are prepared by laser excitation. Detection of the atomic levels is performed through the selective field ionization technique. Precise experimental values for quantum defects and fine structure intervals are reported for the S and P states in sodium and cesium. The hyperfine structure of Rydberg states $n S_{1/2}$ and $n P_{1/2}$ has been observed for the first time in cesium. The extension of these experiments with increased accuracy to the spectroscopy of hydrogen would provide a new way to determine the Rydberg constant in frequency units.

400,479

PB85-130425

(Order as PB85-130078, PC A99/MF A01)
Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

New Method for Measuring the Fine Structure Constant Using Stark Spectroscopy, M. G. Littman, and W. D. Phillips. 1984, 4p

Prepared in cooperation with National Bureau of Standards (NML), Gaithersburg, MD. Electrical Measurements and Standards Div.

Included in Precision Measurement and Fundamental Constants II, p173-176 1984.

Keywords: *Fundamental constants, *Stark effect, Excitation, Atomic energy levels, *Fine structure constant, *Hydrogen atoms, Rydberg series.

An experiment to determine a value for alpha, the fine structure constant, is proposed. The determination is to be based on a measurement of the Stark effect of hydrogen Rydberg states. Hydrogen atoms in a uniform field of known strength will be excited to Rydberg levels using intense tunable lasers. The presence of excited atoms will be detected using the sensitive technique of field ionization. A precise measurement of the linear energy shift of an extreme Stark state is to be made, and from this measurement, in conjunction with reported values of $R(x)$, the Rydberg constant, and $2e/h$, the Josephson frequency-voltage ratio, a value of alpha will be determined. The estimated accuracy of the determination is expected to be competitive with or better than the 0.11 ppm accuracy best non-QED determination of alpha.

400,480

PB85-130433

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Electrical Measurements and Standards Div.

Time Resolved Sub-Natural Width Spectroscopy, W. D. Phillips, and H. J. Metcalfe. 1984, 4p

Prepared in cooperation with State Univ. of New York at Stony Brook. Dept. of Physics.

Included in Precision Measurement and Fundamental Constants II, p177-180 1984.

Keywords: *Line width, *Line spectra, *Mathematical models, Separated oscillatory fields.

A number of techniques exist in both practice and theory for achieving spectral signals narrower than the width imposed by the natural lifetime. The author examines a simple mathematical model for subnatural width spectroscopy, and identify two distinct characteristics of time resolved line narrowing. He discusses the conditions where line narrowing techniques may be valuable, and comments on some misconceptions concerning these techniques.

400,481

PB85-130441

(Order as PB85-130078, PC A99/MF A01)
Cornell Univ., Ithaca, NY. Center for Radiophysics and Space Research.

Spectroscopy of Atoms and Molecules in Gases: Corrections to the Doppler-Recoil Shift, M. P. Haugan, and F. V. Kowalski. 1984, 4p

Prepared in cooperation with Colorado School of Mines, Golden. Dept. of Physics.

Included in Precision Measurement and Fundamental Constants II, p181-184 1984.

Keywords: *Doppler effect, *Atoms, *Molecules, *Gases, Electrodynamics, *Doppler and recoil effects, *High resolution molecular spectroscopy, Doppler broadening.

The authors analyze the excitation by a monochromatic plane electromagnetic wave of a two-level atom or molecule moving through a rarefied gas. This yields a prediction for the Doppler-recoil shift which differs significantly from the familiar formula derived by studying isolated atoms or molecules in vacuum. The difference arises from an interplay between the collective and individual particle responses of a gas to an electromagnetic wave and is of fundamental importance for high-resolution laser spectroscopy. They propose an experiment using saturation spectroscopy to observe sodium molecular transitions near the atomic D lines that could easily verify our prediction for the first order Doppler shift of spectral features due to atomic or molecular absorption in rarefied gases.

400,482

PB85-130466

(Order as PB85-130078, PC A99/MF A01)
California Univ., Davis. Dept. of Physics.

Uncertainties in QED (Quantum Electrodynamics) Fine Structure Calculations,

G. W. Erickson. 1984, 5p

Included in Precision Measurement and Fundamental Constants II, p195-199 1984.

Keywords: *Quantum electrodynamics, *Atomic energy levels, Hydrogen, Protons, Size determination, Dimensions, *Fine structure, Lamb shift, Uncertainty.

The most general calculation of precise one-electron atomic energy levels includes uncertainties which are important in the determination of fundamental constants and in the comparison of QED theory and precision measurements. Besides the usual Lamb shift splitting S between $n S_{1/2}$ and $n P_{1/2}$ states, and the fine structure interval ΔE between $n P_{3/2}$ and $n P_{1/2}$ states, the large interval between $n P_{3/2}$ and $n P_{1/2}$ states has been directly measured to high precision, but the uncertainty in its calculated value is often mistakenly taken to be the combination of uncertainties in S and ΔE . This will be clarified, and the sources of these uncertainties in the low-Z calculations will be discussed. Comparisons will be made with independent calculations at high Z and with experimental values. The overall picture is one of general agreement, but with small unresolved discrepancies. It will be seen that a tentative resolution may be obtained by discarding one of the calculations, the most recent proton and alpha particle size measurements, and 7 of the 27 most precise measurements of energy level difference.

400,483

PB85-130532

(Order as PB85-130078, PC A99/MF A01)
Duke Univ., Durham, NC.

Measured g(sub J)-Factor Ratio of 4 sup He(+ 1) (1 doublet S(1/2)) and 4 sup He(+ 1) (2 triplet S(1)), H. G. Robinson, and C. E. Johnson. 1984, 3p

Sponsored by National Science Foundation, Washington, DC. Prepared in cooperation with North Carolina State Univ. at Raleigh.

Included in Precision Measurement and Fundamental Constants II, p229-231 1984.

Keywords: *Helium, Optical pumping, Zeeman effect, Ions, Metastable state, *G factor, *Helium ions.

The g(sub J)-factor of the ground state hydrogen-like helium ion ($4 \text{ sup He}(+1)$) relative to that of the 2 triplet S(1) state of helium (4 sup He^+) has been measured using a (87Rb) optical pumping technique. The linewidth budget for the $4 \text{ sup He}(+1)$ Zeeman resonance shows the conspicuous absence of broadening due to charge exchange between the ion and ground state He even though the exchange rate is > 10 to the 7th power/s.

400,484

PB85-130557

(Order as PB85-130078, PC A99/MF A01)
Yale Univ., New Haven, CT. Josiah Willard Gibbs Research Labs.

Precision Exotic Atom Spectroscopy,

V. W. Hughes. 1984, 12p

Included in Precision Measurement and Fundamental Constants II, p237-248 1984.

Keywords: *Atomic spectroscopy, Muonium, Quantum electrodynamics, Positronium.

Precision measurements by microwave or laser spectroscopy techniques of the energy levels of exotic atoms containing particles such as positrons, muons, or pions not present in ordinary atoms allow the determination of the fundamental constants associated with these so-called exotic but basic particles. Moreover, the simplicity of some of these atoms, such as positronium ($e(+)\text{e}(-)$) and muonium ($\mu(+)\text{e}(-)$), which consist only of structureless leptons, allows precise tests of quantum electrodynamics which is basic to our understanding of many of the fundamental constants, especially the fine-structure constant, alpha. This paper reviews recent work and work in progress on positronium, muonium, and simple muonic atoms relevant to the precision measurement-fundamental constants field.

400,485

PB85-130581

(Order as PB85-130078, PC A99/MF A01)
National Physical Lab., Teddington (England).

Gas Constant, X-ray Interferometry, Nuclidic Masses, Other Constants, and Uncertainty Assignment: Methods for the Determination of the Gas Constant,

A. R. Colclough. 1984, 13p

Included in Precision Measurement and Fundamental Constants II, p263-275 1984.

Keywords: *Fundamental constants, *Ideal gas law, Reviews, Boltzmann equation.

Following a brief discussion of the role of the gas constant in physics, a review is made of the possible methods for its experimental determination and of values obtained in the past by direct measurements or by inference from other work. Four practicable methods by which the gas constant might be accurately determined are considered. These are (a) the conventional method of the limiting density of a gas based on the virial equation of state, (b) the method of sound velocity measurement in a gas depending upon the normal law for the speed of sound in a compressible fluid together with the virial equation, (c) determination via the Boltzmann constant and Avogadro's constant by the measurement of the electrical noise in a resistance invoking Nyquist's formula, and (d) determination via the Stefan-Boltzmann and other constants by the measurement of the power radiated by a blackbody cavity relying on the Stefan-Boltzmann law. The four methods have very different sources of systematic error. The analysis of the four methods suggests that there is scope for a useful reduction in the uncertainty of the gas and the other thermal constants.

400,486

PB85-130599

(Order as PB85-130078, PC A99/MF A01)
Virginia Military Inst., Lexington. Dept. of Physics.
Ultrasonic Determination of the Gas Constant,
W. C. Sauder. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p277-279 1984.

Keywords: *Fundamental constants, *Ideal gas law, *Ultrasonic tests, *Interferometry.

Progress on a gas constant determination by means of ultrasonic interferometry is reported. The acoustic interferometer is a two arm instrument designed to operate in the range 0.1-1.0 MHz. An approximately half-scale model has been constructed in order to establish the data taking algorithm as well as to investigate aberrations. Electrostatic transducers have been designed for the experiment that will allow characterization of the acoustic field, a necessary step in extracting wave length measurements from the fringe data.

400,487

PB85-130607

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.
Spherical Acoustic Resonators: Promising Tools for Thermometry and Measurement of the Gas Constant,
M. R. Moldover, and J. B. Mehl. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p281-286 1984.

Keywords: *Ideal gas law, *Fundamental constants, *Temperature measurement, Feasibility, *Acoustic resonators.

The authors report progress in our study of the feasibility of using spherical acoustic resonators for primary thermometry and for measurement of the gas constant. Prototype resonators of differing sizes and materials have been tested.

400,488

PB85-130615

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Measurements and Standards Div.
Proposed Method for the Determination of the Molar Gas Constant, R,
L. A. Guildner, and M. L. Reilly. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p287-290 1984.

Keywords: *Fundamental constants, *Ideal gas law, Equations of state, *Molar gas constant.

A new, accurate measurement of the molar gas constant, R, is proposed. The volume occupied by 2 g of neon gas at 273.15 K is to be determined at pressure of 135, 81 and 40 kPa. An error analysis shows that the derived value of R should have a total uncertainty of 2.9 ppm at the 99% confidence level.

400,489

PB85-130698

(Order as PB85-130078, PC A99/MF A01)
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik.
Isotope Shifts of K X-rays of Lead.
G. L. Borchert, O. W. B. Schult, J. Speth, P. G. Hansen, and B. Johnson. 1984, 4p
Contract W-7405-eng-26
Prepared in cooperation with Aarhus Univ. (Denmark). Fysiske Inst., European Council for Nuclear Research, Geneva (Switzerland), and Oak Ridge National Lab., TN.
Included in Precision Measurement and Fundamental Constants II, p331-334 1984.

Keywords: *Lead isotopes, *Isotope effect, *X rays, X ray spectrometers, Nuclear structure, Precision, Resolution, *Spectral shift, Lead 204, Lead 206, Lead 207, Lead 208, K shell.

During the last years progress in nuclear theory has allowed more detailed predictions for ground state properties of heavier elements especially in the vicinity of double magic nuclei. Experimentally the change of the mean square charge radius can be determined by a high resolution measurement of the K x-ray isotope shifts. Therefore, the authors performed a study of the

isotope shifts of all stable lead isotopes and compared them to very recent microscopic calculations.

400,490

PB85-130706

(Order as PB85-130078, PC A99/MF A01)
Minnesota Univ., Minneapolis. School of Physics and Astronomy.
Measurement of Atomic Masses by Mass Spectroscopic Methods and a Role for Atomic Masses in the Determination of the Fundamental Constants,
W. H. Johnson. 1984, 10p
Included in Precision Measurement and Fundamental Constants II, p335-344 1984.

Keywords: *Atomic mass, *Fundamental constants, Mass spectrometers, Precision, Measurement.

A description of atomic mass determinations is given with the emphasis on mass spectroscopic methods. A review of current techniques is made which includes conventional mass spectrometers and radio frequency instruments. Precision attained in these measurements is discussed together with the possibilities of improvements in precision. Finally, the use of atomic mass measurements as input data for the determination of fundamental constants is considered.

400,491

PB85-130748

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
New Determination of the Atomic Weight of Silver and an Improved Value for the Faraday,
L. J. Powell, T. J. Murphy, and J. W. Gramlich. 1984, 2p
Included in Precision Measurement and Fundamental Constants II, p357-358 1984.

Keywords: *Silver, *Fundamental constants, *Atomic mass, *Faraday effect, Chemical analysis, Mass spectroscopy, Standards, Electrochemistry, *Silver 107, *Silver 109.

The atomic weight of a reference sample of silver has been determined by mass spectrometry with an uncertainty of one part in 10 to the 6th power. Accurately known quantities of chemically pure (107)Ag and (109)Ag were mixed to produce standards of known isotopic composition for calibration of the mass spectrometer. Recalculation of the Faraday using this atomic weight and the electrochemical equivalent of silver as determined by Bower and Davis leads to a value of (96486.18 ± or - 0.13). A NBS/s/mol (68 percent CL).

400,492

PB85-134005

Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Thermodynamic Anomalies Near the Liquid-Vapor Critical Point: A Review of Experiments.
Final rept.,
M. R. Moldover. 1982, 32p
Pub. in NATO Adv. Study Inst. Ser. B 72, Phase Transitions, p63-94 1982.

Keywords: *Critical point, *Thermodynamic properties, *Fluids, Review, Liquid phases, Vapor phases, Specific heat, Equations of state, Phase transformation, Reprints.

Recent measurements of the thermodynamic properties of various fluids near the liquid-vapor critical point are described. Among the properties considered are: the liquid and vapor densities at coexistence, the vapor pressure, the equation-of-state, the specific heat, and the density-vs-height profile that develops extremely close to the critical temperature because of the fluids compression under its own weight. The experimental results are interpreted in the context of recent theoretical developments. A particularly important prediction based on the renormalization group is: sufficiently close to the critical point, the functional form of the singular part of the thermodynamic potential for all fluids is identical with the functional form of the thermodynamic potential for the Landau-Ginsberg-Wilson (LGW) hamiltonian with a scalar order parameter in three spatial dimensions. The experimental results are consistent with this prediction, provided the pressure (or the pressure divided by the temperature) is chosen as the potential and analytic functions of temperature and chemical potential are used as its variables. Existing experiments can not clearly resolve the small differences between the numerical values for

critical exponents calculated for the LGW hamiltonian using field theory techniques and the exponents calculated for the three dimensional spin 1/2 Ising model using high temperature series expansions. Straightforward extensions of particular experimental techniques will be able to resolve these small differences.

400,493

PB85-134013

Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Errors Observed in the Analysis of Particle Mixtures by Overscanning.
Final rept.,
R. L. Myklebust, J. A. Small, and D. E. Newbury. 1981, 5p
Pub. in Scanning Electron Microscopy, n1 p477-481 1981.

Keywords: *Particles, *X ray analysis, Error analysis, Mixtures, Performance evaluation, Particle size, Chemical composition, Fluorescence, Absorption, Atomic properties, Reprints, Scanning electron microscopy.

The possible errors associated with analysis of x-ray spectra obtained by overscanning fields of mixed particles have been studied by the use of standard particles of known composition. Three different types of particle aggregates were analyzed: (1) spherical particles of homogeneous composition with a variable size; (2) irregularly shaped particles with a homogeneous composition; and (3) a mixture of spherical particles of two different compositions. A conventional matrix correction procedure (atomic number, absorption, fluorescence) followed by normalization produced large errors in all cases. A modified particle correction method yielded satisfactory results from fields of homogeneous particles. The analysis of particle mixtures gave large errors by both methods, frequently reaching a factor of two or more. Overscanning of particle mixtures should not be used, even for 'semi-quantitative' results.

400,494

PB85-135416

Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Relaxation of Stresses in Grazes at Crack Tips and Rate of Craze Extension.
Final rept.,
E. Passaglia. 1982, 7p
Pub. in Polymer 23, n5 p754-760 1982.

Keywords: *Crazing, *Crack propagation, *Stress analysis, *Polymers, Stress relaxation, Mathematical models, Reprints, *Barenblatt theory.

The Barenblatt theory of cohesive stresses at crack tips is used to investigate the effect of the relaxation of craze stresses at crack tips on the rate of craze extension. A general equation relating the rate of change of craze length to the rate of change of stress intensity factor (K1) and the rate of change of the craze stress is derived. It is argued from this equation that uniform crack growth with a constant craze length cannot occur for a generalized Dugdale model with relaxation. Using plausibility arguments for the behavior of the craze stress with time and position in the craze, and assuming a generalized Dugdale model, differential equations for the rate of craze extension with no crack growth are derived for the constant load and constant K1 cases. These equations relate the rate of change of craze length to the craze stress at the tip of the crack. Assuming a specific form for the time dependence of this stress, the equation for the constant K1 case to yield an expression for the craze length as a function of time is given.

400,495

PB85-135432

Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Multi-Photon Infrared Laser-Induced Decomposition of Acetone-D6.
Final rept.,
W. Braun, and J. R. McNesby. 1980, 7p
Pub. in Jnl. of Physical Chemistry 84, n20 p2521-2527 1980.

Keywords: *Acetone, *Decomposition reactions, Infrared spectroscopy, Binary systems(Materials), Reaction kinetics, Chemical reactions, Pyrolysis, Reprints, *Laser spectroscopy, *Chemical reaction mechanism, *Laser induced reactions.

The focused IR laser induced decomposition of acetone-d6 has been studied to determine if the classical

mechanism for the thermal decomposition can explain the distribution of reaction products. Binary mixtures of acetone-d₆ with acetone, ethane, (CH₃)₂N₂ and cyclopropane have been studied for product composition and isotopic distribution in the products. It is argued on the basis of these observations that ketene is not produced and a classical acetone chain mechanism cannot explain the facts. The material balance and the production of hydrogen and ethylene as major products are best explained on the basis of total decomposition of acetone-d₆ near the focus. This is followed by a rapid temperature rise resulting from recombination of CD₃. The chemistry that follows is simply the thermal decomposition of ethane at temperatures approaching 1900 K.

400,496

PB85-135465 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

X-ray Spectra of Molecular Gases.

Final rept.,

R. E. LaVilla. 1982, 14p

Pub. in *Advances in X-Ray Spectroscopy: A Reference Text in Honour of Professor Y. Cauchois*, Chapter 14 p240-253 1982.

Keywords: *X ray spectra, *Gases, Absorption spectra, Excitation, Reprints, *Free molecules.

The X-ray spectra of free molecules is a very rich source of spectral data and complements the UPS and XPS data in the elucidation of molecular electronic structure and the dynamics of core excitation process. The evolving features to date of molecular X-ray spectra are summarized and briefly discussed. Also indicated are some directions where further work should be directed.

400,497

PB85-135507 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Thermodynamic Properties for Fluid Water.

Final rept.,

L. Haar, J. Gallagher, and G. S. Keil. 1980, 14p

Pub. in *Proceedings of International Conference on Properties of Steam (9th)*, Munich, West Germany, 1979, p69-82 1980.

Keywords: *Thermodynamic properties, *Water, Fluids, Equations of state, Density(Mass/volume).

A fundamental equation is presented for the thermodynamic behavior of steam in the range 0-900C, 0-1000 MPa. The equation contains newly calculated ideal-gas properties; a reference function which becomes accurate for all values of density at high temperatures and for the high density region elsewhere; and deviation functions which provide for an accurate fit to PVT and coloric data everywhere. Detailed comparisons are drawn with the best experimental data are presented and conclusions are drawn on the consistency of the various data sets.

400,498

PB85-135549 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Neutron Cloud Points and Concentration Fluctuations of Polymer Blends.

Final rept.,

H. Yang, M. Shibayama, R. S. Stein, and C. C. Han. 1984, 7p

Pub. in *Polymer Bulletin* 12, p7-13 1984.

Keywords: *Polymers, Polystyrene, Concentration(Composition), Reprints, *Small angle scattering, *Neutron cloud points, Poly(ether/methyl-vinyl).

Cloud points were observed in the blends of deuterated polystyrene (PSD) and hydrogenous poly(vinyl methyl ether) (PVME) by means of temperature scanning Small Angle Neutron Scattering (SANS) technique. The scattering function in the miscible region can be described by the random phase approximation results calculated by de Gennes. This scattering function can also be expressed in the Ornstein-Zernike form in the small q region. A correlation length and spinodal point can then be determined from this critical fluctuation approach.

400,499

PB85-135929 PC A04/MF A01
National Bureau of Standards, Gaithersburg, MD.

Journal of Research of the National Bureau of Standards, Volume 89, Number 3, May-June 1984.

1984, 71p

See also PB85-135937 through PB85-135960 and PB85-115426. Also available from Supt. of Docs as SN003-003-72087-9. Library of Congress catalog card no. 63-37059.

Keywords: *Research, Deuterium, Thermodynamic properties, Electric current meters, Faraday effect, Activity coefficients, Osmosis, Solubility, Hydrocarbons, Liquid hydrogen, Solid hydrogen, Partition coefficients.

The Journal of Research of the National Bureau of Standards features advances in measurement methodology and analyses consistent with the NBS 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 NBS programs in these areas. They include: pressure-volume-temperature relationships for normal deuterium between 18.7 and 21.0 K; an equilibrium model for the calculation of activity and osmotic coefficients in aqueous solution; an absolute electric current probe based on the faraday effect, and a head-space method for measuring activity coefficients, partition coefficients, and solubilities of hydrocarbons in saline solutions.

400,500

PB85-135937 (Order as PB85-135929, PC A04/MF A01)
Los Alamos National Lab., NM.

Pressure-Volume-Temperature Relationships for Normal Deuterium between 18.7 and 21.0 K,

L. A. Schwalbe, and E. R. Grilly. 19 Dec 83, 22p

Included in *Jnl. of Research of the National Bureau of Standards*, v89 n3 p227-250 May-Jun 84.

Keywords: *Deuterium, *Thermodynamic properties, Equations of state, Liquefied gases, Solidified gases, Compressibility, Melting, Volume, *Liquid hydrogen, *Solid hydrogen, Triple point, Pressure dependence, Temperature dependence.

Analytical expressions are derived for the melting line and liquid equation of state of normal deuterium near the triple point. Melting pressures were measured between the triple point and 20.4 K. These results combined with existing pressure measurements along the saturated liquid-vapor curve fix an accurate value, (t sub tp) = 18.723 K, for triple-point temperature. Data for the isothermal compressibility and thermal expansion coefficients of the liquid were taken over the temperature and pressure ranges 18.8 to 21.0 K and 4 to 70 bar, respectively. The liquid molar volume was measured at nine points below 20.4 K. All liquid PVT data are shown to be internally consistent. Measurements of the volume changes on melting are also presented. The heat of fusion and the solid molar volume at melting are deduced from these data. Also included are detailed comparisons of our results with existing data. A critical appraisal is given of all measured thermodynamic quantities in this regime.

400,501

PB85-135945 (Order as PB85-135929, PC A04/MF A01)
National Bureau of Standards, Gaithersburg, MD.

Equilibrium Model for the Calculation of Activity and Osmotic Coefficients in Aqueous Solutions,

R. N. Goldberg. 13 Mar 84, 13p

Included in *Jnl. of Research of the National Bureau of Standards*, v89 n3 p251-263 May-Jun 84.

Keywords: *Chemical equilibrium, *Activity coefficients, *Osmosis, *Mathematical models, Ions, Solutions, Gibbs free energy, Numerical solution, Procedures.

A procedure is described for the calculation of activity and osmotic coefficients which is based upon a knowledge of the equilibria in solution and assumed single-ion activity coefficients. The procedure permits one to introduce chemical equilibria of various types (ion-pairing, complexation, hydration, and hydrolysis) into a

model which can be used to calculate values of the excess Gibbs energy and the activity and osmotic coefficients. Both the Debye-Huckel theory and Pitzer's expression are used to calculate the electrostatic contribution to the single-ion activity coefficients. Calculations have been performed on aqueous sulfuric acid, acetic acid, hydrofluoric acid, cadmium chloride, copper sulfate, and sodium carbonate. Properties which have been calculated are the excess Gibbs energy, the osmotic coefficient, the mean ionic activity coefficient, and Frank's single-ion activity coefficient function. Agreement between calculated and measured properties has been obtained up to molalities of about 1.0 mol/kg.

400,502

PB85-135960 (Order as PB85-135929, PC A04/MF A01)
National Bureau of Standards, Gaithersburg, MD.

Head-Space Method for Measuring Activity Coefficients, Partition Coefficients, and Solubilities of Hydrocarbons in Saline Solutions,

S. P. Wasik, F. P. Schwarz, Y. B. Tewari, M. M.

Miller, and J. H. Purnell. 2 Feb 84, 5p

Prepared in cooperation with University Coll. of Swansea (Wales).

Included in *Jnl. of Research of the National Bureau of Standards*, v89 n3 p273-277 May-Jun 84.

Keywords: *Activity coefficients, *Solubility, *Hydrocarbons, *Laboratory equipment, *Chemical equilibrium, Solutions, Salinity, Vapor phases, Liquid phases, Gas chromatography, *Partition coefficients.

An apparatus is described which measures the equilibrium distribution of a hydrocarbon between a gas and aqueous phase. Soluble hydrocarbons are extracted from an aqueous salt solution by very small bubbles of hydrogen generated electrolytically from a gold electrode located at the bottom of a cylindrical cell. The partition coefficient is determined from the volume of the aqueous solution and the solute concentration in the head-space after a measured volume of hydrogen has bubbled through the cell. The concentration of the solute in the head-space is measured by gas chromatography. The observed distribution is supplemented by vapor pressure and molar volume data and can be used to calculate the solubility and the activity coefficient of the aqueous 0.5 M NaCl at 25 C were measured by this method.

400,503

PB85-136802 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Rh I Isoelectronic Sequence: Analysis of the 4d(sup 9)-4d(sup 8) 5p Transition Array in La XIII.

Final rept.,

J. L. Tech, V. Kaufman, and J. Sugar. Mar 84, 4p

Pub. in *Jnl. of the Optical Society of America B* 1, n1 p41-44 Mar 84.

Keywords: *Lanthanum, *Ultraviolet spectroscopy, Hartree-Fock approximation, Eigenvectors, Least squares method, Reprints, *Isoelectronic sequences.

The spectrum of twelve-times ionized lanthanum (La XIII) was produced by a triggered, high-voltage, vacuum spark discharge and photographed by using the 10.7-m grazing-incidence spectrograph at the National Bureau of Standards. These intensities are in good qualitative agreement with the relative intensities visually estimated from the spectrograms. Least-squares-fitted values for the energy parameters and their ratios to the calculated Hartree-Fock values are given.

400,504

PB85-137438 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Discussion of Electron Cross Sections for Transport Calculations.

Final rept.,

M. J. Berger. May 84, 8p

Sponsored in part by Department of Energy, Washington, DC, and Office of Naval Research, Arlington, VA. Pub. in *Proceedings of Workshop on Electronic and Ionic Collision Cross Sections Needed in the Modeling of Radiation Interactions with Matter*, Argonne, IL., December 6-8, 1983, ANL-84-28, p1-8 1984.

Keywords: *Transport properties, *Mathematical models, Ionization, Excitation, *Biological samples, *Electron cross sections.

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

This paper deals with selected aspects of the cross sections needed as input for transport calculations and for the modeling of radiation effects in biological materials. Attention is centered mainly on the cross sections for inelastic interactions between electrons and water molecules and the use of these cross sections for the calculation of energy degradation spectra and of ionization and excitation yields.

400,505
PB85-137453 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Selectivity of Negative Ion Chemical Ionization Mass Spectrometry for Benzo(a)Pyrene.
Final rept.,
L. R. Hilpert, G. D. Byrd, and C. R. Vogt. 1984, 5p
Pub. in *Analytical Chemistry* 56, n11 p1842-1846 1984.

Keywords: *Mass spectroscopy, *Gas chromatography, *Chemical analysis, Aromatic polycyclic hydrocarbons, Crude oil, Petroleum products, Concentration(Composition), Reprints, *Negative chemical ionization mass spectroscopy, *Benzopyrenes, *Standard reference materials, *Indenopyrene, *Benzoperylene.

Gas chromatography/negative ion chemical ionization mass spectrometry (GC/NICIMS) was used as a selective and sensitive technique for the detection of benzo(a)pyrene (BaP). Under optimized conditions, the molecular anion, M(-1), of BaP was more than 3 orders of magnitude more abundant than that of its isomer benzo(e)pyrene (BeP) using methane as the reagent gas. Quantities of BaP as low as 1 pg can easily be detected in the selected ion monitoring mode and response versus concentration was linear over a range of 3 orders of magnitude. The absolute sensitivity and selectivity for detection were found to depend on the pressure and temperature in the ion source of the mass spectrometer. NICIMS was used for the quantitative determination of BaP, indeno(1,2,3-cd)pyrene, and benzo(ghi)perylene in a sample of petroleum crude oil as part of the process of certifying the oil as a Standard Reference Material.

400,506
PB85-137487 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
4 doublet s 4p (sup 2)p Intervals in the Ga Isoelectronic Sequence from Rb(+6) to In(+18).
Final rept.,
L. J. Curtis, J. Reader, S. Goldsmith, B. Denne, and E. Hinnov. Apr 84, 3p
Pub. in *Physical Review A* 29, n4 p2248-2250 Apr 84.

Keywords: *Atomic energy levels, Molybdenum, Niobium, Palladium, Rhodium, Rubidium, Ruthenium, Silver, Strontium, Yttrium, Zirconium, Reprints, *Fine structure, *Isoelectronic sequences.

Measurements of the fine-structure splitting of the 4 doublet s 4p (sup 2)P ground-state term of the gallium isoelectronic sequence using low-inductance sparks, laser-produced plasmas, and tokamak plasma sources are presented. The observations are in excellent agreement with semiempirical predictions using screening parametrizations, and permit a refinement of these predictions.

400,507
PB85-137495 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Molecular Dynamics Study of Collision Induced Absorption in Rare Gas Liquid Mixtures.
Final rept.,
G. Birnbaum, and R. D. Mountain. 1 Sep 84, 5p
Pub. in *Jnl. of Chemical Physics* 81, n5 p2347-2351, 1 Sep 84.

Keywords: *Infrared spectroscopy, *Absorption spectra, *Rare gases, Absorption, Dipole moments, Mixtures, Argon, Neon, Reprints, *Molecular dynamics.

Molecular dynamics simulation of a rare gas liquid mixture has been used to investigate the connections of the collision induced absorption spectrum and the forces acting between liquid particles. The authors find that the force law and induced dipole moments determined for low density gases are incapable of producing collision induced absorption spectra which are in qualitative agreement with the experimentally observed low frequency part of the spectra for Ar-Ne mixtures. Qualitative agreement is obtained if the gas phase dipole is modified so that the zero of the dipole moment roughly matches the zero of the force between unlike species. This represents a substantial

change in the gas phase dipole. The implications of these results are briefly discussed.

400,508
PB85-137503 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Random Systems of Particles: An Approach to Polydisperse Systems.
Final rept.,
J. J. Salacuse. 1 Sep 84, 14p
Pub. in *Jnl. of Chemical Physics* 81, n5 p2468-2481, 1 Sep 84.

Keywords: *Particles, *Random functions, *Statically determine structures, Thermodynamics, Equilibrium methods, Probability theory, Reprints, *Phase equilibrium.

The concept of a random system of particles is introduced and a probabilistic description of these types of systems is given. In addition the relationship of random systems to polydisperse systems is explored. The random systems approach to polydisperse systems is a particle as opposed to a continuum type theory and yields a number of results concerning the particle structure of polydisperse systems as well as a statistical mechanical description of polydisperse systems. As an illustration of this the thermodynamic properties of a polydisperse system of hard rods are obtained. Phase equilibrium in polydisperse systems is considered in the context of the random systems approach. A set of equilibrium conditions are obtained and shown to be equivalent to conditions previously given.

400,509
PB85-137693 PC A06/MF A01
National Bureau of Standards (NML), Gaithersburg, MD.

Compiled Thermodynamic Data Sources for Aqueous and Biochemical Systems: An Annotated Bibliography (1930-1983).

Final rept.,
R. N. Goldberg. Dec 84, 110p NBS/SP-685
Sponsored in part by American Inst. of Chemical Engineers, New York. Also available from Supt. of Docs as SN003-003-02606-9. Library of Congress catalog card no. 84-601131.

Keywords: *Thermodynamic properties, *Biochemistry, *Bibliographies, Gibbs free energy, Chemical equilibrium, Enthalpy, Specific heat, Entropy, Sources, Transport properties, Mechanical properties, Review, Thermochemistry, Water, *Aqueous systems.

This is a selected and annotated bibliography of sources of compiled and evaluated chemical thermodynamic data relevant to biochemical and aqueous systems. The principal thermodynamic properties considered herein are Gibbs energy and equilibrium data, enthalpies of formation and reaction, heat capacities and entropies, and the corresponding partial molar and excess properties. Derived quantities used in calculating the above are also included. Transport and mechanical data have also been identified to a lesser degree. Included in the annotations to the data sources are brief descriptions of the types of properties tabulated, the classes of materials dealt with, and the degree of completeness of the compilations.

400,510
PB85-137776 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurements of the Viscosity of Compressed Gaseous and Liquid Methane + Ethane Mixtures.
Final rept.,
D. E. Diller. Apr 84, 7p
Pub. in *Jnl. of Chemical and Engineering Data* 29, n2 p215-221 Apr 84.

Keywords: *Viscosity, *Methane, *Ethane, Mixtures, Density(Mass/volume), Temperatures, Reprints, PVT properties.

The shear viscosity coefficients of three compressed gaseous and liquid methane + ethane mixtures have been measured at temperatures between 100 and 300 K and at pressures to about 30 MPa (4350 psia) with a piezoelectric quartz crystal viscometer. The precision of the measurements ranges from 0.5 to about 2 percent, depending on the (density x viscosity) range. The experimental error is estimated to be less than 2 percent in most cases. The measurements have been compared with other data, and with a multiparameter extended corresponding states model, previously proposed for calculating the viscosities of fluid mixtures throughout a wide range of PVT states.

400,511

PB85-137784 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurement of the Shift of Rydberg Energy Levels Induced by Blackbody Radiation.
Final rept.,
L. Hollberg, and J. L. Hall. Jul 84, 4p
Grants N00014-77-C-0656, NSF-PHY82-00805
Pub. in *Physical Review Letters* 53, n3 p230-233 Jul 84.

Keywords: *Atomic energy levels, *Blackbody radiation, Reprints, *Rydberg series, *Laser spectroscopy.

Using high precision laser spectroscopic techniques we have measured the predicted shift of Rydberg energy levels induced by blackbody radiation. Fractional shifts of about 2×10^{-12} to the -12 th power are consistent with theoretical predictions.

400,512
PB85-137842 Not available NTIS
American Chemical Society, Washington, DC.

Journal of Physical and Chemical Reference Data, Volume 13, Number 3, 1984.

Quarterly rept.
c1984, 328p
See also PB85-137859 through PB85-137909 and PB85-116200. Sponsored by National Bureau of Standards, Gaithersburg, MD. Prepared in cooperation with American Inst. of Physics, New York.

Keywords: *Chemical properties, *Physical properties, Stark effect, Spectral lines, Ions, Atoms, Deuterium, Temperature, Heats of formation, Molecules, Isotope separation, Chemical analysis, Thermal conductivity, Water, *Reference materials.

Contents:
Experimental stark widths and shifts for spectral lines of neutral atoms (a critical review of selected data for the period 1976 to 1982);
Experimental stark widths and shifts for spectral lines of positive ions (a critical review and tabulation of selected data for the period 1976 to 1982);
A review of deuterium triple-point temperatures;
Evaluated gas phase basicities and proton affinities of molecules;
heats of formation of protonated molecules;
Isotopic abundances and atomic weights of the elements;
Representative equations for the thermal conductivity of water substance.

400,513
PB85-137859 Not available NTIS
Institute of Physics, Belgrade (Yugoslavia).
Experimental Stark Widths and Shifts for Spectral Lines of Neutral Atoms (A Critical Review of Selected Data for the Period 1976 to 1982),
N. Konjevic, M. S. Dimitrijevic, and W. L. Wiese.
c1984, 29p
Prepared in cooperation with National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
Included in *Jnl. of Physical and Chemical Reference Data*, v13 n3 p619-647 1984.

Keywords: *Stark effects, *Atoms, *Spectral lines, Experimental design, Reviews, Tables(Data), Line width, *Reference materials.

A critical review of all experimental data on Stark widths and shifts of spectral lines of neutral elements published during the period 1976-1982 has been carried out. This work represents an extension and update of an earlier review which covered the period before 1976. Data tables containing the selected experimental Stark broadening parameters are presented together with estimated accuracies. Comparisons with comprehensive calculations based on the semi-classical theory are made whenever possible.

400,514

PB85-137867

Not available NTIS

Institute of Physics, Belgrade (Yugoslavia).

Experimental Stark Widths and Shifts for Spectral Lines of Positive Ions (A Critical Review and Tabulation of Selected Data for the Period 1976 to 1982),

N. Konjevic, M. S. Dimitrijevic, and W. L. Wiese.

c1984, 38p

Prepared in cooperation with National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Included in Jnl. of Physical and Chemical Reference Data, v13 n3 p649-686 1984.

Keywords: *Stark effects, *Ions, *Spectral lines, Experimental design, Line width, Reviews, Tables(Data), *Reference materials.

A new critical review of the available experimental data on the Stark widths and shifts for lines of non-hydrogenic ionized spectra has been carried out which covers the period from 1976 to the present and represents a continuation of an earlier critical review. The relevant literature, compiled by the NBS Data Center on Atomic Lines Shapes and Shifts as well as by the present authors, was critically evaluated, and data tables containing the selected experimental Stark broadening parameters have been assembled. The data are arranged according to spectra and elements and these are presented in alphabetical order. The accuracy of the experimental data is estimated on the basis of guidelines developed during the previous review. Comparisons with theoretical results are made whenever possible since the comparison with theory has often been a principal motivation for the experiments.

400,515

PB85-137875

Not available NTIS

Los Alamos National Lab., NM.

Review of Deuterium Triple-Point Temperatures,

L. A. Schwalbe, and E. R. Grilly, c1984, 7p

Included in Jnl. of Physical and Chemical Reference Data, v13 n3 p687-693 1984.

Keywords: *Deuterium, Temperatures, Reviews, *Reference materials.

A review is presented of the existing measurements of the triple-point temperatures $T_{\text{sub tp}}$ of deuterium. All data are adjusted to a common temperature scale, and error limits are proposed where none was provided in the source publications. The effect of sample contamination are also considered. Impurity corrections, based on estimates from vapor-pressure measurements, are applied to the results.

400,516

PB85-137883

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Chemical Physics.

Evaluated Gas Phase Basicities and Proton Affinities of Molecules; Heats of Formation of Protonated Molecules,

S. G. Lias, J. F. Liebman, and R. D. Levin. c1984, 114p

Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville. Dept. of Chemistry.

Included in Jnl. of Physical and Chemical Reference Data, v13 n3 p695-808 1984.

Keywords: *Heats of formation, *Molecules, Protons, Vapor phases, Tables(Data), *Ion molecule interactions, *Proton affinities, *Reference materials.

The available data on gas phase basicities and proton affinities of molecules are compiled and evaluated. Tables giving the molecules ordered (1) according to proton affinity and (2) according to empirical formula, sorted alphabetically are provided. The heats of formation of the molecules and the corresponding protonated species are also listed.

400,517

PB85-137891

Not available NTIS

Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements.

Isotopic Abundances and Atomic Weights of the Elements,

P. De Bièvre, M. Gallet, N. E. Holden, and I. L.

Barnes. c1984, 84p

Prepared in cooperation with National Nuclear Data Center, Upton, NY., and National Bureau of Standards (NML), Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v13 n3 p809-891 1984.

Keywords: *Atomic weights, *Chemical elements, *Isotope separation, Mass spectroscopy, Tables(Data), *Reference materials.

A large number of measurements describing the isotopic composition of the elements using a variety of analytical methods have been reported since the discovery of the first isotope in 1912. During the past several decades, however, mass spectrometric methods have been used, almost exclusively, to determine the isotopic composition, and thus the atomic weights, of the elements. This evaluated compilation reports the literature references for all complete mass spectrometric measurements published during the period 1920 through 1983. Also given are the isotopic compositions, the isotope ratios, the atomic weights calculated from the data, the appropriate nuclidic masses and an evaluation of the errors of the measurements. For each polynuclidic element, a best measurement has been selected.

400,518

PB85-137909

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Representative Equations for the Thermal Conductivity of Water Substance,

J. V. Sengers, J. T. R. Watson, R. S. Basu, B.

Kamgar-Parsi, and R. C. Hendricks. c1984, 41p

Prepared in cooperation with National Engineering Lab., East Kilbride (Scotland), Maryland Univ., College Park. Inst. for Physical Science and Technology and National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.

Included in Jnl. of Physical and Chemical Reference Data, v13 n3 p893-933 1984.

Keywords: *Thermal conductivity, *Water, *Transport properties, Water vapor, Tables(Data), *Reference materials, Numerical solution.

The paper documents the development of the available information for the thermal conductivity of fluid H₂O since the promulgation of the first international formulation for the transport properties of water substance in 1964. As a result of this development, the International Association for the Properties of Steam has adopted new recommended interpolating equations for the thermal conductivity of fluid H₂O at pressures up to 100 MPa and at temperatures up to 800 C. These new international equations are discussed.

400,519

PB85-139988

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Physical Basis for Piezoelectricity in PVDF.

Final rept.,

M. G. Broadhurst, and G. T. Davis. 1984, 11p

Pub. in Ferroelectrics 60, p3-13 1984.

Keywords: *Crystals, *Molecular structures, *Elastic properties, *Piezoelectricity, Electrodes, Dipole moments, Reviews, Transducers, Polymers, Physical properties, Reprints, *Semicrystalline polymers.

The molecular and bulk structures of PVDF and related semicrystalline polymers are reviewed, and the effects of processing to make transducer films is discussed. A novel way of analyzing the elastic and piezoelectric constant data is introduced. The results of the analysis are shown to support the conclusion that thickness changes contribute about 2/3 of the piezoelectric activity. An increase in thickness decreases the charge on the electrodes. The probable mechanism is simply the motion of the electrodes in the fields of the constant dipole moments of the crystals. The remaining 1/3 of the activity is attributed to changes in the film's dipole moment at constant thickness. Strains in the orientation direction of the film increase the charge on the surface while strains in the plane of the film normal to the orientation direction decrease it.

Eight separate possible contributions to the change in moment are discussed, and qualitative evaluations of their importance are given.

400,520

PB85-140267

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Selfconsistent Eikonal Treatment of Diabatic Rearrangement: Model H(+) + H₂ Calculations.

Final rept.,

J. A. Olson, and D. A. Micha. Mar 84, 13p

Pub. in Jnl. of Chemical Physics 80, n6 p2602-2614 Mar 84.

Keywords: *Diatomic molecules, *Electronic transfer, *Hydrogen, Equations of motion, Comparison, Mathematical models, Reprints, *Ion molecule interactions, *Eikonal approximation, *Hydrogen ions, Numerical solution.

An eikonal treatment of nonadiabatic reactions, in which nuclear positions and moments are selfconsistently coupled to electronic transition amplitudes in a Hamiltonian formalism, is applied to H(+) + H₂ collisions where both electron transfer and nuclear rearrangement may occur. The approach is based on the diabatic electronic representation and uses potential energy surfaces and momentum couplings obtained within the method of diatomics-in-molecules. Equations of motion are obtained for hyperspherical coordinates in a model collinear treatment. Calculations carried out at collision energies 1 eV above the $n = 4$ threshold of H₂ illustrate reactive and nonreactive processes, electron transfer and translational-vibrational energy transfer. Results for total electron transfer probabilities are compared with other calculations within the same model.

400,521

PB85-140309

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Interfacial-Tension Theory of Low and High Molecular-Weight Liquid-Mixtures.

Final rept.,

C. I. Poser, and I. C. Sanchez. 1981, 10p

Pub. in Macromolecules 14, n2 p361-370 1981.

Keywords: *Binary systems(Materials), *Fluids, *Van der Waals equation, *Polymers, *Vapor phases, Equations of state, Interfaces, Surface properties, Interfacial tensions, Reprints, Compressible lattice theory, Cahn-Hilliard theory.

A generalized van der Waals or density gradient theory of interfaces has been combined with a compressible lattice theory of homogeneous fluid mixtures. Binary liquid-vapor and liquid-liquid systems are treated. For non-polar low molecular weight mixtures, liquid-vapor tensions are calculated as a function of composition with an error of less than 5%. These calculations involve no adjustable parameters; all required parameters are determined from pure component properties. For polymer solutions, it is usually necessary to introduce an adjustable interaction parameter to accurately correlate liquid-vapor tensions. Approximate equations are a function of a single interaction parameter; when this parameter is chosen to match experimental tensions, interfacial thicknesses of 1 to 5 nm are obtained. To assess the importance of compressibility effects, the interaction parameter can be chosen so that the heat of mixing is zero for an incompressible system. This 'pure compressibility approximation' works well for polymer pairs with relatively low interfacial tensions. The most serious deficiency of the theory is that intramolecular correlational effects present in long polymer chains are only crudely approximated.

400,522

PB85-140317

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Effect of Water Upon the Critical Points of Carbon Dioxide and Ethane.

Final rept.,

G. Morrison. 1981, 4p

Pub. in Jnl. of Physical Chemistry 85, n7 p759-761, 2 Apr 81.

Keywords: *Critical point, *Carbon dioxide, *Ethane, *Phase diagram, Water, Reprints.

The effect of water upon the critical points of carbon dioxide and ethane has been measured. The critical temperature for CO₂ is raised 0.372K; the critical locus ends at $x(\text{H}_2\text{O}) = .0011$. The critical temperature is

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lowered 0.022K; the critical locus ends at $x(\text{H}_2\text{O}) = 0.0055$.

400,523

PB85-140341 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Fourier Transform Infrared Study of the Gas-Phase Reactions of Ozone with Chloroethylenes. Detection of Peroxyformic Acid.
Final rept.,
H. Niki, P. D. Maker, C. M. Savage, L. P. Breitenbach, and R. I. Martinez. 1982, 4p
Pub. in *Jnl. of Physical Chemistry* 86, n10 p1858-1861 1982.

Keywords: *Infrared spectroscopy, Vapor phases, Chemical reactions, Ozone, Vinyl chloride, Reprints, *Fourier transform spectroscopy, *Formic acid/ (peroxy-ester).

Using the FTIR spectroscopic method, peroxyformic acid was identified among the products formed in the gas-phase reactions of O_3 with chloroethylenes of the form $\text{CHCl}=\text{CH}(\text{x})\text{Cl}(\text{y})$ ($\text{y}=2-\text{x}$ ($0 < \text{x} < 2$)). It was concluded that the transient species observed by Hisatsune and Heicklen (*Canad. J. Spectrosc.* 1973, 18 135) in the $\text{O}_3\text{-CHCl}=\text{CHCl}$ system was $\text{HC}(\text{O})\text{OOH}$ and not the anti conformer of $\text{HC}(\text{O})\text{OH}$ which they had postulated. The results obtained also suggest that the Criegee intermediate $\text{H}(\text{Cl})\text{COO}$ is the precursor of the $\text{HC}(\text{O})\text{OOH}$.

400,524

PB85-140358 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Low-Energy Electron Collisions with Highly Polar Molecules - LIF.
Final rept.,
L. A. Collins, and D. W. Norcross. 1977, 4p
Grant NSF-AER74-20552
Pub. in *Physical Review Letters* 38, n21 p1208-1211 1977.

Keywords: *Lithium fluorides, Inelastic cross sections, Elastic cross sections, Polarity, Hartree-Fock approximation, Reprints, *Electron molecule interactions.

Close coupling calculations of rotational elastic and inelastic cross sections have been performed using the full static Hartree potential surface plus a local approximation to the exchange interaction. The results for this typical highly polar molecule ($D=6.58$ Debye) suggest that while simpler approximations to the interaction potential are adequate for the total integrated cross section, accurate treatment of short-range interactions may be essential for the momentum transfer cross section. In particular, the authors find a resonance with pi symmetry in the momentum transfer cross section at about 2 eV only in the static model-exchange calculations.

400,525

PB85-140366 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Observations by High-Resolution ^{13}C Nuclear Magnetic-Resonance of Cellulose I Related to Morphology and Crystal-Structure.
Final rept.,
W. L. Earl, and D. L. Vanderhart. 1981, 5p
Pub. in *Macromolecules* 14, n3 p570-574 1981.

Keywords: *Nuclear magnetic resonance, *Crystal structure, *Cellulose, *Morphology, Solids, Reprints, *High resolution molecular spectroscopy.

High resolution solid phase (^{13}C) NMR spectra were obtained on celluloses from cotton linters, ramie, hydrocellulose prepared from cotton linters, Acetobacter Xylinum and Valonia Ventricosa. The spectra from cotton, ramie and hydrocellulose are virtually identical. Peak positions for all peaks are the same for the cotton, Acetobacter and Valonia celluloses although there are differences in resolution and in the intensity of two broad resonances attributed to C-4 and C-6. These differences are ascribed to differences in the morphology of the samples. The higher resolution obtained in the NMR spectra of Acetobacter and Valonia celluloses plus the improved resolution obtained at an applied field of 4.7 T relative to 1.4 T shows definite multiplicity in the resonances assigned to C-1 and C-4. It is argued that this multiplicity is higher than two and reflects the fact that there must be more than two anhydrocellulose residues per unit cell in the crystal structure of cellulose I.

400,526

PB85-140374 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Crystal-Chemistry, Modulated Structure, and Electrical-Conductivity in the Oxygen Excess Scheelite-Based Compounds $\text{La}(1-\text{x})\text{Th}(\text{x})\text{NbO}(4+\text{x}/2)$ and $\text{LaNb}(1-\text{x})\text{W}(\text{x})\text{O}(4+\text{x}/2)$.
Final rept.,
R. J. Cava, R. S. Roth, T. Negas, H. S. Parker, and D. B. Minor. 1981, 12p
Pub. in *Jnl. of Solid State Chemistry* 40, n3 p318-329 1981.

Keywords: *Crystal structure, *Electrical resistivity, *Tungsten oxides, Chemical properties, Phase transformation, Reprints, *Lanthanum niobates, *Thorium niobates, Phase equilibrium.

For $\text{La}(1-\text{x})\text{Th}(\text{x})\text{NbO}(4+\text{x}/2)$, three phases with broad homogeneity regions occur, for $0.075 < \text{x} < 0.37$, $0.41 < \text{x} < 0.61$, and $0.65 < \text{x} < 0.74$. All are related to the scheelite structure type, with at least the first exhibiting an incommensurate structural modulation. An analogous structurally modulated phase was found for $\text{LaNb}(1-\text{x})\text{W}(\text{x})\text{O}(4+\text{x}/2)$ for $0.11 < \text{x} < 0.22$. Additional phases occur at $\text{La}(0.2)\text{Th}(0.8)\text{NbO}(4.4)$ and $\text{LaNb}(0.4)\text{W}(0.6)\text{O}(4.3)$. The electrical conductivity and the direction and wavelength of the structural modulation have been characterized for the $\text{La}(1-\text{x})\text{Th}(\text{x})\text{NbO}(4+\text{x}/2)$ phase with $0.075 < \text{x} < 0.37$.

400,527

PB85-140382 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Electron Excitation of Thallium 7 Doublet S (1/2) and 6 Doublet D (3/2), (5/2) Levels.
Final rept.,
S. T. Chen, and A. Gallagher. 1977, 8p
Grant NSF-MPS72-05169
Pub. in *Physical Review A* 15, n3 p888-895 Mar 77.

Keywords: *Thallium, *Atomic energy levels, Excitation, Reprints.

The authors have measured the relative optical excitation function of the 3776-A and 3519-A lines, and the polarization function of the 2768-A line, using crossed beams of electrons and thallium atoms, for electron energies from thresholds to 1500 eV. The electron energy resolution was 0.3 eV for energies below 13 eV, and the atom beam was optically thin. The 2768-A polarization function shows strong resonance at a few electron volts above the threshold.

400,528

PB85-140390 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Thermochemical Information from Ion-Molecule Rate Constants.
Final rept.,
S. G. Lias. 1982, 23p
Pub. in *Lecture Notes in Chemistry* 31, n2 p409-431 1982.

Keywords: *Reaction kinetics, *Thermochemistry, Propylene, Reprints, *Ion molecule interactions, Benzyl radicals, Arrhenius equation.

Examples are given, derived from recent ICR work at NBS, of thermochemical information derived from ion-molecule rate constants. Finally, a series of results are given in which the ΔH of charge transfer reactions are determined by an Arrhenius treatment of the temperature dependence of the rate constant of the endothermic reaction. (An example is also given of a reaction for which this approach does not work because of the negative temperature dependence of the rate constants of both exothermic and endothermic channels.) New absolute values for the proton affinity scale based on propylene and the benzyl radical are given and compared with values based on isobutene, the usual primary standard for the scale.

400,529

PB85-140408 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Time-of-Flight Determination of Radiative Decay Rates for High Rydberg States in Atomic Nitrogen.
Final rept.,
C. A. Kocher, and C. E. Fairchild. 1978, 6p
Pub. in *Jnl. of Chemical Physics* 68, n4 p1884-1889, 15 Feb 78.

Keywords: *Atomic beams, Electric fields, Ionization, Excitation, Reprints, *Rydberg series, *Time of flight mass spectroscopy, *Nitrogen atoms.

State selection by electric field ionization is employed in an atomic beam time-of-flight determination of radiative decay rates for nitrogen atoms in high Rydberg levels. Highly excited nitrogen atoms are produced in the electron impact dissociative excitation of N_2 . As the atomic beam passes through an electric field region, the highest-lying Rydberg states are field-ionized. Populations of the remaining excited states are modified by in-flight radiative decay.

400,530

PB85-140465 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Comparison of Spreading Resistance Correction Factors as Calculated from Continuum and Finite-Layer Models.
Final rept.,
J. Albers. 1979, 1p
Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in *Jnl. of the Electrochemical Society* 126, n8 p374 1979.

Keywords: Mathematical models, Partial differential equations, Nonlinear differential equations, Electrical resistivity, Correction, Reprints, *Spreading resistance, Laplace equation.

A continuum formulation of spreading resistance correction factors is derived in the limit as the layer thickness approaches zero. The correction factors calculated from the continuum equations for an exponentially varying resistivity are compared with the correction factors obtained from the finite layer equations.

400,531

PB85-140507 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Role of Penning Ionization of the Minor Species in a Neon Hollow-Cathode Discharge.
Final rept.,
K. C. Smyth, B. L. Bentz, C. G. Bruhn, and W. W. Harrison. 1979, 2p
Pub. in *Jnl. of the American Chemical Society* 101, n4 p797-799 1979.

Keywords: *Mass spectroscopy, Electric discharge, Atomic energy levels, Neon, Reprints, *Penning ionization, *Hollow cathode discharge, Chemical reaction mechanisms.

Using a tunable dye laser, a neon hollow cathode discharge was irradiated at wavelengths corresponding to $1s(\text{sub } n)$ yields $2p(\text{sub } n)$ neon transitions, and thereby the neon metastable atom population was perturbed. At these wavelengths, changes were detected in both the voltage across the discharge and in the ion signals for the various neon species, as well as for minor (including sputtered) species in the discharge. Attention is focussed on the several possible ionization mechanisms for the minor species. Our results indicate that Penning ionization by metastable neon atoms plays the most important role at low discharge currents, but only a minor role at high currents.

400,532

PB85-140648 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Critical Dilemma of Dilute Mixtures.
Final rept.,
R. F. Chang, G. Morrison, and J. M. H. Levett Sengers. Aug 84, 3p
Pub. in *Jnl. of Physical Chemistry* 88, n16 p3389-3391, 2 Aug 84.

Keywords: *Critical point, *Solutes, *Phase transformation, Mixtures, Specific heat, Enthalpy, Solvents, Solubility, Reprints, Supercritical extraction.

Remarkable anomalies in excess properties and partial molar quantities recently reported in dilute mixtures near the solvent's critical point are explained as due to a solute-induced phase transition. A more intriguing effect, the path dependence of partial molar properties near the solvent's critical point, is analyzed for a classical (analytic) and a nonclassical (scaled) model. Asymptotic expressions are presented for partial molar volumes, enthalpies, and specific heats along a variety of paths to the solvent's critical point. The authors' results contribute to the formulation of supercritical solubility and of impurity effects in near-critical fluids.

400,533
PB85-140671 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Quality Assurance of Chemical Measurements.
 Final rept.,
 J. K. Taylor. 1980, 14p
 Pub. in *Thalassia Jugoslavica* 16, n2-4 p111-124 1980.

Keywords: *Quality assurance, *Chemical analysis, Quality control, Assessments, Sampling, Sources, Laboratories, Reprints, *Standard reference materials.

Quality assurance programs provide a mechanism to reduce analytical errors to tolerable limits and to produce evaluated data of requisite quality. They involve two concepts: quality control to minimize errors; and quality assessment to verify that the quality control procedure is effective. General principles involved in the development and operation of quality assurance programs are discussed. All aspects of the measurement and sampling process must be planned on the basis of tolerance limits for the end use of the data, using chemical and statistical considerations. Protocols for sampling, measurement, and calibration need to be developed and followed rigorously. Quality control involves adherence to good laboratory practices and the use of control charts to monitor statistical error. The quality assessment process makes use of reference samples obtained from external sources to evaluate the effectiveness of the quality control program. The use of Standard Reference Material for quality assessment is discussed together with the considerations involved in establishing sample measurements to measurements of SRMs.

400,534
PB85-140721 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Retention of Ring Structure in Cyclopentane and Alkylcyclopentane Molecular Cations
 Final rept.,
 L. W. Sieck, M. Mautner, and P. Ausloos. 1980, 2p
 Pub. in *Jnl. of American Chemical Society* 102, n22 p6866-6867 1980.

Keywords: *Molecular structure, *Cations, *Cyclopentane, *Cyclopentane compounds, Photoionization, Mass spectroscopy, Reprints, *Ion molecule interactions.

Recent mass spectrometric studies using electron impact ionization have concluded that cyclopentane and alkylcyclopentane molecular ions undergo ring opening to form the corresponding olefin. The extent of cyclic retention was also studied in methylcyclopentane, and iso- and normal propylcyclopentane and it is shown that the extent of ring retention is again wavelength-dependent. The present results are consistent with earlier radiolysis studies, and it appears that the probability for isomerization to the acyclic structure depends upon both the internal energy of the molecular cation and the collision frequency.

400,535
PB85-140739 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Trans-Gauche Concentration in Crystalline Polyethylene Measured by the Intensity of Rocking Mode Vibrations of Deuterated Methylene Groups.
 Final rept.,
 D. H. Reneker, J. Mazur, J. P. Colson, and R. G. Snyder. 1980, 15p
 Pub. in *Jnl. of Applied Physics* 51, n10 p5080-5094 Oct 80.

Keywords: *Polyethylene, *Deuterium compounds, *Infrared spectroscopy, Concentration(Composition), Molecular vibration, Crystal structure, Reprints.

Polyethylene with a low concentration of doubly deuterated displays an infrared band in the region of 646 to 651 wavenumbers. This band is attributed to a rocking normal mode of a CD₂ group with one of the adja-

cent dihedral angles approximately trans and the other approximately gauche (tg). This mode vibrates at 620 wavenumbers when the dihedral angles adjacent to the CD₂ group are both trans (tt). In polyethylene crystals tg sequences can occur only in defects where constraints cause some of the dihedral angles to be only approximately trans or gauche. Calculations of the rocking mode vibrational frequencies of CD₂ groups in model chains which incorporate some of the typical defects showed that the bands were broadened but not completely disrupted by the distorted dihedral angles. Measurements of the relative intensities of the CD₂ rocking bands show an increase in the concentration of tg sequences consistent with the thermal generation of defects which may be involved in transport of the polymer chain through the crystal. Confidence in the particular values of the concentration ratio is limited by uncertainties in the determination of the baseline for the infrared bands of interest. Quantitative measurements of the concentration ratio, tg/(tg + tt), determined from the integrated band intensities, fall between limits set by reasonable independent estimates of the concentration of folds and point dislocations.

400,536
PB85-140788 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Stepwise Excitation Laser Enhanced Ionization Spectrometry.
 Final rept.,
 G. C. Turk, J. R. DeVoe, and J. C. Travis. 1982, 3p
 Pub. in *Analytical Chemistry* 54, n4 p643-645 1982.

Keywords: *Chemical analysis, Excitation, Trace elements, Reprints, *Laser spectroscopy, *Laser enhanced ionization, Standard reference materials.

Laser stepwise excitation, utilizing two electronic transitions connected by a common intermediate level, is an effective technique for populating high energy electronic levels in an atom. Such excitation can be very useful for laser enhanced ionization (LEI) spectrometry, since sensitivity is often limited by the ability to populate an excited state which is close enough to the ionization limit to be efficiently ionized. Stepwise excitation LEI is demonstrated for seven elements, yielding improved detection limits over single-photon LEI. For the first time LEI detection of elements with ionization potentials greater than 9 eV is achieved at concentrations as low as 100 pg/mL. Selectivity is improved by the added dimension of a second excitation wavelength. Unalloyed copper and low alloy steel Standard Reference Materials are successfully analyzed.

400,537
PB85-140804 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Thermodynamic Properties of Selected Species for Flue Gas Scrubbing Processes.
 Final rept.,
 B. R. Staples. 1981, 18p
 Contract DE-AT21-79MC11593
 Pub. in Proceedings of Conference on Flue Gas Desulfurization, Morgantown, West Virginia, November 6-7, 1980, p248-265 1981.

Keywords: *Scrubbing, *Air pollution control, *Thermodynamic properties, Flue gases, Activity coefficient, Enthalpy, Entropy, Solutions, Gibbs free energy, Cations, Anions, Chemical reactions, Flue gas desulfurization.

A critically evaluated and self consistent data base is needed for the thermodynamic properties (ΔH , ΔG , ΔS , ΔC_p , γ , ϕ , $K(\text{eq})$) of chemical species important in flue gas desulfurization systems. Such a data base can form the foundation for the design of flue gas washing units and the modeling and predictive schemes used to describe the chemical processes and speciation occurring in these units. The evaluation of the thermodynamic properties of SO₂, CO₂, and for compounds formed from all combinations of the cations of Ca, Mg, Na, K, Fe, and Mn with the anions SO₃(-2), HSO₃(-1), SO₄(-2), HSO₄(-1), CO₃(-1), HCO₃(-1), and OH(-1) is discussed.

400,538
PB85-140952 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Expansion Factor of a Part of Polymer Chain in Good Solvent Measured by Small Angle Neutron Scattering.
 Final rept.,
 Y. Matsushita, I. Noda, M. Nagasawa, C. C. Han, and T. P. Lodge. 1984, 5p
 Sponsored by Ministry of Education, Science and Culture, Tokyo (Japan).
 Pub. in *Macromolecules* 17, n9 p1785-1789 1984.

Keywords: *Polystyrene, *Neutron scattering, *Expansion, *Solvents, Molecular weight, Perturbation theory, Radius of gyration, Reprints, *Small angle scattering, *Polymer chains.

The radii of gyration of deuterium labelled parts in polystyrenes with narrow molecular weight distributions in good solvent (carbon disulfide) were determined by small angle neutron scattering (SANS). The expansion factors of the labelled parts were calculated from the observed radii of gyration and their unperturbed ones which were estimated from the unperturbed radius of gyration-molecular weight relationship of polystyrene in the literature. The expansion factors of the labelled parts were smaller than those of the whole chains, but were larger than that of a whole chain with the same molecular weight as that part. This result is reasonable compared with a Monte Carlo calculation in the literature and also with the perturbation theory.

400,539
PB85-140960 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Stochastic Dynamics Simulation of Particle Aggregation.
 Final rept.,
 R. D. Mountain, and G. W. Mulholland. 1984, 4p
 Pub. in Proceedings of International Topical Conference on Kinetics of Aggregation and Gelation, Athens, GA., April 2-4, 1984, p83-86.

Keywords: *Particle interactions, *Agglomeration, *Clustering, Particle trajectories, Size determination, Simulation, Soot, Langevin equation, Three dimensional, Fractals.

The kinetics of cluster aggregation and the structure of the resulting clusters have been studied using a 'Brownian dynamics' simulation technique with the coagulation condition that particles stick upon contact. Three dimensional simulations with 500 particles were run to determine the effects of the friction coefficient and the particle concentration on the resulting particle structure and the growth dynamics.

400,540
PB85-141000 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Improved Deuterium Bromide 1-0 Band Molecular Constants from Heterodyne Frequency Measurements.
 Final rept.,
 F. R. Petersen, J. S. Wells, and D. A. Jennings. 1984, 14p
 Sponsored by National Aeronautics and Space Administration, Washington, DC.
 Pub. in *Jnl. of Molecular Spectroscopy* 107, p48-61 1984.

Keywords: *Deuterium compounds, *Hydrogen bromide, *Fundamental constants, Infrared spectroscopy, Reprints, *Laser spectroscopy, *Heterodyne spectroscopy, Far infrared spectroscopy.

Heterodyne frequency measurements have been made on selected deuterium bromide 1-0 band transitions ranging from P(20) to R(17). Difference frequency beat notes between a tunable diode laser whose frequency was locked to the DBR absorption lines and a CO laser whose frequency was either locked or adjusted to a reference synthesized from CO₂ laser frequency standards were measured. The beat note frequency was then combined with the measured CO laser frequency to give the DBR frequency. For two of the measurements, frequency doubled CO₂ laser radiation was substituted for the CO laser radiation. The measurements included electric quadrupole split triplets comprising the R(0) and P(1) transitions in the D(sup 79)Br isotope. New DBR constants have been determined and a table of frequencies is presented for the calibration of spectrometers and tunable lasers in

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the wavenumber range 1600 to 1990/cm. A table of far-infrared frequencies is also given for DBr covering the range from 50/cm to 206/cm.

400,541
PB85-141026 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Wideband Frequency-Offset-Locked Dye Laser Spectrometer Using a Schottky Barrier Mixer.
Final rept.,
J. C. Bergquist, and H. U. Daniel. 1 Jan 84, 7p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and Office of Naval Research, Arlington, VA. Prepared in cooperation with Max-Planck-Inst. fuer Quantenoptik, Garching, (Germany, F.R.).
Pub. in Optics Communications 48, n5 p327-333, 1 Jan 84.

Keywords: *Spectrometers, Crystal mixers, Broadband, Microwave frequencies, Reprints, *Laser spectrometers, Ring lasers, Dye lasers, Schottky diodes, Neon 20.

Precise frequency-controlled operation of a single mode ring dye laser with respect to another is reported at a frequency difference of 234 GHz. This extension of the technique of Laser frequency offset locking into the microwave range has been achieved by mixing the two laser lines with the harmonics of a suitable microwave frequency on a Schottky Barrier Mixer. The capability of this spectrometer was demonstrated by a frequency measurement of the transition singlet s (5) to doublet p (8) in (20)Ne with an uncertainty of 10 to the -9th power.

400,542
PB85-141323 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Search for Chemisorbed HCO: The Interaction of Formaldehyde, Glyoxal and Atomic Hydrogen + CO with Rh.
Final rept.,
J. T. Yates, and R. R. Cavanagh. 1982, 13p
See also AD-A099 970.
Pub. in Jnl. of Catalysis 74, n1 p97-109 1982.

Keywords: *Chemisorption, *Infrared spectroscopy, *Formaldehyde, *Hydrogenation, *Surface chemistry, Reprints, *Formyl, *Glyoxal.

Transmission infrared spectroscopy has been used to search for the chemisorption-stabilization of formyl (HCO) on Al₂O₃-supported Rh surfaces. Formaldehyde (H₂CO) and glyoxal (HCO)₂ have been used as potential sources of HCO. In addition, chemisorbed CO on Rh has been treated with atomic deuterium in an attempt to produce DCO. None of these routes have led to spectroscopically detectable levels of formyl adsorption at temperatures near or above 100K. These results suggest that the formyl intermediate may not be a stable surface species on Rh in CO-hydrogenation chemistry.

400,543
PB85-141398 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Mechanical and Transport Properties of Drawn Isotactic Polypropylene.
Final rept.,
F. de Candia, A. Perullo, V. Victoria, and A. Peterlin. 1984, 15p
Pub. in Paper in Interrelations between Processing Structure and Properties of Polymeric Materials, p713-727 1984.

Keywords: *Mechanical properties, *Transport properties, *Polymeric films, *Polypropylene, Sorption, Diffusion, Samples, Density(Mass/volume), Drawing, Reprints.

Quenched films of isotactic polypropylene were drawn at different temperatures in the range between 25 and 80C. The plastic deformation was quantitatively defined by the true draw ratio lambda (sub loc) of the volume element. Mainly transparent samples were used for the density and transport properties measurement. The observed effects were similar to those obtained formerly with branched and linear polyethylene. The creep deformation before necking is substantially smaller than in polyethylene. In the neck the draw ratio increases by about 6. The axial elastic modulus increases faster than the draw ratio. The drop of the sorption and the zero concentration diffusion coefficient indicate that at the maximum achieved draw ratio the original lamellar structure of the transparent samples is almost completely transformed in the microfibrillar structure.

400,544

PB85-141414 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
High Resolution Spectrum of the nu 5 Band of Nitric Acid HNO₃ Near 880/cm.
Final rept.,
A. G. Maki, and J. S. Wells. 1984, 14p
Pub. in Jnl. of Molecular Spectroscopy 108, p17-30 1984.

Keywords: *Nitric acid, *Infrared spectra, Performance evaluation, Reprints, *Laser spectroscopy.

Tunable diode lasers have been used to measure the spectrum of HNO₃ from 853/cm to 892/cm. A Fermi interaction with the nearby 2 nu (sub g) state perturbs some of the transitions and causes some problems in the analysis, but several hundred lines have been assigned and fit to a set of band constants with a standard deviation of 0.0007/cm. The measurements include most of the P-branch, the strongest lines of the Q-branch, and some R-branch transitions. Only A-type transitions have been identified and any B-type transitions must be much weaker.

400,545

PB85-141554 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Carbon Monoxide Compressibility Data from 100 to 300 K; Derived Virial Coefficients, Orthobaric Densities, and Heats of Vaporization.
Final rept.,
R. D. Goodwin. Aug 83, 12p
Pub. in Cryogenics 23, n8 p403-414 Aug 83.

Keywords: *Carbon monoxide, Density(Mass/volume), Heat of vaporization, Tables(Data), Critical point, Vapor pressure, Cryogenics, Reprints, *Virial coefficients.

Experimental densities of carbon monoxide are tabulated along experimental pseudoisochores from 90 through 300 K at pressures to 350 bar. Virial coefficient data on isotherms are derived from 120 through 300 K and are formulated vs. temperature by inclusion of data from other sources. Vapor pressures from other sources are formulated and used to derive some orthobaric vapor densities via the virial equation; and orthobaric vapor and liquid densities via isochoric P(rho)T data. All available orthobaric vapor and liquid density data then are formulated and are used to derive and to formulate the heats of vaporization.

400,546

PB85-141851 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Transport Properties as an Extremely Sensitive Indicator of the Status of the Amorphous Component in the Elastically and Plastically Deformed Semicrystalline Polymer.
Final rept.,
A. Peterlin. 1984, 20p
Pub. in Paper in Interrelations between Processing Structure and Properties of Polymeric Materials, p585-604 1984.

Keywords: *Transport properties, *Polymers, Diffusion, Density(Mass/volume), Neutron scattering, Drawing, Reprints, *Semicrystalline polymers, *Amorphous materials.

As far as the density is concerned the amorphous component in the semicrystalline polymer does not behave like an incompressible rubber although it is above the glass-transition temperature. As a consequence of the uniaxial elastic extensional deformation the specific volume of the amorphous material increases while that of a strained rubber remains constant. The difference between the amorphous phase in a semicrystalline polymer and in an ideal rubber is a consequence of the intimate connection between the amorphous and crystalline phase. As a consequence of the increased specific volume of the amorphous component in the uniaxially strained semicrystalline polymer the enhancement of the transport properties is large and easy to measure, much easier than any other property of the amorphous component. The plastic deformation retains the specific volume and hence, in first approximation, does not modify the transport properties.

400,547

PB85-141901 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Reaction of the Vanadate Ion with Chlorpromazine and the Chlorpromazine Free Radical with the Vanadyl Ion.
Final rept.,
R. E. Huie, and P. Neta. 1984, 2p
Pub. in Inorganica Chimica Acta 93, pL27-L28 1984.

Keywords: *Chlorpromazine, *Free radicals, *Oxidation, Chemical reactions, Acid treatment, Reprints, *Vanadate ions.

The oxidation of chlorpromazine by the vanadate ion was found to proceed only in strongly acid solutions (pH < 2), contrary to previously published reports. The reverse reaction was observed at higher pH. These results are discussed in terms of the possible physiological effects of chlorpromazine and vanadium.

400,548

PB85-141919 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Spectroscopy of Stored Ions Using Fluorescence Techniques.
Final rept.,
D. J. Wineland, W. M. Itano, J. J. Bollinger, J. C. Bergquist, and H. Hemmati. 1983, 6p
Pub. in SPIE 426, p65-70 1983.

Keywords: *Fluorescence, *Ions, *Spectroscopic analysis, Mass spectroscopy, Reprints, *Laser spectroscopy, *Ion trappings.

Fluorescence light is used in spectroscopic experiments on stored ions. The authors discuss applications in (1) high resolution microwave and rf/optical double resonance spectroscopy, (2) single ion detection, (3) mass spectroscopy and (4) studies of stored ion clouds which exhibit properties of strongly coupled plasmas.

400,549

PB85-141927 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Collisional Redistribution of Light: Far-Wing Line Shapes and Polarizations for the Ba-Ar, Xe Systems.
Final rept.,
W. J. Alford, N. Andersen, K. Burnett, and J. Cooper. Nov 84, 15p
Grant NSF-PHY82-00805
Pub. in Physical Review A: General Physics 30, n5 p2366-2380 Nov 84.

Keywords: *Line spectra, *Barium, *Binary systems(Materials), *Light scattering, Rayleigh scattering, Fluorescence, Argon, Xenon, Atomic energy level, Reprints, *Collision broadening.

The authors have measured the far-wing collisional redistribution line shape, the redistributed fluorescence polarization, and the collisional alignment decay rates for barium perturbed by argon and xenon. The experiment was performed with a heated gas cell (T about 900 K) with perturber gas densities in the 1-30 Torr range and laser light detuned 3-1000/cm from the 5535 A Ba I 6 singlet P - 6 singlet P resonance line. Metal vapor densities were determined by a Rayleigh scattering technique which is outlined in detail. By correlating structure in the line shape with that of the polarization, they are able to make definitive statements about the interatomic potentials. The Ba data show strong similarities with previous experimental results for similar two-electron atoms, namely Ca, Sr, and Hg, so our conclusions are of relevance to these systems as well.

400,550

PB85-141968 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Laser-Induced Fluorescence Measurement of Nascent Vibrational and Rotational Product State Distributions in the Charge Transfer of Ar(+1) + N₂ yields Ar + N₂(+1) (v=0.1) at 0.2 eV.
Final rept.,
L. Huwell, D. R. Guyer, G. H. Lin, and S. R. Leone.
15 Oct 84, 16p
Grants NSF-PHY82-00805, NSF-CHE79-11340
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Jnl. of Chemical Physics 81, n8 p3520-3535, 15 Oct 84.

Keywords: *Molecular vibrational, *Molecular rotational, *Argon, Fluorescence, Nitrogen, Experimental design, Reprints, *Laser induced fluorescence, *Ion molecule interactions, *Argon ions.

A novel experimental technique couples a flowing afterglow ion source with a supersonic nozzle expansion in order to deliver high densities of relatively low kinetic energy ions into a low pressure chamber. Nascent rotational and vibrational state distributions are obtained by the method of saturated laser-induced fluorescence probing. It is found that a substantial fraction of the available energy is partitioned into internal excitation of the N₂(+1) product molecule. It is suggested the experimental findings are best explained in terms of the detailed locations of potential surface crossing seams, rather than by the widely used energy-resonance or diatomic molecule, Franck-Condon ionization models.

400,551

PB85-141992 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
State-Resolved Molecular Reaction Dynamics.
Final rept.,
S. R. Leone. 1984, 27p
Contract DE-AC02-79ER10396, Grant AFOSR-78-3565
Sponsored by Grants NSF-PHY82-00805, NSF-CHE79-11340, and DAA29-82-K-0031.
Pub. in Annual Review of Physical Chemistry 35, p109-135 1984.

Keywords: *Vapor phases, Chemical reactions, Surface chemistry, Trends, Reprints, *Molecular dynamics, Chemical reaction mechanisms, Ion molecule interactions.

The subject of gas phase molecular reaction dynamics is a mature field; but it is one which continues to offer exciting new perspectives on the fundamental nature of chemical transformations. Chemists have in their vocabulary such familiar concepts as 'early' and 'late' reaction barriers, the harpoon mechanism, and 'direct' and 'complex' reaction dynamics. The authors also have a modicum of understanding about which forms of energy, i.e. vibrational, translational, electronic, or rotational, will successfully carry a reaction to completion. Much of this understanding comes from ingenious state-resolved experimental measurements on elementary chemical reactions, coupled with the excellent insight provided by detailed theoretical calculations. Because so much has already been discovered and said about reaction dynamics, it is important to identify significant new developments and results. This review focuses on recent experimental investigations in state-resolved molecular reaction dynamics, involving primarily work carried out from 1980-1983. The trend is toward investigations that involve a higher degree of sophistication to learn about geometrical and orientation effects, bimodal state distributions that result from multiple reaction pathways, resonance effects, and the competition between reactive and inelastic channels. In addition, well-known techniques are being applied to new systems, including investigation of reaction dynamics on catalytic metal surfaces, study of atom-radical reactions and ion-molecule reactions, and determination of product branching in reactions that have a manifold of pathways.

400,552

PB85-142008 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Status of Thermophysical Properties Data for Pure Fluids and Mixtures at Low Temperatures.
Final rept.,
A. J. Kidnay, N. A. Olien, and M. J. Hiza. 1983, 9p
Pub. in AIChE (American Institute of Chemical Engineers) Symposium Series 79, n224 p105-113 1983.

Keywords: *Thermophysical properties, *Low temperature tests, Physical properties, Thermodynamics, Mixtures, Fluids, Experimental design, Reprints.

This paper discusses the need for and the availability of both thermodynamic and physical properties data for the fluids generally encountered in low-temperature processing. The important gaps in the existing data are noted and recommendations are made for future experimental programs.

400,553

PB85-142032 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Gruneisen Parameter in Fluids.
Final rept.,
V. Arp, J. M. Persichetti, and C. Guo-bang. Jun 84, 9p
Pub. in Jnl. of Fluids Engineering 106, p193-201 Jun 84.

Keywords: *Fluids, *Binary systems(Materials), Mixtures, Diatomic molecules, Thermodynamic properties, Hydrocarbons, Mercury(Metal), Sodium, Water, Equations of state, Reprints, *Gruneisen parameters.

The Gruneisen parameter has been identified with the thermodynamic properties of lattice structures for some fifty years. In this paper, the authors show that the same thermodynamic variable also occurs prominently in the hydrodynamics of compressible fluids. In the ideal gas region, the Gruneisen parameter is equal to gamma (the specific heat ratio) minus one, and thus is easily overlooked as a separate parameter in its own right. In this paper, they give examples of its appearance and use in hydrodynamics and diatomic gases, heavy hydrocarbons, water, mercury, liquid sodium, and two-phase (liquid-vapor) mixtures.

400,554

PB85-142073 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Direct Measurement of the 3 triplet P(sub 0)-3 triplet P(sub 1) Fine-Structure Interval and the g(sub j)-Factor of Atomic Silicon by Laser Magnetic Resonance.
Final rept.,
M. Inguscio, K. M. Evenson, V. Beltran-Lopez, and E. Ley-Koo. 15 Mar 84, 4p
Pub. in Astrophysical Jnl. 278, pL127-L130, 15 Mar 84.

Keywords: *Silicon, Interstellar matter, Zeeman effect, Atomic energy levels, Hartree-Fock approximation, Experimental design, Reprints, *Fine structure, *G factor, *Laser magnetic resonance spectroscopy, Laser spectroscopy.

Laser magnetic resonance measurements have been performed on the ground 3(doublet p)triplet P multiplet of atomic silicon. The J = 0 yields 1 fine-structure interval and the g-factor of the triplet P(sub 1) state have been determined with high precision.

400,555

PB85-142099 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Electrochemical Investigation of N-Methyl-4-(5-Phenyl-2-Oxazolyl)Pyridinium p-Toluenesulfonate: A Laser Dye with Product Deposition.
Final rept.,
R. T. Burke, E. A. Blubaugh, W. T. Yap, and R. A. Durst. 1984, 12p
Pub. in Jnl. of Electroanalytical Chemistry 177, p77-88 1984.

Keywords: *Electrochemistry, *Electrodeposition, *Laser materials, *Dyes, Electrodes, Nernst effect, Transport properties, Thermodynamics, Reprints, *Pyridinium toluene sulfonate/N-methyl-(phenyl-oxazolyl).

The electrochemical and spectroelectrochemical behavior of N-methyl-4-(5-phenyl-2-oxazolyl)pyridinium p-toluenesulfonate was studied to provide an evaluation of the electrochromic properties of this laser dye.

Preliminary cyclic voltammetric experiments provided evidence for the deposition onto the electrode of the product of the electrochemical reduction process. Double potential-step chronocoulometry and spectroelectrochemistry at an optically transparent thin-layer gold-minigrid electrode were used to elucidate the reaction mechanism further. Equations were derived to interpret the spectropotentiostatic Nernst plots which exhibit discontinuities as a result of product precipitation onto the electrode. For redox systems in which there is product deposition, the mathematical treatment described permits the calculation of various thermodynamic and transport properties based on spectropotentiostatic and chronocoulometric data.

400,556

PB85-142107 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Prediction of the Viscosity of Pure and Mixed Cryogenic Fluids.
Final rept.,
J. F. Ely, and J. K. Baker. 1983, 5p
Pub. in AIChE (American Institute of Chemical Engineers) Symposium Series 79, n224 p100-104 1983.

Keywords: *Viscosity, *Thermal conductivity, *Fluids, Mixtures, Cryogenics, Comparison, Mathematical models, Reprints.

Viscosity and thermal conductivity play an important role in engineering design. Recently, a predictive corresponding states model for these properties in non-polar mixtures has been developed. The method, which is applicable to the entire range of fluid states, does not require any transport data in the predictions. This manuscript summarizes recent studies dealing with the applicability of a corresponding states principle for fluid viscosity. Comparisons of predictions and experiment for eight pure cryogenic fluids and three mixtures are presented.

400,557

PB85-142123 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Non-Newtonian Phenomena in Simple Fluids.
Final rept.,
D. J. Evans, H. J. M. Hanley, and S. Hess. Jan 84, 8p
Pub. in Physics Today 37, n1 p26-33 Jan 84.

Keywords: *Fluids, Thermodynamics, Liquids, Reprints, *Molecular dynamics.

Computer simulation indicates simple liquids can display a surprising range of exotic nonequilibrium phenomena, many of which are associated conventionally with macromolecular systems. Their presence has significant implications for nonequilibrium statistical mechanics and thermodynamics.

400,558

PB85-142149 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Infrared and Far-Infrared Transition Frequencies for the CH₂ Radical.
Final rept.,
T. J. Sears, A. R. W. McKellar, P. R. Bunker, K. M. Evenson, and J. M. Brown. 1 Jan 84, 4p
Pub. in Astrophysical Jnl. 276, p399-402, 1 Jan 84.

Keywords: *Infrared spectroscopy, *Interstellar matter, Free radicals, Methane, Reprints, *Methyl radicals, *Laser magnetic resonance spectroscopy, *Far infrared spectroscopy, Laser spectroscopy.

Frequencies, wavelengths, and line strengths for transitions of the CH₂ molecule at far-infrared and mid-infrared (9-12 micrometers) wavelengths have been calculated from recently reported laser magnetic resonance spectra.

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

400,559

PB85-142347 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Formulations for the Thermodynamic Properties of Dry Air (from 173.15 K to 473.15 K) and of Saturated Moist Air (from 173.15 K to 372.15 K), at Pressures to 5 MPa.

Final rept.,
A. Wexler, and R. W. Hyland. 1983, 1p
Sponsored by American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., New York. Pub. in ASHRAE Jnl. 25, n5 p64 1983.

Keywords: *Thermodynamic properties, *Air, Pressures, Enthalpy, Entropy, Water vapor, Ideal gas, Humidity, Reprints, Virial coefficients.

Calculations are made of the thermodynamic properties of moist air, in SI units, at pressures of 0.1, 0.5, 1 and 5 MPa, with the thermodynamic temperature as the independent variable. The real-gas behavior of moist air is represented by a volume-series virial equation of state for mixtures. The ideal-gas thermodynamic properties of the constituents of moist air, that is, dry air and water vapor, are formulated as empirical equations based on statistical mechanical computations from spectroscopic data. The volume, enthalpy and entropy of the air-water vapor mixture, per unit mass of dry air, are tabulated at standard atmospheric pressure for two conditions: dry and saturated. Estimates are made of the overall (maximum) uncertainty of these properties. Expressions are given for obtaining values of these properties at any desired relative humidity. Equations are derived for the second and third virial coefficients of dry air, the second and third cross-virial coefficients of water vapor-air mixtures, and their corresponding derivatives (enthalpy coefficients). Computations are made of the enhancement factor and the humidity (mixing) ratios.

400,560

PB85-142354 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Low-Energy Electron-Atom Scattering in a Magnetic Field.

Final rept.,
C. W. Clark. Jul 83, 8p
Pub. in Physical Review A: General Physics 28, n1 p83-90 Jul 83.

Keywords: *Electron scattering, *Cations, *Photoionization, Ionization, Magnetic fields, Reprints.

The threshold laws for electron-atom scattering processes in a magnetic field are shown not to contain singularities in general. Observed modulations of photo-detachment cross sections are due to the presence of true resonances rather than divergence of phase space. These resonances may be associated with thresholds, or they may be analogous to the quasi-Landau resonances observed in photoionization.

400,561

PB85-142370 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Method for Construction of Nonclassical Equations of State.

Final rept.,
J. R. Fox. 1983, 9p
Pub. in Fluid Phase Equilibria 14, p45-53 1983.

Keywords: *Equations of state, *Critical point, Thermodynamics, Van der Waals equation, Vapor phases, Liquid phases, Reprints, Phase equilibrium, Numerical solution.

A method of modifying empirical equations of state in order to improve their performance in the critical region is introduced. The implementation of this method involves the construction of a state function which measures the effective distance between the state in question and the critical state. A mathematical transformation, parameterized by this function, is then used to define a new equation of state which is designed to be identical in behavior to the original formulation outside the critical region, but to develop the nonclassical scaling behavior characteristic of real fluids near the critical point. Application of this method to an equation of state of van der Waals type is presented as an illustration.

400,562

PB85-142388 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Comment on 'A Theoretical Study of Coherence Effects in Charge Transfer Collisions: Application to Na + Li(+1)'.

Final rept.,
I. V. Hertel, and H. Schmidt. Oct 84, 2p
Pub. in Jnl. of Chemical Physics 81, p3361-3362 Oct 84.

Keywords: *Coherent effects, Ions, Atoms, Reprints, *Atom ion interactions.

In a recent article Orel and Kulander have reported theoretical calculations of charge exchange processes involving excited alkali atoms. In view of the experimental possibilities to prepare oriented and aligned atoms by laser optical pumping and the substantial progress made recently in deriving detailed information on excitation and charge exchange amplitudes and their relative phases in ion atom scattering, this is a timely and very interesting study. There are, however, some conceptual misunderstandings which deserve clarification in order to fully exploit the theoretical results when comparing with experiments.

400,563

PB85-142396 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Far Infrared Laser Magnetic Resonance of Singlet Methylene: Singlet-Triplet Perturbations, Singlet-Triplet Transitions, and the Singlet-Triplet Splitting.

Final rept.,
A. R. W. McKellar, P. R. Bunker, T. J. Sears, K. M. Evenson, and R. J. Saykally. 1 Dec 83, 14p
Contract NASA-W-15047
Pub. in Jnl. of Chemical Physics 79, n11 p5251-5264, 1 Dec 83.

Keywords: *Methylene, *Atomic energy levels, Free radicals, Molecular rotation, Molecular vibration, Reprints, *Laser magnetic resonance spectroscopy.

The authors have observed and assigned a number of far infrared laser magnetic resonance spectra arising from rotational transitions within the vibrational ground state of a(sup about 1) A(sub 1) electronic excited state of the methylene radical and from transitions between such singlet levels and vibrationally excited levels of the X(sup about 3) B(sub 1) electronic ground state. The singlet-singlet transitions are magnetically active, and the singlet-triplet transitions have electric dipole intensity, because of the spin-orbit mixing of singlet levels with vibrationally excited levels of the triplet state. By identifying four pairs of singlet and triplet levels that perturb each other we can accurately position the singlet and triplet state relative to each other and determine the singlet-triplet splitting.

400,564

PB85-142404 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Heterodyne Frequency Measurements and Analysis of CO₂ Laser Hot Band Transitions.

Final rept.,
F. R. Petersen, J. S. Wells, K. J. Siemsen, A. M. Robinson, and A. G. Maki. 1984, 7p
Pub. in Jnl. of Molecular Spectroscopy 105, p324-330 1984.

Keywords: Least squares method, Molecular vibrations, Molecular rotation, *Laser spectroscopy, *Band transitions, *Heterodyne spectroscopy.

New frequency measurements of molecular lines in the P-branch of the O₁(sup 1) 1-(-1(sup 1) 0, 03(sup 1) 0)(sup I) band of (12)C(16)O₂, observed in laser emission, and lines in the R-branch, observed in absorption with a tunable diode laser, have been made by heterodyne difference frequency techniques with stabilized CO₂ lasers as the reference frequencies. The data obtained, plus additional results of measurements made by two other groups of researchers, were combined in a least squares fit to obtain improved rovibrational constants for this band. The new constants predict more reliably the frequencies of both the P- and R-branch transitions. A table of transition frequencies and their estimated uncertainties is given for this band.

400,565

PB85-142420 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Determination of Iron in Serum and Water by Resonance Ionization Isotope Dilution Mass Spectrometry.

Final rept.,
J. D. Fassett, L. J. Powell, and L. J. Moore. Oct 84, 6p
Pub. in Analytical Chemistry 56, n12 p2228-2233 Oct 84.

Keywords: *Iron, *Blood analysis, *Water analysis, *Standards, Trace elements, Mass spectroscopy, Chemical analysis, Reprints, *Standard reference materials, *Isotope dilution mass spectrometry, *Resonance ionization spectroscopy, Laser spectroscopy.

Resonance ionization mass spectrometry has been used in conjunction with isotope dilution to determine the iron content of SRM 909 (Human Serum) and SRM 1643b (Trace Elements in Water). Iron was thermally vaporized from a filament at 1250 K. A one-wavelength, two-photon ionization scheme was employed utilizing UV light at 283.6 nm provided by a Nd:YAG pumped dye laser with frequency doubling. The linearity of the detection system was verified by the determination of the (57)Fe/(56)Fe ratios in a set of gravimetrically prepared isotopic calibration mixes. The precision and accuracy of the measurements were typically 2-3%. The mass spectrometric loading blank is presently the limiting source of error.

400,566

PB85-142453 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Sampling, Storage, and Handling of Materials for Trace Element Analysis.

Final rept.,
J. R. Moody. 1984, 19p
Pub. in Sample Preparation Technology (Zymark Corp., Hopkinton, MA 01748) p1-19 1984.

Keywords: *Trace elements, *Chemical analysis, Sampling, Materials handling, Reviews, Reprints.

This report is a review of current practices and methods for sampling, storage and sample handling of materials specifically for trace elements analysis. It is intended to serve as a chapter in an intermediate text series on sample handling. Special emphasis is placed upon generic means of controlling contamination in order to obtain a more valid sample.

400,567

PB85-142479 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Crystal Structures of the Chevrel Phases Li_{3.3}Mo₆S₈ and Li_{3.2}Mo₆Se₈.

Final rept.,
R. J. Cava, A. Santoro, and J. M. Tarascon. 1984, 11p
Pub. in Jnl. of Solid State Chemistry 54, p193-203 1984.

Keywords: *Crystal structures, *Lithium, *Neutron diffraction, Reprints, *Lithium molybdenum sulfide, *Lithium molybdenum selenide.

The crystal structures of Li_{3.3}Mo₆S₈ and Li_{3.2}Mo₆Se₈, Chevrel phases formed by the insertion of lithium into Mo₆S₈ and Mo₆Se₈, were determined by neutron diffraction powder profile analysis. The Mo₆S₈ and Mo₆Se₈ clusters are quite similar to those in other compounds of this type. The lithium atoms in both cases are disordered over the two concentric rings of available tetrahedrally coordinated small atom sites. For both compounds, occupancy of the outer ring is strongly preferred, and in Li_{3.3}Mo₆S₈ the inner lithium ring has a unique puckered geometry.

400,568

PB85-142529 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Detecting Elevated Contamination by Comparisons with Background.

Final rept.,
W. Liggett. 1984, 10p
Pub. in American Chemical Society 267, p119-128 1984.

Keywords: *Environmental surveys, *Soil analysis, Sampling, Tests, Comparison, Reprints, Heavy metals.

In the environmental studies this paper considers, the objective is detection of unusually high levels of an ubiquitous soil contaminant. This objective is achieved by comparison of measurements from a background region with measurements from the region where excess contamination is suspected. In its implications for study design, comparison differs from other approaches to soil-sampling objectives. In particular, comparisons are more sensitive to sampling and subsampling variations that have a positive skewness and an asymmetrical probability distribution with its upper tail more extended than its lower tail. This paper considers design requirements such as comparability of the two regions, uniformity in the execution of the sampling and subsampling procedures, and minimization of the skewness. Since asymmetry cannot always be eliminated, this paper presents a statistical method for detecting occasional high levels of contamination when the background measurements have a positive skewness. This method applies to background measurements that can be transformed to normality by a shift and a power (Box-Cox) transformation. The method accounts for the estimation of the transformation from the data. The method is illustrated with analogous data, blank measurements from a study of trace quantities of heavy metals.

400,569
PB85-142545 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Chronoamperometric Determination of Diffusion-Layer Thickness at Hydrodynamic Electrodes.
Final rept.,
K. W. Pratt. Sep 84, 4p
Pub. in Analytical Chemistry 56, n11 p1967-1970 Sep 84.

Keywords: *Electrodes, *Electrical measurement, Diffusion, Chemical reactions, Mass transfer, Comparison, Reprints, *Hydrodynamic voltammetry.

A new technique is described by which diffusion-layer thicknesses at hydrodynamic electrodes are measured without knowing the electrode area, solution concentration, or number of electrons in the electrode reaction. Comparison of the chronoamperometric current, obtained in quiescent solution, with the limiting current obtained at the same electrode in hydrodynamic voltammetry yields a characteristic 'equivalent time'. This parameter is directly related to the diffusion-layer thickness at the electrode. Experimental diffusion-layer thicknesses are measured at rotating disk and vibrating wire electrodes using this technique. The values agree with those obtained from limiting-current measurements to within 5% at the rotating disk and 16% at the vibrating wire electrode. Factors contributing to these errors are evaluated.

400,570
PB85-142552 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Eigenphase Sum in Electron Scattering by Polar Molecules.
Final rept.,
C. W. Clark. Aug 84, 8p
Pub. in Physical Review A: General Physics 30, n2 p750-757 Aug 84.

Keywords: *Eigenvalues, *Electron scattering, *Diatomic molecules, Polarity, Sulfur dioxide, Water, Reprints, *Electron molecule interactions.

The eigenphase sum for electron-polar-molecule scattering admits separation into a part which is wholly dependent on the long-range field and a part which reflects other interactions. Closed-form expressions are given for the zero-energy eigenphase sum for diatomic molecules and simple polyatomic molecules in the fixed-nuclei approximation. A general framework for performing body-frame scattering calculations is presented.

400,571
PB85-142560 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Isotope Shifts of C I Spectral Lines and Their Application to Radioactive Dating by Laser-Assisted Mass Spectrometry.
Final rept.,
C. W. Clark. Nov 83, 3p
Pub. in Optics Letters 8, n11 p572-574 Nov 83.

Keywords: *Carbon, *Atomic structure, *Mass spectrometry, *Isotope effect, Radioactive age determination, Trace elements, Spectral lines, Carbon isotopes, Reprints, *Laser spectroscopy.

The author has calculated isotope shifts for several one- and two-photon transitions in neutral carbon. The results provide a unified interpretation of existing experimental data, and they demonstrate the applicability of a new method of ultrasensitive isotope trace analysis to carbon.

400,572
PB85-142792 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Handling and Evaluation of Large Networks of Thermochemical Data.
Final rept.,
D. Wagman, D. Garvin, V. Parker, W. Evans, and J. Pedley. 1981, 8p
Pub. in Proceedings of International CODATA Conference, Data Science and Technology, p361-368 1981.

Keywords: *Thermochemical properties, *Information systems, *Organic compounds, Thermodynamics, Least squares method, Tables(Data).

This paper summarizes some recent developments in the automation of the thermochemical evaluation process made in closely related collaborative programs at the U.S. National Bureau of Standards and the University of Sussex in England. The types and contents of both the NBS inorganic compound data banks and the University of Sussex organic compound data banks are described. Emphasis is given to how the machines can assist the data analysts both in making decisions and in disseminating the results of their work. The data banks described have been designed for direct processing. The design provides facilities for search and retrieval, analysis of relationships among measurements, capabilities for evaluations, updating and printing of tables. Validation procedures are described for the data banks of selected thermochemical properties of compounds and for the data banks of the reaction catalogs of thermochemical measurements. The catalogs are the centerpiece for the establishment of 'best values' for the thermochemical properties, delta H, delta G and delta S of chemical processes and of individual substances. At present the catalogs contain only measurements corrected to 298.15K. Automated aids to the analyst in analyzing the catalogs are also described. Some of these are display of measurement networks, loop analysis, least sum and least square solutions and residuals analysis. Tables of thermodynamic properties of compounds can be published directly from the data banks of selected values.

400,573
PB85-142859 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Theory of Charge Exchange and Ionization by Heavy Particles.
Final rept.,
B. H. Bransden. 1983, 24p
Pub. in NATO (North Atlantic Treaty Organization) Advances in Science Instrumentation Series B 101, p245-268 1983.

Keywords: *Ionization, Electron capture, Reprints, *Charge exchange, *Ion-atom interactions, Hydrogen atoms.

The theoretical methods employed to calculate charge exchange and ionization in collisions between ions and atoms are surveyed, with particular emphasis on the interaction between fully stripped ions and hydrogen atoms. The range of energies covered is from about 100 eV/amu to about 1 MeV/amu. A bibliography is provided.

400,574
PB85-142891 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurement of Polymer-Solvent Diffusivity by Inverse Gas-Chromatography.
Final rept.,
G. A. Senich. 1981, 1p
Pub. in Bulletin of the American Phys. Society 26, n3 p429 1981.

Keywords: *Gas chromatography, Diffusivity, Polymers, Polyethylene, Diffusion, Plastics, Reprints, *Inversion gas chromatography.

The diffusivity of a volatile compound or probe in a polymer can be derived from nonequilibrium inverse gas chromatography (IGC) experiments conducted at rapid carrier gas flow rates. The van Deemter equation is commonly used to relate experimentally measured peak broadening to the probe-polymer diffusion coefficient.

This relation, as commonly applied, neglects diffusive processes in the gas phase and variations in the local carrier gas flow velocity, two factors which can have a significant effect on the magnitude of the diffusivity found by IGC studies. Another important parameter is the diffusion path length in the polymer phase. Two extremes in polymer geometry possible within the column are considered, a thin, uniformly distributed covering over the entire surface of the spherical column packing or annulus-like regions collected at the contact points between spheres, each with a different diffusion path length. The influence of these factors on probe-polymer diffusivity determinations is illustrated with results from an experimental IGC study of normal octadecane diffusion in linear polyethylene at 150C.

400,575
PB85-142909 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Optogalvanic Spectroscopy - Application to Combustion Systems.
Final rept.,
P. K. Schenck, and J. W. Hastie. 1981, 7p
See also PB81-199200.
Pub. in Optical Engineering 20, n4 p522-528 Aug 81.

Keywords: *Flames, *Combustion, *Chemical analysis, Ionization, Soot, Hydrocarbons, Reprints, *Optogalvanic spectroscopy, Laser spectroscopy.

Optogalvanic spectroscopy is a method of obtaining absorption spectra of atomic and molecular species in flames and electrical discharges by measuring voltage and current changes upon laser irradiation. This technique alleviates the problems associated with optically monitoring either small absorptions or weak fluorescence in the presence of strong laser light. Optogalvanic spectroscopy in discharges has been useful in characterizing laser linewidths as well as providing a convenient frequency calibration for tunable dye lasers. In addition, the optogalvanic signals have been used to frequency stabilize both continuous wave dye lasers. Optogalvanic spectroscopy has also been possible on some molecular species which exist only in flame or discharge environments. Analytical flame spectrometry utilizing the optogalvanic effect for trace metal detection shows significant promise for many metallic elements. The optogalvanic effect can also serve as a probe of ionization effects in flames. The ionization cross section as well as ion mobilities may be determined from an analysis of optogalvanic signals. This technique has been extended to include the determination of mobilities of soot precursor molecules in rich hydrocarbon flames. Flow velocities may also be determined in laminar flames by following the residual depletion of neutrals in the flame gas stream.

400,576
PB85-142925 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Preparation, Vapor Pressure and Infrared Spectrum of Methyl Nitrite.
Final rept.,
F. L. Rook. 1982, 2p
Pub. in Jnl. of Chemical and Engineering Data 27, n1 p72-73 1982.

Keywords: *Deuterium compounds, *Synthesis(Chemistry), *Vapor pressure, *Infrared spectroscopy, Reprints, *Nitrite/methyl.

A convenient preparation of ordinary and deuterated methyl nitrite has been described, their high resolution infrared spectra recorded, and the vapor pressure curve of CH₃ONO measured in the region 154 < or = T(K) < or = 225: log (sup 10) P(torr) = -1365/T + 8.102.

400,577
PB85-142982 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Asymmetry Patterns of Plasma-Broadened Isolated Lines (Carbon I).
Final rept.,
D. W. Jones, and W. L. Wiese. Nov 84, 7p
Pub. in Physical Review A 30, n5 p2602-2608 Nov 84.

Keywords: *Stark effect, *Line spectra, *Carbon, Line width, Comparison, Asymmetry, Reprints.

The authors have measured detailed profiles of plasma-broadened neutral-carbon lines, utilizing a wall-stabilized arc source and a specially designed data acquisition and processing system. They ana-

lyzed the lines in terms of symmetric Lorentzian profiles in order to isolate the deviations due to asymmetries and found regular patterns of an antisymmetric nature around the line centers. The asymmetry patterns have a common shape with a minimum, maximum, and zero crossing at the same points on a reduced wavelength scale, but they vary widely in their amplitudes. These findings are in excellent qualitative agreement with the quasistatic theory of ion broadening due to the quadratic Stark effect. A comparison and match of experimental and theoretical amplitudes has thus been used to determine the ion broadening parameters of these lines, which are in satisfactory agreement with directly calculated values.

400,578
PB85-143329 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Influence of Molecular Packing on Solid-State ¹³C Chemical Shifts: The n-Alkanes.
 Final rept.,
 D. L. VanderHart. 1981, 9p
 Pub. in *Jnl. of Magnetic Resonance* 44, n1 p117-125 1981.

Keywords: *Alkanes, Solids, Reprints, *Chemical shifts(Nuclear magnetic resonance), *Molecular packing, *Carbon 13, Molecular conformation.

The question of the influence of molecular packing on isotropic chemical shifts (ICS) in solids is probed experimentally. The n-alkanes are found in four crystallographic forms. Since the isolated chain geometry is considered to be the same in all of these forms and since these solids lack specific interactions (e.g. hydrogen bonds), observed shifts should be related to packing effects. It is found that the ICS of the interior methylene groups is very constant in all forms plus orthorhombic polyethylene. The exception is triclinic C-20, for which this resonance is shifted 1.3 + or - 0.4 ppm downfield. The exact reasons for this shift is not obvious, beyond the uniqueness of the triclinic subcell. Magnetic susceptibility effects were considered and dismissed as inadequate. It is suggested that until solid state chemical shifts are better understood, care should be taken in attributing observed shifts for a given carbon to changes in conformation or specific interactions.

400,579
PB85-143337 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
High Energy Forward Elastic Scattering of Electrons: Born Amplitudes for a Pseudostate Model of Atomic Hydrogen.
 Final rept.,
 S. Geltman, and R. K. Nesbet. 1984, 7p
 Grant NSF-PHY82-00805
 Pub. in *Physical Review A: General Physics* 30, n4, p1636-1642 1984.

Keywords: *Electron scattering, Elastic scattering, Ground state, Polarization, Reprints, *Hydrogen atoms, *Electron-atom collisions, KeV range 10-100.

Exact second Born elastic scattering amplitudes are computed for a dipole excitation pseudostate model of electron scattering by ground state atomic hydrogen. Calculations at 15, 25, and 35 keV incident energy show a forward peak in the differential elastic cross section. The optical theorem is exactly satisfied by these calculations, and the magnitude of the forward peak is determined primarily by physical values of the atomic static polarizability and oscillator strength. In the energy range considered, the computed peak is smaller by a large factor than the magnitude required to interpret recently observed experimental data in terms of single elastic collisions of electrons with ground state atoms.

400,580
PB85-143386 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Unified Treatment of Radiative and Dielectronic Recombination.
 Final rept.,
 G. Alber, J. Cooper, and A. R. P. Rau. Nov 84, 4p
 Grants NSF-PHY82-00805, NSF-PHY81-20234
 Pub. in *Physical Review A: General Physics* 30, n5 p2845-2848 Nov 84.

Keywords: Comparison, Experimental design, Reprints, *Autoionization, *Electron ion interactions, *Dielectronic recombination.

A coupled channel analysis of electron-positive ion recombination is carried out, with full treatment of the

coupling between radiation and autoionization continua. The cross section for this process reduces in the appropriate limits to the expressions for radiative and dielectronic recombination. The coupling to the radiation continuum leads to a modified Fano profile for the autoionizing resonances. The more complete, combined expressions derived here may be of interest for recent experimental studies of recombination and their comparison with theory.

400,581
PB85-143402 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Registration/Identification of Crystalline Materials Based on Lattice and Empirical Formula.
 Final rept.,
 J. R. Rodgers, and A. D. Mighell. 1981, 6p
 Pub. in *Jnl. of Chemical Information and Computer Sciences* 21, n1 p42-47 Feb 81.

Keywords: *X ray diffraction, *Crystal lattices, Chemical analysis, Information systems, Organic compounds, Reprints, *Empirical formulas, Registration, Computer applications.

Data files containing information on solid state materials are rapidly expanding. Each year, for example, several thousand new materials are characterized by x-ray diffraction. Consequently, it has become necessary to develop computer techniques to register materials entering large data bases of solid state materials. We have found that registration based on lattice parameters and empirical formula is especially effective. In our present registration procedure, the lattice is uniquely represented by the reduced cell and the elements in the formula are uniquely specified by prime numbers. Such a method has been applied for several years to register new materials entering the Cambridge Crystallography Data File and is currently being adapted to register materials entering the NBS Crystal Data File. The Cambridge File contains data on over 25,000 carbon containing compounds. For these materials, we have found that the lattice/formula registration is extremely effective. In fact, the authors experience shows that it would be highly desirable if organic materials were routinely characterized by cell parameters in addition to the traditional chemical analysis. A solid-state registry number which would allow one to identify the same compound in different data bases could also be based on lattice/formula. Such a number would allow one to distinguish polymorphs and different phases of the same composition.

400,582
PB85-143436 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Determination of the Aqueous Solubilities of Organic Liquids at 10.0 C, 20.0 C, and 30.0 C by Elution Chromatography.
 Final rept.,
 F. P. Schwarz, and J. Miller. 1980, 3p
 Pub. in *Analytical Chemistry* 52, n13 p2162-2164 1980.

Keywords: *Solubility, *Organic compounds, Toluene, Chlorobenzenes, Reprints, *Elution chromatography, Ethane/trichloro, Ethane/tetrachloro, Phthalic acid/(dibutyl-ester), Benzene/ethyl, Benzene/dichloro.

The elution chromatography method was used to determine the aqueous solubilities of toluene, chlorobenzene, m-dichlorobenzene, diethylphthalate, dibutylphthalate, 1,1,1 trichloroethane, and 1,1,2,2 tetrachloroethane at 10.0, 20.0 and 30.0C and the aqueous solubilities of ethylbenzene and o-dichlorobenzene at 20.0 and 30.0C. The aqueous solubility determinations of the family of benzene derivatives were compared to their solubilities determined by UV absorption measurements on the solution phase. Fifteen of the nineteen benzene solubilities determined by elution chromatography agreed to within an experimental error of 4% with the solubilities determined by the UV absorption method. The experimental error of the aqueous solubilities of the chloroethane derivatives was 2%. The solubilities ranged from 0.0011 wt% for dibutylphthalate at 20.0C to 0.385 wt% for 1,1,2,2 tetrachloroethane at 20.0C.

400,583
PB85-143501 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Fluorescence and Photofragmentation of Liquid Saturated-Hydrocarbons at Energies above the Photo-Ionization Threshold.
 Final rept.,
 F. P. Schwarz, D. Smith, S. G. Lias, and P. A. Ausloos. 1981, 9p
 Pub. in *Jnl. of Chemical Physics* 75, n8 p3800-3808 1981.

Keywords: *Fluorescence, *Alkanes, *Photoionization, Excitation, Photolysis, Reprints.

Fluorescence quantum yields, ϕ (sub F), are reported for liquid alkanes and cycloalkanes excited below and above the photoionization threshold. The quantum yields of fluorescence obtained in the subionization region are in excellent agreement with those reported by Lipsky and colleagues. In the photoionization region, the emission quantum yield is seen to decrease continuously from 8 to 11.6 eV. Measurements carried out in the presence of an electron scavenger, SF₆, show that in the photoionization region, emission occurs both from charge recombination processes and deactivation of the superexcited molecule to the vibrationally relaxed singlet state. The presence of these two populations of fluorescing species above the ionization threshold is manifested in differences in the slopes of plots of ϕ (sub F) as a function of energy above and below the ionization onset. Photofragmentation being the only non-radiative channel in the case of saturated hydrocarbons, the modes of fragmentation have been examined for selected hydrocarbons, as a function of energy. It is noted that the two main dissociative processes H and H₂ elimination, show a continuous variation with photon energy, following the trends in the fluorescence quantum yields at these energies. At the highest energy covered in this study (11.6 eV) H atom detachment from the superexcited molecule predominates over all other processes.

400,584
PB85-143568 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Direct Measurement of Fine Structure in the Ground State of Atomic Carbon by Laser Magnetic Resonance.
 Final rept.,
 R. J. Saykally, and K. M. Evenson. 1980, 5p
 Pub. in *Astrophysical Jnl., Letters to the Editor* 238, n2 p107-111, 1 Jun 80.

Keywords: *Atomic energy levels, *Carbon, Interstellar matter, Performance evaluation, Atoms, Sources, Reprints, *Fine structure, *Carbon atoms, *Laser magnetic resonance.

The fine-structure intervals in the ground 2 triplet P multiplet of (12)C(I) have been measured with high accuracy by laser magnetic resonance. These precise measurements have made possible the astronomical detection of far-infrared line emissions from (12)C atoms in several interstellar sources, as reported in another paper in this Journal.

400,585
PB85-143576 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Structure of Diammonium Tricalcium Bis(pyrophosphate) Hexahydrate.
 Final rept.,
 S. Takagi, M. Mathew, and W. E. Brown. 1980, 4p
 Sponsored by American Dental Association Health Foundation, Chicago, IL.
 Pub. in *Acta Crystallographica, Section B: Structural Crystallography and Crystal Chemistry* 36, p2526-2529 1980.

Keywords: *Crystal structure, *Calcium phosphates, Ions, Calcium inorganic compounds, Reprints, *Diammonium tricalcium bis(pyrophosphate).

Ca₃(NH₄)₂(P₂O₇):6H₂O crystallizes in the monoclinic space group P2 (sub 1)/n with a = 7.674(1), b = 11.455(2), c = 11.014(2)Å, beta = 92.44(5) and Z = 2 at room temperature. The structure was refined to R(F) = 0.059, R (sub W) = 0.057 for 2179 reflections with F (sub 0) > 3 sigma F (sub 0).

400,586

PB85-143626 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Role of Angular Momentum for Atomic Scattering
in Intense Laser Fields.**

Final rept.,
P. S. Julienne, and F. H. Mies. 1982, 4p
Pub. in Physical Review A 25, n6 p3399-3402 Jun 82.

Keywords: *Inelastic scattering, *Angular momentum,
Quantum mechanics, Reprints, *Atom interactions,
*Laser applications.

The authors have used nonperturbative quantum mechanical close coupled scattering calculations to investigate inelastic atomic collisions induced by strong laser fields. If a partial wave expansion in total angular momentum states is used for the scattering wavefunction, the selection rule $\Delta J = +$ or -1 for the radiative interaction matrix elements results in an infinite set of close coupled equations. Model calculations for the total laser-induced inelastic cross section for beam and homogeneous gas experiments are carried out for two (1 sup) sigma states coupled by linearly polarized light.

400,587

PB85-143642 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Diode Laser Heterodyne Spectroscopy on the Nu1
Band of Sulfur Dioxide.**

Final rept.,
J. P. Sattler, T. L. Worchesky, and W. J. Lafferty.
1981, 8p
Pub. in Jnl. of Molecular Spectroscopy 88, n2 p364-371 Aug 81.

Keywords: *Sulfur dioxide, *Infrared spectroscopy,
Reprints, *Laser spectroscopy.

Diode laser heterodyne techniques have been used to obtain the frequencies of 55 IR absorption lines of (32)S (16)O₂. From these data and from previous microwave and millimeter wave measurements, new spectroscopic constants for the nu 1 band have been determined. The new constants have been used to predict new optically pumped submillimeter wave emissions.

400,588

PB85-143857 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Melting Temperature of Nickel by a Pulse Heating
Technique.**

Final rept.,
A. Cezairliyan, and A. P. Miller. 1984, 6p
Pub. in Int. J. Thermophys. 5, n3 p315-320 1984.

Keywords: *Nickel, *Melting, Measurement, Reprints,
High temperature.

The melting temperature of 99.98 + % pure nickel was measured by means of a subsecond duration pulse heating technique. The results, based on IPTS-68, yield a value of 1729 K for the melting temperature with an estimated maximum uncertainty of + or - 4 K.

400,589

PB85-143865 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Predicted Wavelengths and Transition Rates for
Magnetic Dipole Transitions within 3 doublet s
3p(sup n) Ground Configurations of Ionized Cu to
Mo.**

Final rept.,
J. Sugar, and V. Kaufman. Apr 84, 6p
Pub. in Jnl. of the Optical Society of America B1, n2
p218-223 Apr 84.

Keywords: *Magnetic dipoles, *Ionization, *Wave-
lengths, Atomic energy levels, Hartree-Fock approxi-
mation, Excitation, Reprints, *Copper ions, *Molybde-
num ions.

Scaled Hartree-Fock radial integrals for the electrostatic parameter (F(sup2)) and the spin-orbit parameter (Zeta(sub p)) and empirical values for the effective far configuration interaction parameter alpha were used in calculating the energy levels of the 3 doublet S 3p(sup n) configurations of ions of copper through molybdenum in the Al, Si, P, S, and Cl isoelectronic sequences. The scale factors were obtained from the trend of fitted values derived from known energy levels of potassium through nickel and known magnetic-dipole lines from copper to molybdenum. The estimat-

ed uncertainty for the transition energies varies from + or - 200/cm for Cu to + or - 1000/cm for Mo. Wave functions generated with the scaled integrals were used to calculate magnetic-dipole transition rates between the calculated energy levels.

400,590

PB85-143873 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Reference Lines for Dye Laser Wavelength Cali-
bration in the Optogalvanic Spectra of Uranium
and Thorium.**

Final rept.,
C. Sansonetti, and K. H. Weber. Jun 84, 5p
Pub. in Jnl. of the Optical Society of America B1, n3
p361-365 Jun 84.

Keywords: *Uranium, *Thorium, *Line spectra, Cali-
brating, Reprints, *Optogalvanic spectroscopy, *Laser
spectroscopy, Fourier transform spectroscopy.

The optogalvanic spectra of uranium and thorium observed in commercial hollow-cathode lamps provide convenient lines for dye-laser wave-number calibration. The authors describe a simple procedure by which a single-frequency cw dye laser can be set on such lines with an accuracy of a few parts in 10 to the 8th power. They report wave numbers for 16 U and 16 Th lines distributed over the wavelength range 5750-6920 A. The estimated uncertainty of the measurements is 0.0003/cm for U and 0.0004/cm for Th. The results are compared with previous U and Th measurements and are found to be in good agreement with recently reported emission wave numbers determined by Fourier spectroscopy.

400,591

PB85-143881 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Vibrational Predissociation, Tunneling and Rota-
tional Saturation in the HF and DF Dimers.**

Final rept.,
A. S. Pine, W. J. Lafferty, and B. J. Howard. 1 Oct
84, 12p
Pub. in Jnl. of Chemical Physics 81, n7 p2939-2950, 1
Oct 84.

Keywords: *Hydrogen fluoride, *Deuterium com-
pounds, *Molecular vibration, *Molecular rotation,
Chemical bonds, Reprints.

The high-resolution spectra of the intramolecular stretching bands of the HF and DF dimers have been recorded with a tunable difference-frequency laser. These measurements yield considerable information about the dynamics of hydrogen bonding in these complexes. Vibrational predissociation is observed as a non-pressure-dependent excess linewidth for the 'bound-H' stretching band of the HF dimer, but no excess linewidth is observed for the 'free-H' stretching band of the HF dimer or for either band of the DF dimer. An unusually large vibrational dependence to the interconversion tunneling frequency is observed for both species, with about a factor of three reduction from the ground state splitting upon excitation of any of the intramolecular stretches. The K subband origins obtained from the A/B hybrid 'free-H' stretching band of the HF dimer exhibit an irregular pattern indicating anomalous centrifugal distortion effects suggestive of rotational saturation of the angular orientation of the hydrogen bond.

400,592

PB85-143899 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Wetting, Multilayer Adsorption, and Interface
Phase Transitions.**

Final rept.,
M. R. Moldover, and J. W. Schmidt. 1984, 9p
Pub. in Physica 12D, p351-359 1984.

Keywords: *Phase transformations, *Adsorption, *Critical point, *Liquid phases, *Wetting, Interfaces, Fluids,
Reprints.

When two fluid phases coexist near their mutual critical point one fluid phase forms a layer which intrudes between the other fluid phase and any third phase that happens to be present. As the two fluid phases are taken away from their critical point a phase transition often occurs such that the intruding layer vanishes. The authors present recent evidence that the transition from the complete wetting (intruding layer) configuration to the incomplete wetting (three-phase contact) configuration is a first-order phase transition. The thickness of the intruding layers has been measured

for diverse systems. These data are not fully understood. The intruding layers are extreme examples of multilayer adsorption. Certain theories predict that a 'prewetting' transition from high adsorption to low adsorption is associated with the transition from complete wetting to incomplete wetting. Their search for this transition is inconclusive.

400,593

PB85-143915 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Amino Acid Analysis of Angiotensin I by Proton
Nuclear Magnetic Resonance Spectroscopy.**

Final rept.,
S. A. Margolis, and B. Coxon. 1984, 6p
Pub. in Analytical Biochemistry 141, p355-360 1984.

Keywords: *Amino acids, *Chemical analysis, *Angio-
tensin, Nuclear magnetic resonance, Hormones, Re-
prints, *Chemical shifts(Nuclear magnetic resonance).

The chemical shifts of the isoleucine and histidine protons of angiotensin I were assigned and the chemical shifts of the protons of the other amino acids in this peptide were confirmed at a field strength of 400 MHz. These chemical shift assignments were used to determine the amino acid composition of angiotensin I. These data were then compared to the amino acid composition which was determined by chromatographic analysis of the peptide hydrolysate. The results obtained by the chromatographic method were similar to those obtained by the NMR method. The standard deviations of the results were similar, indicating that these methods are equally precise. The major advantages of the NMR method are that it permits the recovery of the peptide after completion of the analysis and improves the quantitation of amino acids which are either partially destroyed by the hydrolysis procedure or require special derivatization methods for detection and quantitation.

400,594

PB85-143931 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Kinetics Investigation of the Gas-Phase Reactions
of Cl(doublet P) and OH(X(sup 2)/pi) with CH3CN:
Atmospheric Significance and Evidence for De-
creased Reactivity between Strong Electrophiles.**

Final rept.,
M. J. Kurylo, and G. L. Knable. 19 Jul 84, 4p
Pub. in Jnl. of Physical Chemistry 88, n15 p3305-3308,
19 Jul 84.

Keywords: *Reaction kinetics, *Electrophilic reactions,
*Vapor phases, Coulomb interactions, Fluorescence,
Photolysis, Reprints, *Chlorine atoms, *Hydroxyl radi-
cals.

The kinetics of the reactions of Cl(doublet P) and OH(X(sup 2)pi) with acetonitrile (CH₃CN) in the gas phase were investigated by the flash photolysis resonance fluorescence technique. The low preexponential factor for the OH reaction as well as the low reactivity of Cl are discussed in terms of coulombic interactions between the attacking free radical and the electrophilic substituent on methane. Changes in reactivity for OH and Cl in the reactant sequence CH₃OH, CH₃Cl, and CH₃CN indicate inadequacies in our current predictive abilities for reaction rate parameters. The atmospheric significance of the present results for acetonitrile is also discussed.

400,595

PB85-143949 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Rydberg Series 5p(sup 6) 6snd in the Autoionizing
Continua of Neutral Cesium.**

Final rept.,
V. Kaufman, J. Sugar, C. W. Clark, and W. T. Hill.
Nov 83, 5p
Pub. in Physical Review A: General Physics 28, n5
p2876-2880 Nov 83.

Keywords: *Cesium, *Absorption spectra, Compari-
son, Reprints, *Autoionization, *Rydberg series.

An absorption spectrum of neutral cesium between the 5p(sup 5)(doublet P_{3/2})6s and 5p(sup 5)(doublet P_{1/2})6s thresholds was observed in the range of 650-700 A with the National Bureau of Standards 10.7-m grazing-incidence spectrophotometer. Rydberg series 5p(sup 5)6sns and 5p(sup 5)6snd approaching both upper threshold states (doublet P(sup 1/2)6s, J = 0,1 were identified on the basis of quantum-defect comparisons

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

and Hartree-Fock term energies. Distinctive nd line shapes are compared with those of neutral xenon.

400,596
PB85-143956 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Ag I-like Array 4d sup 10 5s-4d sup 9 5s5p of I VII through Eu XVII.
Final rept.,
V. Kaufman, and J. Sugar. Mar 84, 3p
Pub. in Jnl. of the Optical Society of America B1, p38-40 Mar 84.

Keywords: *Iodine, *Xenon, *Atomic energy levels, Hartree-Fock approximation, Reprints, *Isoelectronic sequence.

The spectra were produced with a high-voltage spark discharge and photographed with the National Bureau of Standards' 10.7-m grazing-incidence spectrograph. The Ag I-like transition array 4d sup 10 5s-4d sup 9 5s5p was first identified by comparison with the analogous array in the Cu I isoelectronic sequence, then by comparison with a calculated spectrum. The latter was obtained with scaled Hartree-Fock radial energy integrals. The array has been observed most completely in I VII and Xe VIII and, with decreasing strength, to higher sequence members. In Sm XVI and Eu XVII only the strongest line was found. The energy levels and the fitted parameter values for I VII and Xe VIII are given.

400,597
PB85-143972 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Evidence for Molecular Reorientations on a Surface: Coadsorption of CO and Na on Ru(001).
Final rept.,
F. P. Netzer, D. L. Doering, and T. E. Madey. 1984, 8p
Pub. in Surface Science 143, pL363-L370 1984.

Keywords: *Surface chemistry, *Carbon monoxide, *Sodium, Chemisorption, Reprints, *Electron stimulated desorption, *Molecular configuration.

Evidence is presented for a local interaction between CO and Na adsorbed on Ru(001). For low coverages of Na ($\theta_{\text{Na}} < 0.15$ ML) and saturation coverages of CO at 80 K, a fraction of the CO molecules undergo a substantial change in bonding configuration: molecular CO bound perpendicular to the Ru(001) surface changes to an 'inclined' configuration in the presence of low coverages of Na.

400,598
PB85-143980 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Influence of the Image Interaction on Ion Desorption Processes.
Final rept.,
Z. Miskovic, J. Vukanic, and T. E. Madey. 1984, 16p
Pub. in Surface Science 141, p285-300 1984.

Keywords: *Desorption, *Surfaces, Particle trajectories, Electrons, Ions, Reprints, Ion scattering, Ion trajectories.

A classical treatment of the interaction between an ion and a conducting surface during an ion desorption process is presented. Analytical expressions have been obtained for the trajectories of desorbing ions as well as for the trajectories of ions trapped by the image potential. The distortion by the image potential of a general form of the energy and angular distribution of desorbing ions is estimated. The authors' objective has been to provide a guide for experimentalists to the surprisingly large changes in such distributions caused by the image forces.

400,599
PB85-144004 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Threshold Photoelectron-Photoion Coincidence Spectrometric Study of Dimethylether (CH₃OCH₃).
Final rept.,
J. J. Butler, D. M. P. Holland, A. C. Parr, and R. Stockbauer. 1984, 15p
Pub. in International Jnl. of Mass Spectrometry and Ion Physics 58, p1-14 1984.

Keywords: *Cations, *Photoionization, *Photoelectrons, Heat of formation, Ions, Spectroscopic analysis, Reprints, *Ether/dimethyl, *Autoionization.

The technique of threshold photoelectron-photoion coincidence spectroscopy has been used to study the

dissociation of state-selected dimethylether (CH₃OCH₃)⁺ cations. The crossover region (10.5-11.5 eV) of the breakdown curve for the lowest energy dissociation (CH₃OCH₃(+1) yields CH₃OCH₂(+1) + H has been recorded using threshold photoelectron-photoion coincidence with variable ion residence time.

400,600
PB85-144384 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Low Temperature Plasma-Enhanced Epitaxy of GaAs.
Final rept.,
K. P. Pande, and A. C. Seabaugh. Jun 84, 3p
Pub. in Jnl. of the Electrochemical Society 131, n6 p1357-1359 Jun 84.

Keywords: *Low temperature tests, *Gallium arsenides, *Epitaxy, Plasmas(Physics), Deposition, Reprints, *Chemical vapor deposition.

Low-temperature (<450C) deposition of single crystal GaAs using a new plasma-enhanced MO-CVD technique is reported. In this technique, plasma is created by a dc potential and the substrate is not directly exposed to the plasma. Deposition of GaAs was achieved at extremely low plasma power (<5 W) using trimethylgallium (TMGa) and arsine (or trimethylarsenic) reactants. The resulting epitaxial films show excellent surface morphology and thickness uniformity over a large area substrate. Measurements on Schottky barrier devices fabricated on n/n+ layers show uniform impurity doping profiles. Temperature dependence of the diode capacitance indicates a density of deep trapping centers as low as 6.2 x 10 to the 13th power/cc.

400,601
PB85-144459 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Adsorption of Polystyrene on Thermally Oxidized Silicon.
Final rept.,
J. A. Hinkley. Apr 84, 2p
Pub. in Polymer Preprints, American Chemical Society, Division of Polymer Chemistry 25, n1 p178-179 Apr 84.

Keywords: *Polystyrene, *Adsorption, *Surface chemistry, Silicon, Oxidation, Ellipsometry, Reprints, Molecular conformation.

Ellipsometry was used to observe the adsorption, from theta solvents, of polystyrene on thermally oxidized silicon. Since no adsorption was seen with a polar solvent, it is concluded that specific acid-base interactions are decisive in adsorption. At high surface coverages, the present results agree with those on various metal surfaces, and the root mean square extension of polymer coils from the surface is almost twice the radius of gyration of a chain in solution.

400,602
PB85-144863 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Flexibility of the Framework of Zeolite Rho. Structure Variation from 11 to 573 K. A Study Using Neutron Powder Diffraction Data.
Final rept.,
J. B. Parise, L. Abrams, T. E. Gier, D. R. Corbin, and J. D. Jorgensen. 1984, 5p
Pub. in Jnl. of Physical Chemistry 88, p2303-2307 1984.

Keywords: *Neutron diffraction, *Crystal structure, *Ion exchange resins, X ray diffraction, Reprints, *Rietveld refinement technique, *Zeolite Rho.

The structure of the dehydrated and deuterium-exchanged form of deammoniated zeolite Rho (Cs_{1.15}(SiAl)₄₈O₉₆D) has been studied at 11, 295, 423, and 573 K. All data sets were refined by using the Rietveld refinement technique in the noncentrosymmetric space group I43m and are characterized by the presence of elliptically distorted double 8-rings. In agreement with a previous study of the effects of hydration upon the framework, increase in temperature causes a monotonic increase in the cubic-unit-cell parameter (a sup 0) and a corresponding decrease in delta, the parameter describing the 'degree of ellipticity' as measured by the difference between the major and minor axes of the 8-ring ellipses. The variations of both delta and a sup 0 with temperature in the range 11 < T < 573 K appear to fall close to smooth curves. Extrapolation of these curves suggests that the structure may be centrosymmetric above 800 K. This prediction is supported by a study of the changes in the X-

ray diffraction pattern of deammoniated Rho up to 773 K.

400,603
PB85-144871 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Refinement of the Structure of Trilanthanum Trichlorohexaoxotungstate, La₃WO₆Cl₃, from Neutron Powder Diffraction Data.
Final rept.,
J. B. Parise, L. H. Brixner, and E. Prince. 1983, 3p
Pub. in Acta Crystallographica C39, p1326-1328 1983.

Keywords: *Neutron diffraction, *X ray analysis, *Molecular structure, Chemical bonds, Reprints, *Lanthanum trichlorotungstate.

M(sup r) = 802.9, P6(sup 3)/m, a = 9.4092(2), c = 5.4276(2) A, V = 416.15(2) Cu A, Z = 2, high-resolution neutron powder diffraction data (lambda = 1.5416(3) A, T = 295K), collected from 10 to 122 degrees in 2 theta with 0.05 step size; final weighted profile R = 9.6% was compared to an expected R(sup E) = 7.41% (conventional R based on integrated intensities = 6.00%). The refinement confirms the unusual trigonal prismatic coordination found for the WO6 group in the X-ray study (Brixner, Chen & Foris (1982). J. Solid State Chem. 44, 99-107). The W-O and La-Cl bond lengths determined in this study are slightly shorter, by 0.006 (2)-0.014(4) A, than those found in the X-ray determination.

400,604
PB85-144889 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Electron Emission and Ion Desorption Spectroscopy of Clean and Oxidized Ti(0001).
Final rept.,
E. Bertel, R. Stockbauer, and T. E. Madey. 1984, 33p
See also AD-A141 319.
Pub. in Surface Science 141, p355-387 1984.

Keywords: *Titanium, *Surfaces, Hexagonal lattices, Synchrotron radiation, Oxidation, Reprints, *Electronic structure, Photoemission, Electron energy loss spectroscopy, Auger electron spectroscopy, Electron stimulated desorption.

The electronic structure of Ti(0001) has been investigated using energy loss spectroscopy (ELS), Auger electron spectroscopy (AES), UPS (ultraviolet photoemission spectroscopy) and electron stimulated desorption (ESD). Resonant electron emission due to a direct recombination process involving an atomic 3p-3d interaction has been observed. Surface oxidation results in the formation of a thin protective TiO₂ layer which is stable to 250C. In the oxide, the direct recombination process following 3p excitation gives rise to resonantly enhanced emission from the oxide valence band. The cross section for electron stimulated O(+) desorption is shown to be dominated by these atomic resonance effects as well.

400,605
PB85-144897 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Production Rates for Discharge Generated SOF₂, SO₂F₂, and SO₂ in SF₆ and SF₆/H₂O Mixtures.
Final rept.,
R. J. Van Brunt, W. E. Anderson, and T. C. Lazo. 1984, 10p
Sponsored by Department of Energy, Washington, DC. Div. of Electric Energy Systems.
Pub. in Proceedings of International Symposium on Gaseous Dielectrics (4th), Knoxville, TN., April 29-May 3, 1984, p276-285.

Keywords: *Sulfur dioxide, *Gas analysis, *Electric corona, Sulfur hexafluoride, Mixtures, Chemical equilibrium, Concentration(Composition), *Tracer techniques, *Fluoride/sulfuryl, *Fluoride/thionyl.

Production rates for SOF₂, SO₂F₂, and SO₂ have been measured by quantitative gas analysis during continuous corona discharges in compressed SF₆ containing trace levels (10 to 200 ppm) of water vapor for total gas pressures between 100 and 300 kPa. The rates are expressed both in terms of moles-per-unit of energy dissipated in the discharge, and in moles-per-unit of charge transported in the gap. Variations in the absolute and relative concentrations of H₂O and SOF₄ respectively were also monitored. Determinations were made of the polarity, power, and pressure dependences of these rates. The time rates-of-production for SOF₂ and SO₂F₂ are more nearly propor-

tional to the discharge current than to the power dissipation. The results indicate that the equilibrium concentration of H₂O is significantly affected by the discharge. The influence of O₂ and H₂O on oxyfluoride production is discussed.

400,606

PB85-145191 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Aqueous Solubility and Octanol/Water Partition Coefficient of Organic Compounds at 25.0 C.
Final rept.,
Y. B. Tewari, M. M. Miller, S. P. Wasik, and D. E. Martire. 1982, 4p
Pub. in Jnl. of Chemical and Engineering Data 27, n4 p451-454 1982.

Keywords: *Organic compounds, *Solubility, *Thermodynamics, Temperature, Gas chromatography, Reprints, *Activity coefficients, *Octanol, High pressure liquid chromatography.

Aqueous solubilities (C(sub s)(sup w)) and octanol/water partition coefficients (K(sub o/w)) of 62 organic solutes, falling into 7 general chemical classes, have been systematically determined using the modified generator column method. From thermodynamics an equation is derived relating K(sub o/w) to the volume-fraction-based solute activity coefficient in water (gamma(sub s)(sup w)), the latter being determinable from C(sub s). For each class of compounds, excellent linear correlations are found between log C(sub o/w) and log gamma (sub s)(sup w), with slopes close to the theoretical value of unity.

400,607

PB85-145290 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Distribution of Straight-Chain Lengths in Unannealed and Annealed Solution-Crystallized Polyethylene by Raman Spectroscopy.
Final rept.,
R. G. Snyder, J. R. Scherer, D. H. Reneker, and J. P. Colson. 1982, 9p
Pub. in Polymer 23, n9 p1286-1294 Aug 82.

Keywords: *Raman spectroscopy, *Polyethylene, Crystallization, Sampling, Solutions, Reprints, *Polymer chains.

The effect of annealing on the morphology of solution-crystallized polyethylene had been studied by analyzing the shape of the low-frequency Raman LAM-1 band. The distributions of lengths of straight-chain segments have been determined for samples annealed at different temperatures. Unannealed samples, which have distribution peaks L(max) near 100 Å, have halfwidths delta L(sub 1/2) less than 20 Å. However, this narrow distribution is drastically broadened when the sample is annealed. The broadening is less if the breadth of the distribution of the unannealed sample is initially less. For equilibrium crystallized samples, the observed halfwidth and peak position of LAM-1 are related. This relation can be understood quantitatively if it is assumed that delta L(sub 1/2) and 1/L(sub max) are linearly related as is indeed found to be the case for solution-crystallized samples. As L(max) becomes very large, delta L(sub 1/2) approaches a limiting value near 300 Å.

400,608

PB85-145308 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
NBS (National Bureau of Standards): Current Work and Future Plans in Reference Materials.
Final rept.,
S. D. Rasberry. 1982, 3p
Pub. in Analytical Proceedings 19, n1 p5-7 1982.

Keywords: *Chemistry, Forecasting, Reprints, *Standard reference materials.

This paper is an extended abstract (1,000-word summary) of a talk presented to the Royal Society of Chemistry in London on 4 February 1981. It describes the status of the NBS program in Standard Reference Materials and indicates the directions planned for the program over the next five years.

400,609

PB85-145373 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Aqueous Solubilities and Octanol-Water Partition Coefficients of Binary-Liquid Mixtures of Organic Compounds at 25 C.
Final rept.,
Y. B. Tewari, D. E. Martire, S. P. Wasik, and M. M. Miller. 1982, 11p
Pub. in Jnl. of Solution Chemistry 11, n6 p435-445 1982.

Keywords: *Binary systems(Materials), *Liquid phases, *Solubility, Mixtures, Organic compounds, Solutions, Experimental design, Hexane, Chloroform, Nitrobenzenes, Thermodynamics, Reprints, *Activity coefficients, Benzene/propyl, Benzene/ethyl, Ether/isopropyl, Benzene/nitro.

From thermodynamics it is shown that, under the usual experimental conditions, the octanol-water partition coefficient (K(sub o/w)) of a given organic liquid should be the same whether the substance is partitioned by itself or as part of a mixture.

400,610

PB85-145399 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Corrosion Phenomena for Iron Covered with a Cellulose Nitrate Coating.
Final rept.,
J. J. Ritter, and M. J. Rodriguez. 1982, 4p
Pub. in Corrosion 38, n4 p223-226 Apr 82.

Keywords: *Corrosion, *Protective coatings, *Organic coatings, *Cellulose nitrate, Electrochemistry, Ellipsometry, pH, Reprints.

The corrosion of metals protected by organic coatings is an incompletely understood phenomenon. Recent investigations by an in situ ellipsometric-electrochemical technique combined with microanalytical studies have provided new insights into the destructive processes. Events such as the roughening of the metal surface, chloride ion accumulation and the thickening of the surface oxide have been detected under the coating and are interpreted in terms of the chemistry which develops between the microenvironment and the substrate.

400,611

PB85-145431 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Stochastic Defect Diffusion Model for Relaxation Effects in Crystalline Polyethylene.
Final rept.,
D. H. Reneker, and J. Mazur. 1982, 12p
Pub. in Polymer 23, n3 p401-412 Mar 82.

Keywords: *Polyethylene, *Mathematical models, *Diffusion, *Crystal defects, *Molecular relaxation, Reprints.

It is suggested that some relaxation processes observed in crystalline polyethylene are consequences of the diffusive motion of a particular defect called a point dislocation or twist dispiration loop along the polyethylene stems in lamellar crystals. The motion of the defect, characterized by a diffusion coefficient and a mobility, is described by solutions of the Smoluchowski diffusion equation with boundary conditions that constrain the defect to move along routes that produce experimentally observable results. The fact that passage of the defect causes both a 180 rotation of the chain and moves an extra CH₂ group in the direction of the chain axis is important to the interpretation of the data according to this model. The diffusion coefficient for a defect is estimated to be around 5 x 10 to the -9th power sq cm/s. This value is shown to be reasonable both from the viewpoint of detailed computer modeling of defect motion and contemporary ideas about scaling.

400,612

PB85-145464 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Total and Partial Electron Collisional Ionization Cross Sections for CH₄, C₂H₆, SiH₄ and Si₂H₆.
Final rept.,
H. Chatham, D. Hils, R. Robertson, and A. Gallagher. Aug 84, 8p
Sponsored by Solar Energy Research Inst., Golden, CO.
Pub. in Jnl. of Chemical Physics 81, n4 p1770-1777 Aug 84.

Keywords: *Ionization, *Methane, *Ethane, *Silane, *Disilane, Comparison, Reprints, *Electron molecule interactions.

The total and partial electron collisional ionization cross sections for CH₄, C₂H₆, SiH₄ and Si₂H₆ have been measured for electron energies from threshold to 300 eV. Comparisons are made to earlier measurements.

400,613

PB85-145480 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Shear Viscosity Coefficients of Nitrogen + Methane and Methane + Ethane Mixtures.
Final rept.,
D. E. Diller. Nov 83, 5p
Pub. in American Society of Mechanical Engineers Paper No. 83-WA/HT-49, 5p Nov 83.

Keywords: *Binary systems(Materials), *Viscosity, *Shear tests, *Nitrogen, *Methane, *Ethane, Mixtures, Temperatures, Pressures, Density(Mass/volume), Reprints.

The shear viscosity coefficients of compressed gaseous and liquid nitrogen + methane and methane + ethane mixtures have been measured with a torsional crystal viscometer at three fixed compositions (each) and throughout a large range of temperatures (100-300 K), pressures (0.5-30 MPa) and densities (0.1-3 pc). This PVT range includes states near liquid-vapor equilibrium, states near liquid-solid equilibrium and states near the critical region. The measured dependences of the viscosities on density, temperature and composition are compared with an extended corresponding states model.

400,614

PB85-145506 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Calculations for Separations with Three Phases. 2. Continuous Contact Systems.
Final rept.,
P. C. Wankat, and R. D. Noble. 1984, 7p
Pub. in Industrial and Engineering Chemistry Fundamentals 23, n2 p137-143 1984.

Keywords: *Phase measurement, Separations, Membranes, Extraction, Steam distillation, Graphs(Charts), Reprints, *Phase equilibrium.

General graphical solution methods for continuous contact separations with two cocurrent streams flowing countercurrent to the third stream are developed. Applications include liquid membrane separations, slurry adsorption, three-phase extraction, and steam distillation. For two phases in equilibrium, and methods are simplified. For nonlinear equilibria two graphical techniques are developed. One method uses variable operating lines while the other method develops a pseudo-equilibrium curve. The analysis shows that the evaluation of NTU is independent of a series or parallel separation when two phases are in equilibrium. HTU does depend on the separation path.

400,615

PB85-145548 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Effect of Vibration-Rotation Interaction on the Quadrupole Hyperfine Structure of Molecular Rotational Levels.
Final rept.,
M. R. Aliev, and J. T. Hougen. 1984, 14p
Pub. in Jnl. of Molecular Spectroscopy 106, p110-123 1984.

Keywords: *Molecular rotation, *Hyperfine structure, *Quadrupole moments, Molecular vibration, Reprints.

Group 7D—Physical Chemistry

By using a contact transformation method similar to that commonly employed when determining higher-order corrections to the harmonic oscillator and rigid rotor energy levels of molecules, analogous centrifugal distortion and anharmonic corrections to the nuclear quadrupole coupling energies have been obtained for molecules containing one quadrupolar nucleus. The J , K dependence and v , l dependence of these higher-order corrections to the quadrupole hyperfine energies can be cast in a form which is remarkably similar to the form taken for ordinary vibrational and rotational energy corrections, a result which was not evident from earlier partial treatments of this general problem. Results are obtained here for asymmetric top, symmetric top, spherical top, and linear molecules.

400,616
PB85-145589 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Absolute Frequency Measurements of the 00(sup 0)2-00(sup 0)0, 20(sup 0)1-00(sup 0)0, and 12(sup 0)1-00(sup 0)0 Bands of N2O by Heterodyne Spectroscopy.
 Final rept.,
 C. R. Pollock, F. R. Petersen, D. A. Jennings, J. S. Wells, and A. G. Maki. 1984, 10p
 Pub. in *Jnl. of Molecular Spectroscopy* 107, p62-71 1984.

Keywords: *Nitrogen oxide(N2O), *Infrared spectroscopy, Absorption, Standards, Molecular vibration, Calibrating, Reprints, *Heterodyne spectroscopy.

The absolute frequency of 39 lines in the 00(sup 0)2-00(sup 0)0, 20(sup 0)1-00(sup 0)0, and 12(sup 0)1-00(sup 0)0 band of N2O in the 4300 - 4800/cm range have been measured through heterodyne frequency measurements. The lines were each measured in Doppler-limited absorption using a color center laser as a tunable probe of the N2O, and two stabilized CO2 lasers as reference frequencies. New ro-vibrational constants have been fitted to these measurements. Tables of calculated transition frequencies are given with estimated absolute uncertainties as small as .0001/cm. The pressure shift of four lines has been measured and the values fall within the range of 0 to -2 kHz/Pa (0 to -200 kHz/Torr).

400,617
PB85-145605 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Electrochemical Studies on Doping of Polyacetylene.
 Final rept.,
 C. K. Chiang, E. A. Blubaugh, and W. T. Yap. Aug 84, 5p
 Pub. in *Polymer* 25, p1112-1116 Aug 84.

Keywords: *Electrochemistry, *Additives, Reprints, *Polyacetylene, *Voltammetry.

The mechanism for electrochemical doping of polyacetylene was studied using cyclic voltammetry. The I-V curve of a thin (CH)_x film (<1 micrometer) electrode exhibited a redox peak with a formal redox potential of +0.63 V vs sodium SCE. Approximately 30% of the total charge that oxidized (CH)_x was not reversible when held at the open circuit voltage of the cell. A more negative potential was needed to recover the remaining charge. This large charge-trapping phenomenon was the consequence of the (CH)_x film being doped. Using a thick film electrode or freestanding film (about 0.1 mm) as an electrode, the I-V curve gave only a broad reduction peak at +0.4 V. The disappearance of the well-defined redox peak implies that the redox process revealed by the thin film data may not be the primary mechanism for the doping process.

400,618
PB85-145613 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Effective Potentials in Molecular Quantum Chemistry.
 Final rept.,
 M. Krauss, and W. J. Stevens. 1984, 29p
 Pub. in *Annual Review of Physical Chemistry* 35, p357-385 1984.

Keywords: *Quantum chemistry, *Molecular structure, *Potential energy, *Mathematical models, Reprints.

Model potentials and effective core potentials are impacting quantum chemistry by allowing accurate structure calculations to be performed for very large systems such as solid state systems, complex organic and biomolecules, and polymers. Relativistic effective

potentials have allowed, for the first time, systematic theoretical exploration of heavy atom chemistry. The most appealing aspect of these effective potential methods is that they are ab initio, and, therefore, like the all-electron methods they simulate, extensible to all atomic and molecular systems. The theoretical framework that underlies the determination of effective potentials is intuitively sound, but sometimes less than rigorous. This is especially true for the relativistic extensions which need to be examined much more carefully since direct comparisons with more rigorous all-electron results are difficult.

400,619
PB85-145621 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Collision Dynamics of Three Interacting Atoms: Model Calculations of H + H2 Resonances.
 Final rept.,
 A. C. Kuruoglu, and D. A. Micha. May 84, 15p
 Pub. in *Jnl. of Chemical Physics* 80, n9 p4262-4276 May 84.

Keywords: *Hydrogen, *Mathematical models, *Resonance scattering, Diatomic molecules, Reprints, *Atom atom interactions.

Collisions of H and H2 at thermal energies are studied within a three-body theory of atom-diatom rearrangement collisions. A previously developed general formalism based on a diabatic electronic representation is shown to be equivalent, for this system, to a treatment in terms of atomic spins. It further provides a novel approach to nuclear exchange symmetry. The interaction potential is parametrized by introducing a minimal valence-bond basis, and the collision dynamics is described with the Faddeev equations. These equations are reduced to two-body form, and are analyzed in terms of angular momentum components. A detailed description is given of the numerical procedure applied to the coupled integral equations that result from expanding in diatomic square integrable basis functions. Those equations are solved in momentum variables using quadrature techniques, and provide K-matrix elements.

400,620
PB85-147908 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Picosecond Vibrational Energy Relaxation of Surface Hydroxyl Groups on Colloidal Silica.
 Final rept.,
 E. J. Heilweil, M. P. Casassa, R. R. Cavanagh, and J. C. Stephenson. 15 Sep 84, 3p
 Pub. in *Jnl. of Chemical Physics* 81, n6 p2856-2858, 15 Sep 84.

Keywords: *Surface chemistry, *Molecular vibration, *Infrared spectroscopy, *Molecular relaxation, Chemisorption, Silicon dioxide, Atomic energy levels, Reprints, *Hydroxyl radicals.

The authors report the first time-resolved measurement of vibrational energy relaxation (T1) for a chemisorbed species. A picosecond infrared saturation and ground state recovery technique measured population decay of vibrationally excited hydroxyl groups bound to room temperature colloidal SiO2 dispersed in CCl4. The ground electronic state vibrational decay times correspond to twenty thousand vibrational periods.

400,621
PB85-148021 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Priority Toxic Pollutants in Human Urine: Their Occurrence and Analysis.
 Final rept.,
 A. J. Fatiadi. 1984, 31p
 See also PB83-225888.
 Pub. in *Environment International* 10, p175-205 1984.

Keywords: *Chemical compounds, *Pesticides, *Urine, *Chemical analysis, *Environmental surveys, Public health, Industrial wastes, Toxicity, Herbicides, Reprints, *Toxic substances.

This survey reviews and discusses the occurrence of priority pesticides and industrial chemicals in human urine. An overview of some recent analytical methodology for determination of selected toxic pollutants and their metabolites as they are found in human urine is also presented.

400,622

PB85-148039 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Development of Reference Materials for Acid Rain Research.
 Final rept.,
 W. F. Koch, G. Marinenko, and Y. C. Wu. 1984, 5p
 Pub. in *Environment International* 10, p117-121 1984.

Keywords: *Rain, *Air pollution, *Water analysis, Standards, Trace elements, Chemical analysis, Reprints, *Standard reference materials, *Acid rain, *Air pollution detection.

The Center for Analytical Chemistry of the National Bureau of Standards is actively engaged in research to provide the basis for quality assurance in chemical measurements of rain water. Several types of SRM's are currently available which have direct applicability to atmospheric deposition programs. In addition, research is proceeding to develop an SRM specifically for rain-water analyses. Initial attempts, using a single solution containing all the components of rain and stored in glass ampoules, were unsuccessful due to the chemical instability of the solution. Current efforts are directed to improving the stability by using polyethylene bottles to store the solutions, and by preparing two separate solutions, one for the major components of rain (sulfate, nitrate, chloride, sodium, potassium, calcium, magnesium, ammonium, and hydrogen ions), and the other for the trace metals. Preliminary results on the stability of a pilot set of simulated rainwater solutions are encouraging.

400,623
PB85-148062 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Vibrational Energy Disposal in Reactive and Inelastic Collisions of H(D) + HCl(DCl) at 1 to 3 eV.
 Final rept.,
 C. A. Wight, F. Magnotta, and S. R. Leone. 1 Nov 84, 7p
 Contract DAAG29-82-K-0031, Grant NSF-PHY82-00805
 Sponsored by Grant NSF-CHE79-11340.
 Pub. in *Jnl. of Chemical Physics* 81, n9 p3951-3957, 1 Nov 84.

Keywords: *Hydrogen chloride, *Deuterium compounds, *Molecular vibrations, *Inelastic scattering, Excitation, Infrared spectroscopy, Fluorescence, Reprints, *Atom molecule interactions, *Hydrogen atoms.

Vibrational energy disposal due to reactive exchange and unreactive translational-to-vibrational excitation in hyperthermal collisions of H + HCl and deuterated analogues is investigated by the excimer laser photolysis/infrared fluorescence technique. This is consistent with an interpretation that the inelastic T-V excitation pathway is predominant. No information is obtained on the H atom abstraction channel.

400,624
PB85-148070 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Pilot Environmental Specimen Bank Program.
 Final rept.,
 S. A. Wise, and R. Zeisler. Oct 84, 6p
 Pub. in *Environmental Science and Technology* 18, n10 p302A-307A 1984.

Keywords: *Environmental surveys, *Chemical analysis, Feasibility, Trace elements, Sampling, Pesticides, Samples, Cryogenic, Humans, Reprints.

Since 1980, the National Bureau of Standards has been involved in a pilot study to evaluate the feasibility of long-term environmental specimen banking as an important part of environmental monitoring. Human liver was selected as the first environmental sample type for the pilot program. Sampling, homogenization, and storage procedures, which were designed to avoid contamination of either trace inorganic or trace organic constituents, were developed and implemented. Analytical results are discussed for the determination of trace elements and organochlorine pesticide residues in samples collected during the first three years of this program.

400,625
PB85-148088 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Dependence of the Phase Diagram on the Coupling Parameters in Water-Lattice Models.
 Final rept.,
 E. Van Royen, and P. H. E. Meijer. 1984, 26p
 Pub. in *Physica* 127A, p87-112 1984.

Keywords: *Phase diagrams, *Mathematical models, *Water, *Crystal lattices, Chemical bonds, Ice, Reprints.

This paper reports specific results obtained with the two previously proposed lattice models of water as based on the cluster variation method. The hydrogen-bonded lattice gas with next nearest neighbor repulsion has a Hamiltonian with three coupling parameters. The authors map out the region in the coupling parameter space which gives a phase diagram that has the same topology as the phase diagram of water. They first discuss, using the simple model, how one diagram evolves into a seemingly different topology and explain how the first order terminal points disappear in the metastable region. They then use the extended model, which contains two extra degrees of freedom to describe four phase diagrams that show some of the desired features the authors want in a water potential. The final choice is made, using a potential labelled 9, which shows all desired features in a qualitative way. A discussion is given about the limitations of the model.

400,626
PB85-148104 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Transient Heat Transfer Processes.
 Final rept.,
 V. D. Arp, D. E. Daney, P. J. Giarratano, and W. G. Steward. 1983, 7p
 Pub. in AICHE (American Institute of Chemical Engineers) Symposium Series 79, n224 p126-132 1983.

Keywords: *Heat transfer, *Mathematical models, *Experimental design, *Fluids, Equations of state, Boundary layer, Reprints.

An integrated experimental and modeling study of transient heat transfer to a compressible fluid involving rapid convective motion normal to the heated surface, perturbations due to superimposed motion parallel to the surface, and modeling of these effects will be summarized. Analyses done for both one and two-dimensional thermally-induced convective motions and deviations from incompressible fluid theory documented in one dimension will be discussed. Mathematical stability problems associated with the form of the fluid equation of state also will be discussed.

400,627
PB85-148112 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Nonlinear Flow Behavior of Gases.
 Final rept.,
 S. Hess, H. J. M. Hanley, and N. Herdegen. 15 Oct 84, 3p
 Sponsored by Department of Energy, Washington, DC. Office of Basic Energy Sciences.
 Pub. in *Physical Letters* 105A, n4-5 p238-240, 15 Oct 84.

Keywords: *Gases, *Boltzmann equation, Computerized simulation, Comparison, Kinetic theory, Pressure, Viscosity, Reprints, Lennard Jones system.

Computer simulation results for a dilute Lennard-Jones gas subjected to a shear are compared with theoretical predictions from an approximate solution of the Boltzmann equation. Nonlinear, non-newtonian characteristics are observed in the gas, including the existence of normal pressure differences. Agreement between the simulations and kinetic theory is satisfactory.

400,628
PB85-148146 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Surface Chemistry of Bone and Tooth Mineral.
 Final rept.,
 D. N. Misra. 1984, 31p
 Sponsored by American Dental Association Health Foundation, Chicago, IL.
 Pub. in *Methods of Calcified Tissue Preparation*, Chapter 13, p435-465 1984.

Keywords: *Surface chemistry, *Bones, *Dental materials, Adsorption, Crystal structure, Electrochemistry,

Ion exchanging, Solubility, Reprints, Fluorapatite, Hydroxyapatite.

This article will constitute a chapter of a book 'Calcified Tissue Preparation', edited by Dr. Glenn R. Dickson of The Queens University of Belfast and will be published by Elsevier/North Holland. The chapter reviews the surface chemistry of hydroxyapatite, the structural prototype of bone mineral, from the viewpoints of adsorption, chemical and crystal structure, electrochemistry, isoionic exchange, and solubility.

400,629
PB85-148492 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
NBS (National Bureau of Standards) Standard Reference Materials for Food Analysis.
 Final rept.,
 R. Alvarez. 1984, 15p
 Pub. in *Modern Methods of Food Analysis*, Chapter 5, p85-99 1984.

Keywords: *Food analysis, *Chemical analysis, *Beverages, Standards, Toxicology, Nutrients, Trace elements, Quality assurance, Laboratories, Concentration(Composition), Calibrating, Reprints, *Standard reference materials.

The National Bureau of Standards is responsible under Federal statute for issuing Standard Reference Materials (SRM's) to assist investigators improve the accuracy of their laboratory tests. For the food science laboratory, these well-characterized, certified materials are available to serve as accuracy-control materials; to prepare primary standard solutions; and to evaluate and monitor the performance of instruments and devices, such as polarimeters and spectrophotometers. Of the approximately 900 different SRM's listed in the current catalog, the biological matrix materials are especially suitable for long-term quality assurance of food analyses. Examples of these are: Oyster Tissue (SRM 1566), Bovine Liver (SRM 1577a), Wheat Flour (SRM 1577), Rice Flour (SRM 1568), and a Non-Fat Milk Powder (Proposed SRM 1549), expected to be issued in late 1983. The Certificate of Analysis for these SRM's include certified concentrations of nutritionally and toxicologically important elements. Other SRM's for food and beverage analysis include a stabilized wine and compounds of certified high purity, such as cholesterol. Additional SRM's have been developed for metabolic studies, such as Human Serum (SRM 909).

400,630
PB85-151587 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Characterization of Surfaces Using Electron and Photon Stimulated Desorption.
 Final rept.,
 T. E. Madey, D. E. Ramaker, and R. Stockbauer. 1984, 26p
 Pub. in *Annual Review of Physical Chemistry* 35, p215-240 1984.

Keywords: *Surface chemistry, *Chemisorption, Molecule structure, Reprints, *Electron stimulated desorption ion angular distribution method, *Photon stimulated desorption.

The authors review various mechanisms of electron and photon stimulated desorption of ions and neutrals from surfaces. Examples include desorption from ionic surfaces, from covalent adsorbates on metal surfaces, and from layers of physically adsorbed atoms. The use of the electron stimulated desorption ion angular distribution (ESDIAD) method for determining local structures of surface molecules is described.

400,631
PB85-151603 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Vibrational Excitation, Harpooning, and Sticking in Molecule-Surface Collisions.
 Final rept.,
 J. W. Gadzuk, and J. K. Noerskov. 15 Sep 84, 11p
 Pub. in *Jnl. of Chemical Physics* 81, n6 p2828-2838, 15 Sep 84.

Keywords: *Diatomic molecules, *Metals, *Surface chemistry, *Molecular vibration, Excitation, Reprints.

The problem of vibrational excitation of a diatomic molecule scattering from a metal surface is considered for encounters in which the molecular electron affinity level crosses the surface Fermi level, thus allowing for electron transfer back and forth between metal and

molecule during the scattering process. The problem is formulated within a diabatic representation in terms of a Landau-Zener-Tully-Preston curve hopping at the location where charge transfer or harpooning occurs, following related theory for other surface charge transfer processes. Account is taken of both the time dependence of the affinity level position and width due to the translational motion of the molecule. Vibrational excitation probability distributions for scattered molecules are calculated. Under certain circumstances, these are obtained in analytic form using a semi-classical wave packet dynamics model. A novel mechanism in which the energy redistribution from translational to internal vibrational modes gives rise to sticking of the undissociated molecule on the surface is presented.

400,632
PB85-151660 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Heat Transfer Effects in Facilitated Transport Liquid Membranes.
 Final rept.,
 N. J. Kemp, and R. D. Noble. 1984, 19p
 Pub. in *Separation Science and Technology* 18, n15 p1147-1165 1984.

Keywords: *Heat transfer, *Transport properties, *Membranes, *Mathematical models, Temperature, Isothermal treatment, Diffusion, Reprints, *Liquid membranes.

Various mathematical models have been developed to describe facilitated transport. There are two limiting regimes where steady-state analytical solutions are available; diffusion-limited (reaction equilibrium) and reaction-limited (frozen condition). For intermediate cases, numerical solutions are available. All of these models are valid for isothermal conditions. It is possible in practice that the system may not be isothermal. The gas streams on each side of the membrane may be at different temperatures and/or there can be heat of reaction effects. These effects can cause the total facilitated flux to deviate from the isothermal case.

400,633
PB85-151702 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Electrostriction and Dielectric Friction on Ions Moving through Compressible Polar Solvents.
 Final rept.,
 P. J. Stiles, and J. B. Hubbard. 6 Apr 84, 4p
 Pub. in *Chemical Physics Letters* 105, n6 p655-658, 6 Apr 84.

Keywords: *Ions, *Electrostriction, *Dielectric properties, *Mathematical models, Solvents, Drag, Reprints.

The Hubbard-Onsager electrohydrodynamic model is extended to examine the influence of electrostriction on the mobilities of large ions in compressible polar solvents. The authors find that electrostriction leads to significant augmentation of the drag coefficients of large ions in aprotic solvents such as acetonitrile and acetone.

400,634
PB85-151744 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Application of the Extended Corresponding States Model to Hydrocarbon Mixtures (Computer Program EXCST).
 Final rept.,
 J. F. Ely. 1984, 14p
 Sponsored by National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
 Pub. in *Proceedings of Gas Processors Association Annual Convention* (63rd), New Orleans, LA., March 19-21, 1984, p9-22.

Keywords: *Hydrocarbons, *Fluids, *Thermophysical models, Mixtures, Van der Waals forces, Computer programs, Density(Mass/volume), Viscosity, Thermal conductivity, Enthalpy, Phase equilibrium.

The past few years have seen a resurgence of interest in accurate modelling of thermophysical properties of fluids. This interest can be attributed to both emerging new technological demands and to economic factors such as rising energy costs and needs for more accurate custody transfer models. In this report results obtained from a study designed to develop an accurate predictive model for the thermodynamic properties of hydrocarbon mixtures are presented. The model is called the extended corresponding states model and incorporates a mixture one-fluid concept originally due

Field 7—CHEMISTRY

Group 7D—Physical Chemistry

to van der Waals. In order to test the accuracy of the model, extensive comparisons between predicted and experimental densities, viscosities and thermal conductivities are presented. In addition, work is currently in progress to document phase equilibria and enthalpy prediction accuracy.

400,635

PB85-151777

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Thermodynamic Properties of Ethylene at Saturation.

Final rept.,

M. Jahangiri, R. T. Jacobsen, R. B. Stewart, and R.

D. McCarty. 1984, 8p

Pub. in *Advances in Cryogenic Engineering* 29, p965-972 1984.

Keywords: *Thermodynamic properties, *Ethylene, Mathematical models, Vapor pressure, Density(Mass/volume), Temperature, Reprints, *PVT properties.

A new analysis of the liquid-vapor coexistence PVT of ethylene is presented. Mathematical models of the vapor pressure, saturated liquid and vapor densities are presented. Deviations between calculated and experimental data are given.

400,636

PB85-151785

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Semi-Automated Facilities for Measuring Density, PVT and VLE of Energy-Related Fluids.

Final rept.,

J. V. Sengers, and J. M. H. Levelt Sengers. 1984,

11p

Pub. in *Proceedings of Symposium on Energy Engineering Sciences, Research on Instrumentation, Testing and Evaluation (2nd)*, Argonne, IL., April 10-11, 1984, p17-27.

Keywords: *Fluids, *Density(Mass/volume), Critical point, Ethylene, Butanes, *PVT properties, *Vapor liquid equilibrium, Propane/methyl.

To characterize the behavior of the thermodynamic properties of systems near a critical point systems are grouped into universality classes. Systems within a universality class have the same universal critical exponents and scaling functions. Specifically, fluids are expected to belong to the universality class of 3-dimensional Ising-like systems for which the universal quantities have been calculated with considerable accuracy. A scaled fundamental equation is presented which incorporates these theoretical predictions. Results obtained for various technologically important fluids, namely ordinary steam, heavy steam, ethylene and isobutane, are discussed.

400,637

PB85-151793

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Universal Representation of the Thermodynamic Properties of Fluids in the Critical Region.

Final rept.,

J. V. Sengers, and J. M. H. Levelt Sengers. Feb 84,

14p

Pub. in *Int. J. Thermophys.* 5, n2 p195-208 Feb 84.

Keywords: *Fluids, *Density(Mass/volume), Critical point, Ethylene, Butanes, Reprints, *PVT properties, *Vapor liquid equilibrium, Propane/methyl.

To characterize the behavior of the thermodynamic properties of systems near a critical point systems are grouped into universality classes. Systems within a universality class have the same universal critical exponents and scaling functions. Specifically, fluids are expected to belong to the universality class of 3-dimensional Ising-like systems for which the universal quantities have been calculated with considerable accuracy. A scaled fundamental equation is presented which incorporates these theoretical predictions. Results obtained for various technologically important fluids, namely ordinary steam, heavy steam, ethylene and isobutane, are discussed.

400,638

PB85-154581

PC A09/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Thermodynamic Properties of Isobutane-Isopentane Mixtures from 240 to 600K and up to 20 MPa (with Supplemental Tables from -40 to +600F and up to 1000 psia).

Interim rept.,

J. S. Gallagher, J. M. H. Levelt Sengers, G. Morrison, and J. V. Sengers. Nov 84, 183p NBSIR-84/2971

See also DE84-015137. Sponsored by Department of Energy, Oakland, CA. San Francisco Operations Office.

Keywords: *Butanes, *Propanes, Mixtures, Thermodynamic properties, Critical points, Tables(Data), Enthalpy, Binary systems(Materials), Vapor pressure, *Helmholtz function, *Propane/methyl, *Butane/methyl.

The Helmholtz function for pure isobutane from a recent correlation has been converted to a dimensionless form and a pressure-enthalpy chart based on this function has been generated by computer. A Helmholtz function for mixtures of isobutane and isopentane has been formed based upon the dimensionless isobutane Helmholtz function as the reference fluid by means of an extended corresponding-states principle. Scarce literature data for saturation properties of isopentane, and new data for its vapor pressure and for the critical line of the mixture were used. The accuracy of the surface was checked by comparing with literature enthalpy data and with new VLE data for the mixture. Tables of thermodynamic properties have been generated from this Helmholtz function for the 0.1 mole fraction isopentane-in-isobutane mixture in the single-phase region and on the dew- and bubble-point curves, together with properties of the coexisting phase. A pressure-enthalpy chart for this mixture has also been generated.

400,639

PB85-161313

(Order as PB85-161271, PC A05/MF A01)

National Bureau of Standards, Gaithersburg, MD.

Report on the National Bureau of Standards pH Standards,

Y. C. Wu, W. F. Koch, and G. Marinenko. 19 Sep 84, 6p

Included in *Jnl. of Research of the National Bureau of Standards*, v89 n5 p395-400 Sep-Oct 84.

Keywords: *pH, *Standards, Thermodynamics, Activity coefficients, *Standard reference materials.

In 1980, the research program in pH was re-established at the National Bureau of Standards (NBS). This report describes the state of this research, as well as the state of the NBS pH standards. The thermodynamic definition and the determination of pH are elaborated. The problems of liquid junction potentials encountered in the practical determination of pH are discussed. The goal of the research program in pH is to develop and maintain a unified pH scale based on clearly stated thermodynamic criteria, with a wide range of applicability to practical pH measurements.

400,640

PB85-165900

PC A04/MF A01

National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Materials.

Methods and Procedures Used at the National Bureau of Standards to Certify Sulfur in Coal SRM's (Standard Reference Materials) for Sulfur Content, Calorific Value, Ash Content.

Final rept.,

T. E. Gills. Dec 84, 55p NBS/SP-260/94

Also available from Supt. of Docs as SN003-003-02629-8. Library of Congress catalog card no. 84-601148.

Keywords: *Chemical analysis, *Standards, *Sulfur, *Ash content, *Calorific value, Performance evaluation, Sampling, Mass spectroscopy, *Standard reference materials, Procedures.

This Special Publication consists of a collection of analytical methods used at NBS for the determination of total sulfur, calorific value, and ash content in four different coals, SRM's 2682, 2683, 2684, and 2685, with nominal sulfur contents of 0.5, 2.0, 3.0, and 4.5 percent, respectively. Also, included are descriptions of methods and procedures used for providing noncertified values for approximately 30 elements including carbon, hydrogen, and nitrogen. These procedures

were selected and often specifically developed, by the scientific staff members of NBS, to provide measurements with the best obtainable accuracy and precision. The materials for these SRM's were obtained and processed by Valley Forge Laboratories under a grant from the National Bureau of Standards. Material preparation of the four coal SRM's is described in NBS Special Publication 260-84, 'Sampling, Materials Handling, Processing, and Packaging of Standard Reference Coal Materials.'

7E. Radio and Radiation Chemistry

400,641

PB84-221878

Not available NTIS

National Bureau of Standards, Washington, DC.

Radiochemical Isolation and Radioactivity Calibration and Gamma-Ray Spectrometry.

Final rept.,

J. R. Noyce, and J. M. R. Hutchinson. 1983, 9p

Pub. in *Jnl. of Radioanal. Chem.* 79, n1 p5-13 1983.

Keywords: *Radiochemistry, *Radium isotopes, *Separation, Radioactivity, Ion exchanging, Extraction, Gamma ray spectroscopy, Reprints, *Radium 228, Thorium 232.

Radium-228 was separated from aged thorium nitrate by liquid-liquid, two-phase extraction and extensively purified, principally by ion-exchange chromatography. The radioactivity concentration of the purified radium-228 was measured by means of liquid-scintillation beta-particle measurements of the (228)Ac daughter (Corrected for progeny ingrowth). The results were confirmed by Ge(Li) well-detector intercomparison with radium-228 in equilibrium with its thorium-232 precursor which had been measured gravimetrically. Three hundred ampoules were provided to the U.S. Environmental Protection Agency, Las Vegas, for distribution.

400,642

PB85-102242

Not available NTIS

National Bureau of Standards, Washington, DC.

Charge Transfer and Neutralization Mechanisms Involving Saturated Hydrocarbon Cations.

Final rept.,

P. Ausloos. 1982, 11p

Pub. in *Radiation Physics and Chemistry* 20, n1 p87-97 1982.

Keywords: *Hydrocarbons, *Cations, *Radiolysis, Mass spectroscopy, Excitation, Charging, Radiation chemistry, Reprints.

Charge transfer reactions occurring in saturated hydrocarbons in both the gas and condensed phases are discussed in light of results from recent mass spectrometric and pulse radiolytic investigations. It is concluded that in both phases, electron transfer from a hydrocarbon molecule to a molecular cation occurs at every encounter except when the reaction is close to thermoneutral. The mechanism of the charge recombination process for solvent and solute cations is examined for both solvent and solute cations in binary mixtures of saturated hydrocarbons using results from recent studies on the photofragmentation of highly excited hydrocarbon molecules. It is concluded that while the mechanism of neutralization of the solute cation can be predicted from the photochemical results, that of the solvent cation can not. It is suggested that solvent cations are produced with excess vibrational and electronic energy which is not entirely dissipated at the time of charge recombination. These findings are consistent with pulse radiolysis findings, which showed that the G-value of thermally relaxed singlet excited molecules produced by charge recombination is quite low.

400,643

PB85-123644

Not available NTIS

National Bureau of Standards, Washington, DC.

Counters, Accelerators, and Chemistry.

Final rept.,

L. A. Currie, and G. A. Klouda. 1982, 27p

Pub. in *American Chemical Society Symposium Series* 176, p159-185 1982.

Keywords: *Radioactive age determination, *Radioactive isotopes, Sampling, Accelerating(Chemistry), Sampling, Chemical analysis, Reprints.

Important advances in radioactive dating techniques are extending our measurement frontiers to very much smaller samples and smaller radioisotope ratios (greater ages). These advances promise major progress in our understanding of both anthropogenic and natural processes provided that we pay strict attention to: (a) the inherent accuracy and precision of the respective techniques, and (b) the tremendous increase in information content and sample reliability which may come about through the selective addition of microchemical or physical observations (or operations). Following a brief discussion of the comparative performance of small sample liquid scintillation counting, gas proportional counting and direct atom (accelerator) counting (with respect to precision, sample size and destruction, and non-Poisson error components), the authors shall illustrate the critical role that serial and parallel chemical information has played in the modeling and interpretation of environmental radiocarbon data. (Serial data have included selective sampling (<10 mg-C samples), followed by the determination of (^{14}C) in specific compounds or classes of compounds as well as in volatile/non-volatile and size-selected particle fractions; parallel data have included isotopic ((^{13}C)), elementary and organic composition.)

8.

EARTH SCIENCES AND OCEANOGRAPHY

8A. Biological Oceanography

400,644
PB85-140770 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Pressure-Retaining Deep Ocean Sampler and Transfer System for Measurement of Microbial Activity in the Deep Sea.
 Final rept.,
 P. S. Tabor, J. W. Deming, K. Ohwada, H. Davis, and M. Waxman. 1981, 15p
 Pub. in *Microbial Ecology* 7, n1 p51-65 1981.

Keywords: *Marine microorganisms, *Samplers, *Ocean environments, Deep water, Pressure, Temperature, Populations, Reprints, *Oceanographic equipment.

A Deep Ocean Sampler (DOS) has been developed for microbiological sampling and is capable of aseptically collecting 400 ml water samples from any depth in the world oceans. The instrument maintains samples under in situ pressure and temperature. A hyperbaric transfer system has also been developed, enabling transfer of sample volumes up to 150 ml, without decompression or dilution, to pressurized incubation chambers. Utilization of (^{14}C) -glutamate (21 to 96 micrograms/l) and (^{14}C) -acetate (4.6 micrograms/l) by microbial populations in undecompressed water samples from the N.W. Atlantic and the Cape and Angola Basins was recorded over incubation periods of 2 to 18 weeks.

8C. Dynamic Oceanography

400,645
PB85-138592 PC A04/MF A01
 Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
Practical Approximations of Peak Wave Forces,
 M. Grigoriu, and B. Alibe. Nov 84, 60p NBS/GCR-84/481
 Sponsored in part by Minerals Management Service, Reston, VA.

Keywords: *Water waves, *Storms, Statistical analysis, Drag, Inertia, Force, Ocean waves, Approximation, Simulation, Peaks.

According to Morrison's equation, wave forces acting on cylindrical members have two components: drag forces, which depend nonlinearly on wave particle velocity, and inertia forces, which are proportional to wave particle acceleration. Wave forces are then non-Gaussian processes although fluid velocities are assumed to follow Gaussian distributions. This report develops approximations of the mean of the peak of wave forces during design storms. It shows that the square root of the sum of the squares (SRSS) rule can be applied to approximate the mean of the peak wave force from the average peaks of inertia and drag forces. The approximation is satisfactory for any ratio of drag to inertia forces and frequency content of the wave particle velocity process. The report also provides various descriptors of drag, inertia, and wave forces, including marginal distributions, mean crossing rates, and extreme value distributions.

8D. Geochemistry

400,646
PB85-145340 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Biological Methylation of Metals and Metalloids.
 Final rept.,
 J. S. Thayer, and F. E. Brinckman. 1982, 44p
 Pub. in *Advances in Organometallic Chemistry* 20, p313-356 1982.

Keywords: *Metals, *Metal containing organic compounds, *Environmental surveys, *Methylation, Reviews, Geochemistry, Enzymes, Chemical reactions, In vitro analysis, In vivo analysis, Reprints, *Biological processes.

The current state of understanding biological methylation of metals and metalloids is reviewed with 250 references. The subject is treated both from the viewpoint of organometallic chemists, with emphasis on aquatic transmethylation reactions occurring in vitro under abiotic and biological conditions, and from a phenomenological survey of corresponding in vivo processes occurring in environmental media such as pure cultures, soils, sediments, and animals. Against this background, mechanisms of transmethylation are inspected, and the relationship of trace organometallic speciation applied to biogeochemistry or to modelling environmental pollution are considered.

8E. Geodesy

400,647
PB85-130821
 (Order as PB85-130078, PC A99/MF A01)
 Bureau International des Poids et Mesures, Sevres (France).
Gravitational Acceleration, Mass, and Electrical Quantities: Present Status of the Absolute Measurement of Gravitational Acceleration,
 A. Sakuma. 1984, 8p
 Included in *Precision Measurement and Fundamental Constants II*, p397-404 1984.

Keywords: *Gravity, Portable equipment, Gravimeters, Acceleration, Measurement, Reviews, *Gravimetry, Free fall.

The paper reviews the recent work on the absolute measurement of gravitational acceleration g , covering the last decade since PMFC-I in 1970. The single principle involved in the precise absolute measurement of g to better than 1 part in 10 to the 8th power is the observation of free fall in the gravity field: All the ten or so laboratories presently engaged in this measurement employ only this principle of free fall and no longer the traditional reversible pendulum. A large number of new absolute gravity stations (about 50 by the end of 1980) have been created in Europe, North America, Asia, and Oceania by transportable absolute gravity meters of several laboratories. These stations are aimed at improving the accuracy of the world gravity network, IGSN 1971, and also at monitoring in the future the secular variation of the network.

400,648
PB85-130839
 (Order as PB85-130078, PC A99/MF A01)
 Joint Inst. for Lab. Astrophysics, Boulder, CO.
New, Portable, Absolute Gravimeter,
 M. A. Zumberge, J. E. Faller, and R. L. Rinker. 1984, 5p
 Included in *Precision Measurement and Fundamental Constants II*, p405-409 1984.

Keywords: *Gravimeters, *Gravity, Optical interferometers, Portable equipment, Performance, Measurement, Accuracy, *Laser interferometry, Free fall.

The authors report on the performance of a new and easily portable apparatus for the absolute measurement of the acceleration of gravity. Rapid acquisition of data and high accuracy result from the use of a drag-free dropping chamber that descends with the falling object whose acceleration is measured interferometrically. Preliminary results indicate an absolute accuracy of 6 parts in 10 to the 9th power.

400,649
PB85-130854
 (Order as PB85-130078, PC A99/MF A01)
 National Inst. of Metrology, Beijing (China).
Transportable Gravimeter for the Absolute Determination of Gravity,
 Y. G. Guo, D. L. Huang, D. X. Li, G. Y. Zhang, and J. L. Gao. 1984, 3p
 Included in *Precision Measurement and Fundamental Constants II*, p419-421 1984.

Keywords: *Gravimeters, *Gravity, Optical interferometers, Helium neon lasers, Portable equipment, Rubidium frequency standards, Measurement, Free fall.

At the National Institute of Metrology in Beijing, a transportable gravimeter, using the method of free fall has been constructed. The instrument consists of an optical interferometer illuminated by light from a stabilized He-Ne laser, in which one of the mirrors, a corner-cube reflector, falls freely. The time standard is obtained from a highly stabilized rubidium clock. The methods of time and distance measurement are described. The effect of the verticality or collimation is discussed. A positive correction has to be included. Some recent (1979-1980) results are presented. The accuracy achieved with this apparatus is about two parts in 10 to the 8th power.

400,650
PB85-130862
 (Order as PB85-130078, PC A99/MF A01)
 Air Force Geophysics Lab., Hanscom AFB, MA.
New Techniques for Absolute Gravity Measurement,
 J. A. Hammond, R. L. Iliff, and R. W. Sands. 1984, 4p
 Included in *Precision Measurement and Fundamental Constants II*, p423-426 1984.

Keywords: *Gravity, Portable equipment, Measurement, Precision, Correction, Laser applications, Free fall.

In the 11 years since PMFC-1, a number of new techniques have been put into practice in the Air Force Geophysics Laboratory's transportable system for measuring the acceleration of gravity. The improved system in use at the present time incorporates an earlier vacuum chamber with some modifications and includes new electronics, data analysis, and optical subsystems. The electronics now produce time measurement at a large number (500) points during the free fall of the object. These time values are analyzed with a least-squares fit to a second-order polynomial to obtain the average acceleration. The correction for air resistance is now made by monitoring the pressure and making a correction based on extrapolation from high pressures to the low operating pressures. The use of an iodine-stabilized laser as a reference for the length measurement has significantly reduced the uncertainty due to the wavelength of the Lamb-dip stabilized laser.

Field 8—EARTH SCIENCES AND OCEANOGRAPHY

Group 8E—Geodesy

400,651
PB85-147973 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Fluid-Fiber Gradiometers: Their Promise for Tunnel Detection - A Status Report.

Final rept.,
J. E. Faller, J. K. Hoskins, P. T. Keyser, and T. M. Niebauer. 1984, 19p
Pub. in Proceedings of Technical Symposium on Tunnel Detection (2nd), Golden, CO., September 26-28, 1984, p1-19.

Keywords: *Tunnel detection, Security, *Gravity gradiometers, *Gradiometers, *Intrusion detection.

At the Joint Institute for Laboratory Astrophysics, the authors are working on a new type of torsion pendulum gravity gradiometer. In this torsion pendulum apparatus, the traditional fiber is replaced with two surrogates in which the fiber's suspension role is provided entirely by a fluid while its restoring and centering functions are achieved by an appropriate electrode array with adjustable voltages. The authors have constructed -- for purposes of testing the concept -- two fluid gradiometers each 10 inches in diameter, a size such that their sensitivities would theoretically permit one to see the change in gravity gradient resulting from a tunnel at a distance of one kilometer. The authors have also under study one very large 50 inch diameter float whose intended purpose is to improve on the accuracy of the Eotvos experiment (equivalence of gravitational and inertial mass). This float is presently being used as a sensitive test bed to look at the effects of various noise terms on floats in general. At the July 21-23, 1981 Symposium on Tunnel Detection, the authors presented a paper, 'Tunnel Detection Utilizing Field-Stationary Gravity Gradiometry.' Since that time, an experimental program to study this idea has been under way. A number of unforeseen problems have been encountered, but in all cases satisfactory solutions have been found. The authors briefly review the idea and the present status of this work, and discuss their prognosis for this type of device as a field-practical instrument.

8G. Geology and Mineralogy

400,652
PB84-218437 Not available NTIS
National Bureau of Standards, Washington, DC.
Calibrating Pollen Data in Climatic Terms: Improving the Methods.

Final rept.,
S. Howe, and T. Webb. 1983, 35p
Pub. in Quaternary Science Review 2, p17-51 1983.

Keywords: *Pollen, *Climate, *Paleoclimatology, Yield, Regression analysis, Periodic variations, Calibrating, Atmospheric temperature, Computer programming, Michigan, Reprints.

When properly calibrated, Holocene pollen data provide an important source of quantitative information about Holocene climates. Multiple linear regression of modern climate and pollen data allows the development of statistical calibration functions that transform percentages of certain pollen types into quantitative estimates of climatic variables, and these functions, when applied to Holocene pollen data, yield estimates of climatic variables for past times. Confidence intervals for the climatic variables provide estimates of the statistical errors. In order to illustrate the sequence of procedures, the authors used data from the lower peninsula of Michigan to develop a calibration function for July mean temperature and then used Holocene pollen data from central lower Michigan to estimate past temperatures.

400,653
PB84-226257 Not available NTIS
National Bureau of Standards, Washington, DC.
Performance of a Deep Borehole Tiltmeter.

Final rept.,
J. Levine, J. C. Harrison, and C. M. Meertens. 1983, 11p
Sponsored in part by Air Force Geophysics Lab., Hanscom AFB, MA.
Pub. in Proc. Ninth Int. Conf. Earth Tides, Stuttgart, West Germany, August 17-22 1981, p47-57 1983.

Keywords: *Boreholes, Deep depth, Design criteria, Performance evaluation, Tides, Sites, *Tiltmeters, *Earth tilt, Earth tides, Case studies.

Deep borehole tiltmeters described by Harrison, Levine and Meertens at this symposium have been installed at two sites near Boulder, Colorado. One site is at the edge of the foothills with closely spaced holes 6 m, 16 m, and 33 m deep. The other site is 24 km to the east in the flat plains where five holes, each 33 m deep have been drilled spaced from 30 m to 120 m apart. Using an observation time of 28 days, earth tides are observed with a signal to noise ratio of almost 40 dB and with an apparent secular tilt of about 0.1 micro-radian. Data from the instruments are used to construct the tidal admittance and to study the coherence among the instruments. The semi-diurnal tidal admittance shows very good agreement with theory. Consecutive monthly admittance show a standard deviation of approximately 6% and no secular trend. The instruments show no nonlinear behavior.

400,654
PB85-143675 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Mineralogical Characteristics of Asbestos.

Final rept.,
E. B. Steel, and A. G. Wylie. 1981, 7p
Sponsored by Society of Mining Engineers of AIME, Littleton, CO.
Pub. in Geology of Asbestos Deposits, p93-99 1981.

Keywords: *Amphiboles, *Asbestos, *Serpentine, Crystal structure, Surface properties, Reprints.

The asbestiform habit is most commonly developed in certain amphiboles and chrysotile, but other minerals may also crystallize with this unusual habit. The habit may be characterized by (1) a fibril structure, single or twinned crystals of very small widths (generally less than 0.5 micrometer) which have grown with a common fiber axis direction but which are disoriented in the other crystallographic directions, (2) anomalous optical properties, primarily parallel extinction, (3) unusual tensile strength, (4) high aspect ratio, and (5) flexibility. In addition, there is evidence to indicate that some amphibole asbestos may have unusual surface properties.

8H. Hydrology and Limnology

400,655
FIPS PUB 103 PC A07/MF A01
National Bureau of Standards, Washington, DC.

Codes for the Identification of Hydrologic Units in the United States and the Caribbean Outlying Areas. Category: Data Standards and Guidelines. Subcategory: Representations and Codes; Earth Science Series.

Federal information processing standards (Final),
R. G. Saltman. 15 Nov 83, 129p
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Hydrology, *Coding, *River basins, *Standards, *Information, Water resources, *Geographic codes, Federal information processing standards.

This standard adopts the set of codes used to identify hydrologic units published in Geological Survey Circular 878-A. These codes identify a hydrologic system that divides the United States and Caribbean outlying areas into 21 major regions. These regions are further subdivided into approximately 2150 units that delineate river basins having drainage areas usually greater than 700 square miles. The codes provide a standardized base for use by water-resources organizations. FIPS 103 was developed by the U.S. Geological Survey, U.S. Department of the Interior, for use in automated earth-science systems, and was adopted as a result of a Memorandum of Understanding signed in February 1980 between the National Bureau of Standards and the Geological Survey.

400,656
PB85-142594 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Vertical Temperature Distribution in Lakes.

Final rept.,
R. D. Noble, N. J. Kemp, and R. G. Buschman. 1985, 13p
Pub. in Jnl. of Environmental Systems 14, n1 p63-75 1984-85.

Keywords: *Temperature distribution, *Lakes, Mathematical models, Water flow, Heat transfer, Adsorption, Radiation, Reprints.

Analytical solutions are presented for the vertical temperature distribution in lakes. The solutions are good for large water bodies where inflows and outflows are negligible. The solution is based on a linearization of the surface heat exchange term. Solutions are presented for both zero-order and first order linearizations. An analytical expression is used to describe the actual daily absorbed radiation at the air-water interface. The model contains no adjustable parameters. A comparison of model results with experimental data is presented.

8I. Mining Engineering

400,657
PB83-165001 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.

Improved Coal Interface Detector.
Final rept.,
Keith C. Roe, and Ronald C. Wittmann. May 82, 52p
NBSIR-82-1663
Contract DE-ET-77-C-01-8881

Keywords: *Detectors, *Coal deposits, *Continuous wave radar, Coal mining, Interfaces, Shales, Frequency modulation, Electromagnetic radiation, Detection.

This report describes the theory, design, construction and testing of an electromagnetic coal interface detector. The purpose of this type detector is measuring the thickness of roof coal left during underground mining operations. An above ground test facility constructed to evaluate the coal interface detector is also described.

400,658
PB84-165877 PC A09/MF A01
National Bureau of Standards, Washington, DC.
Use of Hazard Pictorials/Symbols in the Minerals Industry.

Open file rept. 30 Jan 81-31 Jan 83 (Final).
B. L. Collins. Sep 83, 194p NBSIR-83-2732,
BUMINE-OFR-44-84
Contract J01113020

Keywords: *Mining, *Safety engineering, *Symbols, Accident prevention, Hazards, Color codes, Responses, Human factors engineering, Guidelines, Handbooks, *Mine safety, *Mineral industries.

This report documents a multiphase research effort on the evaluation of the effectiveness of safety symbols and hazard pictorials for use in mining and milling operations. The first phase reviews applicable codes and standards, and documentation of typical mining hazards to determine relevant safety messages. In the second phase, visits were made to eight mine sites to document existing sign practice and common mining hazards. In the third phase, the effectiveness of 2 sets of symbols for 40 different safety messages was evaluated with 267 miners from 10 sites at disparate geographical locations. The evaluation included an assessment of the effectiveness of six different symbol surround shapes and colors. The most effective symbols depicted both the person and the hazard or protective gear; these were more representational than highly abstract. Based on this research, a set of 40 symbols are suggested for further graphic refinement, additional evaluation, and eventual use.

400,659
PB85-104123 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Field Evaluation of SPT (Standard Penetration Test) Energy, Equipment, and Methods in Japan Compared with the SPT in the United States.
W. D. Kovacs, and L. A. Salomone. Aug 84, 75p
NBSIR-84/2910

Keywords: *Drilling, Penetration tests, Drilling rigs, Equipment, Production methods, Japan, Field tests, Energy consumption, Comparative evaluations.

Field energy measurements on Japanese drill rigs were made during the performance of the Standard Penetration Test to document the difference between Japanese and present U.S. Practice. A total of 78 Standard Penetration Tests were performed using 19 different testing conditions (equipment and operators). Over 2000 data points are reported.

400,660

PB85-128866

Not available NTIS

National Bureau of Standards, Washington, DC.
Dielectric Measurements of Oil Shale as Functions of Temperature and Frequency.

Final rept.,

R. L. Jesch, and R. H. McLaughlin. Jan 83, 7p

Sponsored in part by Department of Energy, Laramie, WY. Laramie Energy Technology Center.

Pub. in Institute of Electrical and Electronics Engineers Transactions on Geoscience and Remote Sensing GE-22, n2 p99-105 Mar 84.

Keywords: *Oil shale, *Dielectric properties, Measurement, Samples, Holders, Temperature, Frequencies, Electromagnetic properties, Reprints.

A high-temperature sample holder designed by the National Bureau of Standards was used to determine the dielectric properties of approximately 40 oil shale samples as functions of temperature and frequency. A description of the sample holder characterization is given along with the measurement procedure and the sample preparation.

400,661

PB85-137669

PC A05/MF A01

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Microwave Detection of Lost Wells and Unknown Water-Filled Voids in Coal Mines.

Final rept. Jan 79-Mar 84,

D. R. Belsher, R. H. McLaughlin, A. G. Repjar, and

H. E. Bussey. Sep 84, 87p NBSIR-84/3017

Contract H0272007

Keywords: *Coal mines, *Radar detection, Voids, Detection, Microwave equipment, Antennas, Detectors, Fluid infiltration, Safety, Hazards, Computer programs, Signal to noise ratio.

Work on contract H0272007 is summarized for the period of January 1979 through March 1984. The development of improved antennas useable with both a pulse system or an FM-CW system is described. The development of a field prototype pulse sampling system is described. Initial theoretical work on the problem of dielectric loading of antennas as well as a study of potential system range is included.

400,662

PB85-161305

(Order as PB85-161271, PC A05/MF A01)

National Bureau of Standards, Boulder, CO.

Radio Propagation in a Coal Seam and the Inverse Problem.

D. A. Hill. 17 Jul 84, 10p

Included in Jnl. of Research of the National Bureau of Standards, v89 n5 p385-394 Sep-Oct 84.

Keywords: *Coal deposits, *Radio transmission, Attenuation, Remote sensing, Inverse problems.

The longwall method of mining in underground coal seams very efficient in uniform seams, but coal seam anomalies can make the method unprofitable and unsafe. This paper describes the theoretical basis for detection of coal seam anomalies using medium frequency (MF) radio transmission over paths on the order of 200 m in length. The key to the method is the sensitivity of the attenuation rate of the coal seam mode of propagation to changes in the coal seam parameters, such as height or electrical conductivity. From a large number of transmission paths, the principles of tomography can be used to reconstruct an image of the seam.

8M. Soil Mechanics

400,663

PB85-128130

PC A03/MF A01

National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.

Influence of Soil Type and Gradation on the Thermal Resistivity of Soils.

L. A. Salomone, F. Y. Yokel, and H. Wechsler. Oct 84, 39p NBSIR-84/2935

Keywords: *Thermal conductivity, *Soil tests, Thermal measuring instruments, Soil compacting, Soil water, Sands, Clay soils, Silts, Moisture content, Heat transfer, Tables(Data), Graphs(Charts).

Laboratory thermal probe tests performed on four (4) different soils were used to study the influence of soil type and gradation on the thermal resistivity of soils. The four soils covered a wide range of gradations and included: two sands (SP and SP-SM), a silty clay (CL), and a silt (ML). Results are presented which indicate that as the sand content increases in a silty clay (CL), the minimum thermal resistivity and the critical moisture content decrease for the range of compactive efforts studied. Increasing the medium and coarse sand fraction in a granular soil significantly increases the heat conductive properties of the soils. Also, in the stable region of each of the major soil groups (i.e. granular and fine-grained soils), the influence of soil type and density on the thermal resistivity of soils is negligible and a constant value of thermal resistivity is observed. The constant value of thermal resistivity is approximately 30 to 40C cm/watt and 50 to 70C cm/watt for granular soils and fine-grained soils, respectively.

400,664

PB85-137719

PC A04/MF A01

Maryland Univ., College Park. Dept. of Civil Engineering.

Size Effect in Simple Shear Testing.

M. I. Amer, M. S. Aggour, and W. D. Kovacs. Nov 84, 66p NBS/GCR-84/478

Prepared in cooperation with Rhode Island Univ., Kingston.

Keywords: *Soil mechanics, *Shear tests, Damping, Finite element analysis, Shear properties, Earthquake engineering.

Simple shear testing is considered to be one of the most appropriate ways of reproducing in the laboratory the stresses that would be experienced by an element of soil subjected to earthquake loading. The main drawback concerns the sample size, in that for a small sized sample, the test results are affected by the non-uniformity of the stress in the sample. To investigate the sample size effect on the primary dynamic soil properties, namely the shear modulus and damping, a large simple shear apparatus was constructed. A total of 144 tests were performed to study the size effect and to choose an ideal size for testing dry sand. The suggested size gave results of shear modulus and damping independent of the sample boundaries. Formulas and charts for correction factors were also developed to be used to correct the results from simple shear tests on samples having sizes other than the ideal size proposed herein.

9.

ELECTRONICS AND ELECTRICAL ENGINEERING

9A. Components

400,665

PATENT-4 437 080

Not available NTIS

Department of the Air Force, Washington, DC.

Method and Apparatus Utilizing Crystalline Compound Superconducting Elements Having Extended Strain Operating Range Capabilities without Critical Current Degradation.

Patent,

J. W. Ekin, J. R. Gavaler, and A. I. Braginski. Filed

14 Feb 83, patented 13 Mar 84, 12p AD-D011 007/

2, PAT-APPL-6-465 942

Supersedes PAT-APPL-6-465 942.

Availability: This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.00.

Keywords: *Patents, *Superconductors, *Crystals, Electric current, Elastic properties, Strain(Mechanics),

Crystal structure, Electromagnets, High density, Magnetic fields, Superconductivity, Magnet coils, Alloys, PAT-CL-335-216.

A method and apparatus are disclosed utilizing superconducting elements with extended strain operating range capabilities. The superconducting element is formed from a crystalline compound superconductive material that does not exhibit appreciable critical current degradation in the presence of high elastic strains imposed on the element. Such a crystalline compound superconductive material is selected from materials in the B1 and C15 crystal structure classes. The thus formed superconducting element is particularly useful in electromagnets requiring high magnetic fields for operation in the intended manner.

400,666

PB84-197300

PC A03/MF A01

National Bureau of Standards, Washington, DC. National Engineering Lab.

Development of Power System Measurements--Quarterly Report, October 1, 1983 to December 31, 1983.

R. E. Hebner. May 84, 27p NBSIR-84-2861

See also PB84-115104 and PB84-109891. Sponsored in part by Department of Energy, Washington, DC. Div. of Electric Energy Systems.

Keywords: *Electric fields, Electric measuring instruments, Magnetic fields, Errors, Electric corona, Insulating oil, Sulfur hexafluoride, Electric insulation.

This report documents the progress of three technical investigations sponsored by the Department of Energy and performed by or under a grant from the ElectroSystems Division, the National Bureau of Standards. The work described covers the period October 1, 1983 to December 31, 1983. This report emphasizes the errors associated with measurements of electric and magnetic fields, the properties of corona in compressed SF6 gas, and the measurement of interfacial phenomena in transformer oil.

400,667

PB84-216530

PC A03/MF A01

National Bureau of Standards (NEL), Washington, DC. Electrosystems Div.

Development of Power System Measurements, Quarterly Report, April 1, 1983 to June 30, 1983.

R. E. Hebner. Feb 84, 42p NBSIR-84-2809

Sponsored in part by Department of Energy, Washington, DC. Div. of Electric Energy Systems.

Keywords: *Electric fields, *Electrical measuring instruments, *Electric corona, *Electric insulation, Calibrating, High voltage, Insulating oil, Sulfur hexafluoride, Dielectric breakdown, Electrical insulators.

The report emphasizes the calibration of instruments designed to measure the 60-Hz electric field in biological exposure facilities, the effect of water on SF6 corona discharges, the measurement of failure mechanisms in liquid/solid and gas/solid insulating systems, and the development and behavior of active insulators.

400,668

PB84-216902

PC A02/MF A01

National Bureau of Standards (NML), Washington, DC. Electrical Measurements and Standards Div.

Transportable 1000 pF Standard for the NBS (National Bureau of Standards) Capacitance Measurement Assurance Program.

Final rept.,

G. Free, and J. Morrow. Oct 82, 19p NBS-TN-1162

Also available from Supt. of Docs as SN003-003-02444-9.

Keywords: *Standards, *Capacitors, *Calibrating, Capacitance, Portable equipment, Performance, Stability, Reference standards, Measurement assurance program.

A capacitance transport standard has been constructed for use in the National Bureau of Standards Measurement Assurance Program. The transport standard was designed so that variations in ambient temperature and mechanical shock would have a minimal effect on the value of the internal reference capacitors. A significant improvement in stability of 1000 pF capacitors during shipment and in the laboratory has been achieved through this design.

Field 9—ELECTRONICS AND ELECTRICAL ENGINEERING

Group 9A—Components

400,669

PB84-216944 Not available NTIS
National Bureau of Standards, Washington, DC.
Verification of Models for Fabrication of Arsenic Source-Drains in VLSI MOSFETs.
Final rept.,
J. Albers, P. Roitman, and C. L. Wilson. Nov 83, 10p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices ED30, n11 p1453-1462 Nov 83.

Keywords: *Field effect transistors, *Metal oxide transistors, *Semiconductor junctions, Integrated circuits, Silicon, Arsenic, Annealing, Measurement, Reprints, Very large scale integration, Ion implantation, Secondary ion mass spectroscopy, Rutherford backscattering, Spreading resistance.

The understanding of the effects of both low- and high-temperature anneals of arsenic implanted into silicon is critical in the calculation of p-n junction profiles of sources and drains in short-channel MOSFET's. The work reported here uses a sample matrix of arsenic implanted into silicon over a wide range of fluences and annealed in both the low- and high-temperature regimes. This matrix of samples was measured by means of Rutherford Backscattering Spectrometry (RBS), spreading resistance (Rsp), and Secondary Ion Mass Spectrometry (SIMS). The measurement techniques are compared with each other, with the predictions of ion-implantation models, and with the annealing/diffusion models.

400,670

PB84-217165 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Ionizing Radiation on the Breakdown Voltage of Power MOSFETs.
Final rept.,
D. L. Blackburn, J. M. Benedetto, and K. F. Galloway. Dec 83, 6p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science NS30, n6 p4116-4121 Dec 83.

Keywords: *Field effect transistors, *Metal oxide transistors, *Ionizing radiation, *Electrical faults, Electric potential, Reprints, *Breakdown voltage, *Breakdown(Electronic threshold), *Physical radiation effects, Voltage.

It is shown that the drain-source breakdown voltage of power MOSFETs is a strong function of the total dose of ionizing radiation to which the device has been exposed. For the n-channel MOSFETs studied, the breakdown voltage after exposure is reduced from the unirradiated value. The cause for the effect is postulated to be the trapping of radiation generated charge in the field oxide and the generation of traps at the field oxide-silicon interface. The devices studied varied in breakdown voltage between 60 to 500 V and used field plates and/or field rings to terminate the high voltage junction.

400,671

PB84-217264 Not available NTIS
National Bureau of Standards, Washington, DC.
Comparison of Simple Approximations and Numerical Solutions for the Threshold Voltage of Ion-Implanted Long-Channel MOSFETs.
Final rept.,
B. P. Brodfuehrer, K. F. Galloway, and C. L. Wilson. Feb 84, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Education E27, n1 p3-6 Feb 84.

Keywords: *Metal oxide transistors, Electric potential, Approximation, Reprints.

The very simple approximations used for calculating the threshold voltage shifts for ion-implanted long-channel MOSFETs in classroom discussions are compared with the results of a more exact numerical simulation. Limited experimental measurements are compared with the calculated threshold voltage shifts.

400,672

PB84-217439 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Electrosystems Div.
Development of Power System Measurements - Quarterly Report, July 1, 1983 to September 30, 1983.
R. E. Hebner. Feb 84, 28p NBSIR-84-2818
See also PB84-197300. Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Electric fields, *Electric insulation, Measurement, Space charge, Electric corona, Insulating oil, Sulfur hexafluoride, Dielectric breakdown, High voltage.

The report emphasizes the measurement of the 60-Hz electric and magnetic field in biological exposure facilities, the measurement of water vapor, the production rates of oxyfluorides in SF6 corona discharges, and in the measurement of space charge in transformer oil.

400,673

PB84-221753 Not available NTIS
National Bureau of Standards, Washington, DC.
Method for Selecting a Minimum Test Chip Sample Size to Characterize Microelectronic Process Parameters.
Final rept.,
J. S. Suehle, L. W. Linholm, and K. Kafadar. May 83, 5p
Pub. in Proceedings of IEEE Custom Integrated Circuits, Rochester, New York, May 23-25, 1983, IEEE Cat. No. 83CH1859-8, p308-312.

Keywords: *Integrated circuits, Sampling, Microelectronics, Tests, Estimates, *CMOS.

A method for determining a test chip sample size to estimate effectively the electrical parameter distributions on an integrated circuit wafer is presented. This method gives relations among sample size and the figure of merit for four statistical techniques (trimmed mean, biweighted mean, median, and arithmetic mean) by which estimates are calculated. To demonstrate the use of this method, it has been applied to the evaluation of a CMOS fabrication process.

400,674

PB84-222132 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of the Spatial Variation of Interface Trapped Charge Using Short-Channel MOSFET's.
Final rept.,
T. J. Russell, C. L. Wilson, and M. Gaitan. Dec 83, 10p
Pub. in IEEE Transactions on Electron Devices ED-30, n12 p1662-1671 Dec 83.

Keywords: *Field effect transistors, *Metal oxide transistors, Mathematical models, Interfaces, Silicon, Reprints, *Interface trapped charge, Two dimensional.

Previous measurements of interface trapped charge (ITC) by charge pumping used long-channel metal gate transistors. In this paper charge pumping is extended to short-channel self-aligned polysilicon gate transistors and used to determine the spatial variation of ITC on wafers. Only the MOSFET gate area and a pulse frequency are required to calculate ITC density from the charge pumping current.

400,675

PB84-222603 Not available NTIS
National Bureau of Standards, Washington, DC.
Degradation of Native Oxide Passivated Silicon Photodiodes by Repeated Oxide Bias.
Final rept.,
J. Verdebout, and R. L. Booker. 15 Jan 84, 7p
Pub. in Jnl. of Applied Physics, v55 n2 p406-412, 15 Jan 84.

Keywords: *Photodiodes, Silicon, Degradation, Quantum efficiency, Reprints.

A thin, native oxide p-n photodiode was repeatedly subjected to combinations of negative and positive oxide bias in order to document on a larger scale the degradation noticed on a thicker-oxide photodiode used in a self-calibration procedure. The photodiode's quantum efficiency (QE) decreased considerably during the course of the measurements but could be partially restored by exposure to steam or hydrogen. These and other results are discussed in terms of a simple model of the front p+ region that distinguishes

the influences of interface recombination velocity and the induced surface electric field on the QE. According to the model, the observed decrease in QE implies an increase of several orders of magnitude in the recombination velocity at the oxide-silicon interface. Some experimental observations indicate that a change also occurs in the charge density at the Si-SiO2 interface.

400,676

PB84-223429 Not available NTIS
National Bureau of Standards, Washington, DC.
Conductors for Advanced Energy Systems, Annual Report 1982.
Final rept.,
F. R. Fickett. 1983, 104p
Sponsored in part by International Copper Research Association, Inc., New York.
Pub. in International Copper Research Association, Project No. 312A, pi-97 1983.

Keywords: *Superconducting magnets, *Copper, Electric conductors, Electrical resistivity, Magnetoresistivity, Superconductors, Cryogenics, Annealing, Stresses, Strains.

The coppers that are almost always chosen for stabilizing superconductors are the oxygen-free grades, usually CDA 102 in the U.S. As the copper undergoes considerable deformation and thermal treatment in the production of the conductor, it is essential that information be available that will allow the magnet designers to determine the amount of copper required for optimum protection and maximum current density. It is this problem that is addressed in the experimental program reported here. Data are presented on the resistance and magneto-resistance at 4 K of various coppers and how these parameters are affected by temper, anneal, and strains induced by several methods.

400,677

PB84-224096 Not available NTIS
National Bureau of Standards, Washington, DC.
Understanding the Purcell Filter.
Final rept.,
P. Debenham. Sep 81, 4p
Pub. in Proceedings of Workshop on High-Resolution, Large-Acceptance Spectrometers, Argonne, Illinois, September 8-11, 1981, pIII.H-1-III.H-4.

Keywords: *Magnets, Design, *Purcell filters.

The observation that H-magnets with Purcell filters do not automatically produce a homogeneous magnetic field is explained. The importance of proper design of the pole-end and coil geometry is shown.

400,678

PB84-224716 Not available NTIS
National Bureau of Standards, Washington, DC.
Peak Conductance Measurements of GaAs Switching Devices.
Final rept.,
B. A. Bell, and A. G. Perrey. Aug 83, 12p
Pub. in Proceedings of SPIE (Society of Photo-Optical Engineers), San Diego, CA., August 24-26, 1983, p128-139.

Keywords: *Photoconductive cells, Photoconductivity, Measurement, Computerized simulation, Gallium arsenides, Electric switches, Comparison, Tests.

This paper describes the test apparatus and circuitry used to make measurements of pulsed light conductance on samples of high resistivity (10 to the 7th power ohm-cm) gallium arsenide switching devices, having nominal 25 micrometer and 700 micrometer gap spacings. Differences in conductance are observed on variously grown samples. Comparisons are made between the observed pulse measurements and the pulse waveforms generated by computer simulation using a model based on a theoretical analysis of the relationships between photoconductance and irradiated optical power.

400,679

PB84-225408

Not available NTIS

National Bureau of Standards, Washington, DC.

Two-Dimensional Analysis of Semiconductor Devices Using General-Purpose Interactive PDE Software.

Final rept.,

J. L. Blue, and C. L. Wilson. Sep 83, 23p

Pub. in SIAM (Society for Industrial and Applied Mathematics) Jnl. of Scientific Statistical Computers, v4 n3 p462-484 Sep 83.

Keywords: *Semiconductor devices, *Integrated circuits, *Nonlinear differential equations, *Partial differential equations, *Elliptic differential equations, Mathematical models, Metal oxide transistors, Field effect transistors, Semiconductor junctions, Minicomputers, Reprints, Very large scale integration, Two dimensional calculations, Computer software.

Analyzing currents and fields in VLSI devices requires solving three coupled nonlinear elliptic partial differential equations in two dimensions. Historically, these equations have been solved using a special-purpose program and batch runs on a large fast computer. The authors use a general-purpose program and interactive runs on a large minicomputer. They discuss the physical formulation of the semiconductor equations and give three example solutions: a short-channel MOSFET near punchthrough, a DMOS power transistor in the ON state, and a beveled p-a junction. These examples demonstrate that solutions to a very general class of semiconductor-device problems can be obtained using these methods.

400,680

PB84-225440

Not available NTIS

National Bureau of Standards, Washington, DC.

Optical Modulator and Link for Broadband Antennas.

Final rept.,

J. C. Wyss, M. Kanda, D. Melquist, and A. Ondrejka.

1982, 2p

Pub. in Proceedings of Conference Precision Electromagnetic Measurements, CPEM Digest 82, Boulder, CO., June 28-July 1, 1982, IEEE Cat. No. 82CH1737-6, p16-17.

Keywords: *Electrooptics, Broadband antennas, Frequency response, Fiber optics, Lithium inorganic compounds, Tantalates, Detectors, *Optical modulators, Light modulation, Laser radiation, Lithium tantalates.

To avoid pick-up and electromagnetic perturbation problems normally associated with the use of metallic cables between an antenna and receiver electronics, an optical modulator and optical link are used instead. Laser light (632.8 nm) is modulated at the antenna by an electro-optical, lithium tantalate crystal and is then transmitted optically to the receiver electronics where the laser light is detected using an avalanche phototransistor. The crystal is mounted directly on the antenna without amplifiers or other active components. In initial tests, a modulating voltage is applied directly to the antenna. The frequency response was tested to be flat (+ or - 3 dB) from 10 MHz to at least 430 MHz. The output signal was linear from 0.01 - 10 V input with a signal to noise ratio of 2:1 at 10 mV input.

400,681

PB84-225580

Not available NTIS

National Bureau of Standards, Washington, DC.

Fabrication and Characterization of Ultra-Drawn Thick PVDF (Polyvinylidene Fluoride) Transducers.

Final rept.,

A. J. Bur, and A. K. Tsao. 1982, 1p

Pub. in Proceedings of Int. Union Pure Appl. Chem., Macromolecular Symposium (28th), University of Massachusetts, Amherst, MA., July 12-16, 1982, p457.

Keywords: *Piezoelectric transducers, *Transducers, *Pyroelectricity, Fluorine organic compounds, Piezoelectric crystals, Fabrication, Drawing, *Vinylidene fluoride polymers.

Ultra-drawn PVDF (polyvinylidene fluoride) transducers have been fabricated from pellet resin material with thicknesses of 0.23, 0.30 and 0.50 mm. The samples were mechanically ultra-drawn beyond their natural 4:1 draw ratio to a 7:1 ratio in order to enhance the molecular orientation and thereby optimize the piezoelectric activity. The samples were characterized using modulus and x-ray measurements which showed that modulus increases with increasing draw ratio and that the

crystalline portion of the 7:1 drawn material was mostly beta phase. Ten out of fourteen samples were successfully poled at room temperature with fields ranging from 1.6 to 2.5 MV/cm. The pyroelectric activities ranged from 2.0 to 4.1 nc/(sq cm)K and the hydrostatic piezoelectric coefficients ranged from 8.6 to 15.6 pC/N.

400,682

PB84-226273

Not available NTIS

National Bureau of Standards, Washington, DC.

Evidence of Band-Gap Narrowing in the Space-Charge Layer of Heavily Doped Silicon Diodes.

Final rept.,

J. R. Lowney, and W. R. Thurber. 2 Feb 84, 2p

Pub. in Electronics Letters 20, p142-143, 2 Feb 84.

Keywords: *Semiconductor diodes, *Energy gap, *Silicon, Semiconductor doping, Space charge, Capacitance, Reprints.

The gradient voltage has been measured for seven heavily doped, graded-junction silicon diodes at 300 K. Experimental values up to nearly 0.5 V lower than conventional theoretical predictions have been observed. The lowering is attributed to bandgap-narrowing in the space-charge region. This narrowing is expected to be much larger than in neutral material of the same doping density because of the absence of free-carrier screening.

400,683

PB84-226380

Not available NTIS

National Bureau of Standards, Washington, DC.

Numerical Methods for Solving Coupled Semiconductor Equations on a Minicomputer.

Final rept.,

J. L. Blue, and C. L. Wilson. 1984, 10p

Pub. in Elliptic Problem Solvers 2, p521-530 1984.

Keywords: *Semiconductor devices, *Mathematical models, *Nonlinear differential equations, *Elliptic differential equations, Partial differential equations, Finite element analysis, Numerical integration, Electric current, Iteration, Minicomputers, Reprints, Newton method, Interactive graphics, Two dimensional calculations.

A general mathematical model for analyzing currents and fields in semiconductor devices requires three coupled nonlinear elliptic partial differential equations in two dimensions. A general-purpose solver for systems of coupled nonlinear elliptic PDEs is used. The numerical framework is linear elements on triangles, with nonuniform triangulations. The nonlinear finite element equations are solved by approximate Newton methods; the linearized equations are solved by sparse Gaussian elimination and by multi-level iteration. For accurate solutions, triangle refinements are generated adaptively.

400,684

PB84-226794

Not available NTIS

National Bureau of Standards, Washington, DC.

Double Transformer Coupling to a Very Low Noise SQUID.

B. Muhlfelder, W. Johnson, and M. W. Cromar. May

83, 5p

Pub. in Institute of Electrical and Electronics Engineers Transactions on Magnetics MAG-19, n3 p303-307 May 83.

Keywords: *Coupling circuits, Superconductors, Josephson junctions, Transformers, Reprints, *SQUID devices.

The authors demonstrate a new way to couple efficiently to a low-inductance, low-noise SQUID. They built and tested a planar dc SQUID with an integral matching transformer. The measured coupling agrees with their calculations. They demonstrate that this configuration can efficiently couple a 1 (mu)H signal source to a 16 pH SQUID loop. They have also built an uncoupled SQUID of this design that has an energy sensitivity, referred to the SQUID inductor, of 1.3 x (10 to the -32 power) J/Hz = 20 h over a flux range of about 0.15 (phi sub D).

400,685

PB84-243856

Not available NTIS

National Bureau of Standards, Washington, DC.

Ionizing Radiation Effects on Power MOSFETs during High Speed Switching.

Final rept.,

D. L. Blackburn, D. W. Berning, J. M. Benedetto, and

K. F. Galloway. Dec 82, 4p

Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science NS-29, n6 p1555-1558 Dec 82.

Keywords: *Metal oxide transistors, Radiation effects, Integrated circuits, Reprints.

Data on the effects of gamma radiation on the electrical characteristics of power VDMOS transistors are presented. The devices were exposed to radiation while the gate voltage was switching at 100 kHz or while held at a dc voltage. Several drain voltage configurations were also explored.

400,686

PB84-244862

Not available NTIS

National Bureau of Standards, Washington, DC.

Superconducting Current Injection Transistor.

Final rept.,

B. J. Van Zeghbroeck. 15 Apr 83, 3p

Pub. in Applied Physics Letters 42, n8 p736-738, 15 Apr 83.

Keywords: *Transistors, Superconductivity, Josephson junctions, Reprints.

A new superconducting transistor has been investigated, both theoretically and experimentally. The device has a current gain of 10 and an estimated power-delay product of 90 aJ. It is shown that in principle, the gain of the device is limited only by its length. Possible applications include analog amplification and digital logic.

400,687

PB84-244953

Not available NTIS

National Bureau of Standards, Washington, DC.

Quartz Crystal Resonators and Oscillators, Recent Developments and Future Trends.

Final rept.,

R. J. Besson, J. M. Gros Lambert, and F. L. Walls.

1982, 9p

Pub. in Ferroelectrics 43, p57-65 1982.

Keywords: *Quartz resonators, *Crystal oscillators, Development, Trends, Reprints.

The paper deals only with the most recent and significant developments in the field, because excellent review papers on crystal resonators and oscillators are available and given in reference. A short historical review providing general concepts is presented first. Then, since important advances have recently been made in the resonator and oscillator field as well, the most significant improvements are pointed out and discussed.

400,688

PB85-100204

Not available NTIS

National Bureau of Standards, Washington, DC.

Electro-Optic Electric-Field Measurements near Oil-Pressboard Interfaces.

Final rept.,

R. E. Hebner, and E. F. Kelley. Jun 84, 4p

Pub. in Proceedings of 1984 IEEE International Symposium on Electrical Insulation, Montreal, Canada, June 11-13, 1984, p311-314.

Keywords: *Electric fields, *Measurement, Dielectrics, Electrical insulation, Insulating oil, Kerr electrooptical effect, Space charge.

Electro-optical Kerr-effect measurements are made to characterize the electric field in the vicinity of pressboard interfaces in transformer oil. The interfaces are placed between parallel plate electrodes and are oriented parallel to the field direction. In the case where the interface is parallel to the field it is in contact with both electrodes. The electric field enhancement in the liquid alone (due to space charge) is compared with the enhancement with interfaces installed. These results serve to better define the roles of space charge and interfacial surface charging in pressboard/transformer-oil high-voltage systems.

Field 9—ELECTRONICS AND ELECTRICAL ENGINEERING

Group 9A—Components

400,689

PB85-108652 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Magnetic Package Leads on the Measurement of Thermal Resistance of Semiconductor Devices.
Final rept.,
D. W. Berning, and D. L. Blackburn. May 81, 3p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices ED-28, n5 p609-611 May 81.

Keywords: *Semiconductor devices, Thermal resistance, Measurement, Electric leads, Reprints.

Magnetic package leads can cause errors in the measurement of the thermal resistance of semiconductor devices. The errors are the result of distortions of the voltage waveforms apparently caused by an increase in the impedance of the leads at short times after switching. This is related to the skin effect, which is the tendency of currents to concentrate on the surface of and decay exponentially into the leads. The concentration increases as the magnetic permeability increases. The influence of the skin effect in the magnetic leads on the measured waveforms and on the measured thermal resistance is shown. A technique for correcting the measured thermal resistance is demonstrated.

400,690

PB85-110146 Not available NTIS
National Bureau of Standards, Washington, DC.
Physical Basis for the Self-Calibration of Silicon Photodiodes.
Final rept.,
J. Geist. 1980, 5p
Pub. in Proceedings of Tech. Program Electro. Opt. Laser Conference Expo., Boston, MA., November 19-21, 1980, p203-207.

Keywords: *Photodiodes, Silicon, Calibrating, Photoelectric emission, Photoconductivity.

Recently a technique that is very accurate and completely independent of radiometric standards has been developed to measure the absolute spectral response of a silicon photodiode. The technique involves the measurement of the magnitude of the various loss mechanisms that reduce the absolute quantum efficiency. The structure and behavior of silicon photodiodes will be discussed from the standpoint of the determination of true absolute quantum efficiency. The various effects that limit the collection efficiency will be described as well as the physics of the measurement of the magnitudes of these effects.

400,691

PB85-113017 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Electronics and Electrical Engineering.
Evaluation of Transient Measurement Methods in Gas-Insulated Transmission Lines.
Final rept.,
R. H. McKnight, and H. K. Schoenwetter. Aug 83, 77p NBSIR-83/2753
Sponsored in part by Bonneville Power Administration, Portland, OR.

Keywords: *Transmission lines, Surges, Power lines, Measurement, Detectors, High voltage, *Gas-insulated cables.

Capacitive sensors suitable for measuring transients in gas-insulated transmission lines have been studied in the laboratory. Measurements of the step response of three different sensors were made with a test line using both low voltage (200 V) and high voltage (10 kV) signals. Sensor designs were based on those used in pulse power measurements. The use of active electronics at the sensor output in the form of fast buffer amplifiers or commercial FET input probes was investigated as a means of extending low frequency cutoff. Lumped parameter models were used to provide theoretical analysis of experimental results.

400,692

PB85-118453 Not available NTIS
National Bureau of Standards, Washington, DC.
Two Theoretical Results Suggesting a Method for Calibrating Ultrasonic Transducers By Measuring the Total Nearfield Force.
Final rept.,
E. B. Miller, and A. D. Yaghjian. 1979, 8p
Pub. in Jnl. of the Acoustical Society of America 66, n6 p1601-1608 Dec 79.

Keywords: *Electroacoustic transducers, Calibrating, Ultrasonic frequencies, Evaluation, Measurement, Reprints, Near fields, Ultrasonics.

Theory and preliminary experiments are outlined relating to a near-field method of evaluating electro-acoustic transducers. The theoretical results are conveniently organized into two theorems. These state: (1) The total complex force on all infinite planes to one side of a transducer and perpendicular to an arbitrary direction, has a constant magnitude equal to the far-field pressure amplitude in that same direction multiplied by the wavelength. (2) The output voltage of a baffled, reciprocal, plane-piston receiver is proportional to the total incident force perpendicular to its face.

400,693

PB85-118594 PC A04/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Critical Current Measurements on an NbTi Superconducting Wire: Standard Reference Material.
Final rept.,
L. F. Goodrich, D. F. Vecchia, E. S. Pittman, J. W. Ekin, and A. F. Clark. Sep 84, 70p NBS/SP-260/91
Also available from Supt. of Docs as SN003-003-02614-0. Sponsored in part by Department of Energy, Washington, DC. Library of Congress catalog card no. 84-601108.

Keywords: Niobium intermetallics, Titanium intermetallics, Magnetic fields, Electric fields, Cryogenics, *Standard reference materials, *Critical current, *Superconducting wires, *Niobium tin.

This report reviews the selection and certification by NBS of a Standard Reference Material (SRM) for the measurement of superconducting critical current. Procedures for preparing and measuring five candidate conductors are described. Evaluation criteria are discussed by which one of the five conductors was selected for the critical current SRM. The designated superconducting wire, SRM 1457, has been subdivided and wound onto 500 spools for distribution. Certified critical current measurements were made on a sample of these spools. Material variability, or inhomogeneity, along the whole wire is included in a statistical model based on the dependence of critical current on temperature and electric field. Critical currents for SRM 1457 are certified at magnetic fields of 2, 4, 6, and 8 T for temperatures from 3.90 to 4.24 K and electric field criteria from 0.05 to 0.2 microV/cm. Statistical tolerance limits and estimated systematic errors are combined to give an overall uncertainty in the certified values. The total uncertainty is no greater than 2.57 percent of the reported critical current at any of the four magnetic fields.

400,694

PB85-120822 Not available NTIS
National Bureau of Standards, Washington, DC.
Superconducting Devices, 1979.
Final rept.,
J. E. Zimmerman, and D. B. Sullivan. 1979, 3p
See also AD-A140050.
Pub. in McGraw-Hill Encycl. Sci. Technol., p378-380 1979.

Keywords: Josephson functions, Superconductivity, Magnetometers, Cryogenics, Reprints, *SQUID devices.

The history of the SQUID is reviewed with emphasis on recent developments.

400,695

PB85-123354 Not available NTIS
National Bureau of Standards, Washington, DC.
Novel Variable-Temperature Chuck for Use in the Detection of Deep Levels in Processed Semiconductor Wafers.
Final rept.,
R. Y. Koyama, and M. G. Buehler. 1979, 5p
Sponsored in part by Advanced Research Projects Agency, Arlington, VA.
Pub. in Review of Scientific Instruments 50, n8 p983-987 Aug 79.

Keywords: *Silicon, *Crystal defects, *Chucks, Semiconductor diodes, Wafers, Band structure of solids, Design, Fabrication, Gold, Reprints, Deep levels.

This paper describes the design, construction, and characterization of a temperature-controllable wafer apparatus for use in the detection of electrically active defects which produce deep levels in the band gap of silicon. In its present form, the wafer chuck can heat and cool wafers as large as 51-mm in diameter over the temperature range from -196 to 350C. Heating rates as high as 7 deg C/s have been achieved. The use of this apparatus is illustrated by wafer mapping the gold defect density in diodes fabricated across a silicon wafer.

400,696

PB85-134021 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Principles of Superconductive Devices and Circuits.
Final rept.,
D. G. McDonald, and A. F. Clark. 1982, 1p
Pub. in Physics Today 35, n2 p80 Feb 82.

Keywords: *Superconductors, *Josephson junctions, Reviews, Reprints, High magnetic field research.

The book is a good introductory text for superconducting electronics.

400,697

PB85-136240 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Training Studies of Epoxy-Impregnated Superconductor Windings. Part III. Epoxies, Conductor Insulations, and Copper Ratio.
Final rept.,
J. W. Ekin, E. S. Pittman, R. B. Goldfarb, M. J. Superczynski, and D. J. Waltman. Jul 84, 8p
See also PB83-177477.
Pub. in Advances in Cryogenic Engineering 30, p977-984 Jul 84.

Keywords: *Superconducting magnets, *Magnet coils, Impregnating, Epoxy resins, Niobium intermetallics, Titanium intermetallics, Coils, Superconductors, Reprints.

A systematic study of the materials and construction factors that affect training in epoxy-impregnated superconductor windings are reported. Using relatively small test rings (18 cm diam), the training rate was measured for several epoxies currently used in magnet construction. These training data correlated well with the strain at fracture measured on these same epoxy materials at 4 K. Results are also reported on the dependence of the training rate on the fiberglass cloth configuration in the winding, the type of superconductor insulation, and the copper-to-superconductor ratio of the conductor.

400,698

PB85-136976 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Critical Current Measurements on a NbTi Superconducting Wire Standard Reference Material.
Final rept.,
L. F. Goodrich, D. F. Vecchia, E. S. Pittman, and A. F. Clark. Jul 84, 8p
Pub. in Advances in Cryogenic Engineering 30, p953-960 Jul 84.

Keywords: *Standards, Niobium intermetallics, Titanium intermetallics, Cryogenics, Reprints, *Standard reference materials, *Superconducting wires, *Critical current, *Niobium titanium.

The experimental evaluation of five candidate conductors for a standard reference material is presented. Data on the variations in the critical current are given

for the conductor chosen to be the SRM. The goal is to present the data that led to the selection and to provide preliminary results on the NbTi superconducting wire standard reference material.

400,699
PB85-137701 PC A07/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Materials and Processes Div.
TERRY-2: A Test Chip for Characterization of the Performance of Buried-Channel Charge-Coupled Device (CCD) Imagers.
 Rept. for 1 Dec 82-30 Nov 83,
 G. P. Carver, and R. A. Wachnik. Dec 84, 137p
 NBSIR-84/2894
 Sponsored in part by Charles Stark Draper Lab., Inc., Cambridge, MA.

Keywords: Microelectronics, Automatic test equipment, *Test chips, Charge coupled devices, Test patterns, Test structures.

Test chip TERRY-2 is intended to be used for characterization of the performance of buried-channel charge coupled device (CCD) imagers fabricated with a double-polysilicon-gate process which includes several implants. Test structures in TERRY-2 address two areas judged to be key ones for CCD performance, device parameters and process parameters, including material properties. TERRY-2 is a modular chip designed for automated testability; wire bonding of selected devices for radiation effects testing; thinning of a region containing test structures, in the same manner a back-side-illuminated CCD would be thinned; and beveling of large devices for spreading resistance or analytical analysis. This report describes the features of TERRY-2, the test structure designs, and the measurement procedures. The technique of charge pumping for measuring interface state density is discussed in an appendix.

400,700
PB85-141018 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Stability and Thermal Quenches in Force-Cooled Superconducting Cables.
 Final rept.,
 V. D. Arp. May 79, 15p
 Sponsored by Massachusetts Inst. of Tech., Cambridge. Francis Bitter National Magnet Lab.
 Pub. in Proceedings of Superconducting MHD Magnet Design Conference, Cambridge, MA, Oct. 18-19, 1978, p142-156 May 79.

Keywords: *Heat transfer, Liquid helium, Thermal stability, Hydrodynamics, Cooling, *Superconducting cables, Temperature dependence, Transients.

This paper describes the active heat transfer and hydrodynamic processes occurring when a cable-in-conduit superconductor is subjected to a localized, time dependent, thermal perturbation. The coupled partial differential equations describing the superconductor temperature and the helium pressure, temperature, and flow are integrated numerically for several practical geometries. The program can be used to predict both the stability limit and the subsequent quench behavior of the system. Comparison with existing multiple-stability data suggests that the predictions are close but further refinements in the heat transfer parameterization are necessary. Predicted quench behavior will be tested in experiments planned for late 1980.

400,701
PB85-141331 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Two-Dimensional Finite Element Charge-Sheet Model of a Short-Channel MOS Transistor.
 Final rept.,
 C. L. Wilson, and J. L. Blue. 1982, 17p
 Pub. in Solid State Electronics 25, n6 p461-477 Jun 82.

Keywords: *Field effect transistors, *Metal oxide transistors, *Mathematical models, Partial differential equations, Finite element analysis, Computation, Reprints, Nonlinear analysis.

A two-dimensional charge-sheet model for short-channel MOS transistors has been developed which extends the one-dimensional charge-sheet model, developed by Brews, to transistors of 1-micrometer channel length. The model is formulated to include the effect of channel inversion layer charge as a nonlinear integral boundary condition on the two-dimensional electrostatic fields in the transistor. This formulation allows the drain current and electrostatic potential to be com-

puted simultaneously without including the full electron current continuity equation. This simplification results in significant increases in computational efficiency. The accuracy of this model is verified by modeling a sequence of transistors with channel lengths between 4.6 micrometers and 1.1 micrometers. The triode and saturation region characteristics of these transistors are calculated and found to be in good agreement with the experimentally measured characteristics.

400,702
PB85-142206 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Some Problems Associated with Interpreting Shielding Effectiveness Measurement Results.
 Final rept.,
 P. F. Wilson, and M. T. Ma. 1984, 10p
 Pub. in Proceedings of EMI/RFI Shielding Plastics, Rosemont, IL., June 18-20, 1984, p9-18.

Keywords: *Electromagnetic shielding, Effectiveness, Measurement, Insertion loss.

Shielding effectiveness is usually measured in terms of insertion loss, that is, the reduction in the fields coupled between a transmitter and receiver achieved by introducing the shield material or case, etc. Although the insertion loss concept is simply stated, problems arise when one attempts to interpret specific insertion loss measurements. Insertion loss depends not only on the shield introduced but also on antenna types used and their positioning, the waveform incident on the shield, and contact resistance. Variations in these factors can yield almost any level of insertion loss for the same shield sample. These concepts will be discussed to emphasize both the difficulty in making even relative insertion loss comparisons and the importance of controlling and understanding insertion loss parameters.

400,703
PB85-142446 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Research Opportunities in Superconductivity.
 Final rept.,
 M. Tinkham, M. R. Beasley, D. C. Larbalestier, A. F. Clark, and D. K. Finnemore. Jul 84, 11p
 Pub. in Cryogenics 24, p378-388 1984.

Keywords: *Superconductors, *Research, Superconductivity, Materials, Reprints, *Superconducting devices.

Opportunities for research in the field of superconductivity are identified in this report of a 'Workshop on Problems in Superconductivity' held at Copper Mountain, Colorado, August 22-23, 1983. Key problems in superconductivity, high payoff areas of research, barriers to progress, and the need for new facilities are outlined in the three areas of basic physics, materials, and devices.

400,704
PB85-143410 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Effect of the Drain-Source Voltage on Dopant Profiles Obtained from the DC MOSFET Profile Method.
 Final rept.,
 M. G. Buehler. 1980, 5p
 DARPA Order-2397
 Pub. in IEEE Transactions on Electron Devices 27, n12 p2273-2277 Dec 80.

Keywords: *Metal oxide transistors, *Field effect transistors, *Semiconductor doping, Direct current, Additives, Profiles, Reprints, Drain source voltage.

An analysis, developed for the influence of a finite drain-source voltage, $V(DS)$, on dopant profiles derived from the dc MOSFET profile method, indicates that the measured profile falls below the true profile near the surface. The effect occurs because the edge of the depletion region in the silicon is not parallel to the oxide-silicon interface for a finite $V(DS)$. For the case of uniformly doped silicon near room temperature, the analysis indicates, for reverse bias applied across the silicon, that the error in the measured dopant density due to a finite $V(DS)$ is less than one percent if $V(DS) =$ or < 0.5 for the built-in voltage, a condition that is easily met in practice. The analysis also reveals that the profile depth determined from the depth profile equation is a simple average of the depletion widths at the source and drain ends of the channel in uniformly doped silicon. Experimental results are presented which confirm the general trends indicated by the analysis.

400,705

PB85-143840 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Measurements of DC Electric Fields and Ion Related Quantities.
 Final rept.,
 R. H. McKnight. Jul 84, 28p
 Pub. in Proceedings of Conference on Environmental Ions and Related Biological Effects, Philadelphia, PA., October 30, 1982, p34-61 Jul 84.

Keywords: *Power transmission lines, Electric fields, Measurement, Current density, Space charge, Ions, Direct current, High voltage, HVDC systems.

Measurement techniques developed by atmospheric scientists for characterizing the earth's electrical environment are useful for measuring various electrical parameters near high voltage dc (HVDC) transmission lines. Parameters of primary interest are the electric field, vertical current density, and polar space charge density. Other quantities which have been measured include conductivity, net space charge density and the mobility spectrum of ions making up the space charge. Errors associated with the various measurements are discussed, including those which result from the high electric fields and space charge densities existing near the lines. In addition, these measurement techniques are being used to characterize the operation of biological exposure systems.

400,706

PB85-144418 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Improved Device Physics for Calculating the Gain of Bipolar Structures in Silicon.
 Final rept.,
 H. S. Bennett. 1984, 5p
 Pub. in The Physics of Submicron Structures, p307-311 1984.

Keywords: *Transistors, Carrier mobility, Semiconductor doping, Gain, Silicon, Energy gap, Reprints, *Bipolar transistors, Carrier lifetime.

A model which is more physically correct than the extensions of the empirical procedures of Slotboom and de Graaff for donor densities above 2.5×10^{10} to the 19th power/cc has been developed for the effective intrinsic carrier concentration in n-type silicon. This new approach, which is based upon quantum mechanics and optical measurements for the bandgap, has been applied to an npn transistor with a 1 micrometer emitter-base junction depth and with donor densities greater than 10 to the 20th power/cc. Conventional device physics with even unrealistic carrier lifetimes does not predict the measured dc common emitter gain. The approach described here with carrier lifetimes comparable to those expected in processed silicon (about 0.1 microsecond) does predict the gain correctly.

400,707

PB85-148120 Not available NTIS
 National Bureau of Standards, Boulder, CO.
Microwave-Induced Constant-Voltage Steps at One Volt from a Series Array of Josephson Junctions.
 Final rept.,
 J. Niemeyer, J. H. Hinken, and R. L. Kautz. 15 Aug 84, 3p
 Pub. in Applied Physics Letters 45, n4 p478-480, 15 Aug 84.

Keywords: *Josephson junctions, Superconductivity, Cryogenics, Microwaves, Standards, Reprints, *Voltage standards.

It is demonstrated that a series array of 1474 Josephson junctions can produce quantized voltages up to 1.2 V when driven by microwaves at 90 GHz in the absence of a dc bias. This result brings closer the possibility of a practical Josephson voltage standard at the 1-V level.

Field 9—ELECTRONICS AND ELECTRICAL ENGINEERING

Group 9A—Components

400,708

PB85-151678 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Comments on 'Determining Specific Contact Resistivity from Contact End Resistance Measurements'.

Final rept.,
J. A. Mazer, and L. W. Linholm. Sep 84, 2p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Electron Device Letters EDL-5, n9 p347-348 Sep 84.

Keywords: *Electric contacts, *Electrical resistivity, Measurement, Reprints.

A recent letter in this journal by Chern and Oldham discussed a method of determining specific contact resistance from measurements on a specifically designed test structure. The purpose of this letter is to comment on the application of the transmission-line model (TLM) in that letter and to comment on the interpretation of other work, specifically that of Proctor and Linholm that appears in that letter.

9B. Computers

400,709

FIPS PUB 101 PC A03/MF A01
National Bureau of Standards, Washington, DC.

Guideline for Lifecycle Validation, Verification, and Testing of Computer Software. Category: Software. Subcategory: Validation, Verification, and Testing.

Federal information processing standards (Final),
D. R. Wallace. 6 Jun 83, 42p
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Computer programming, *Standards, *Guidelines, National government, *Federal Information Processing Standards, *Computer software tools, *Computer software validation, Computer software verification, Automatic programming, Life cycle.

The Guideline is intended for those who direct or implement software development projects. It recommends that validation, verification, and testing (VV&T) be performed throughout the software development lifecycle, and presents information on selection and use of such techniques to meet project requirements. The Guideline also explains how to develop a VV&T plan to fulfill a specific project's VV&T requirements.

400,710

FIPS PUB 102 PC A05/MF A01
National Bureau of Standards, Washington, DC.

Guideline for Computer Security Certification and Accreditation. Category: ADP (Automatic Data Processing) Operations. Subcategory: Computer Security.

Federal information processing standards (Final) Jan 81-Sep 82,
W. Neugent, and Z. G. Ruthberg. 27 Sep 83, 94p
Prepared in cooperation with System Development Corp., McLean, VA.

Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Guidelines, *Computers, *Security, Risk, Verifying, *Computer security, *Federal information processing standards.

This Guideline is intended for use by ADP managers and technical staff in establishing and carrying out a program and a technical process for computer security certification and accreditation of sensitive computer applications. It identifies and describes the steps involved in performing computer security certification and accreditation; it identifies and discusses important issues in managing a computer security certification and accreditation program; it identifies and describes the principal functional roles needed within an organization to carry out such a program; and it contains sample outlines of an Application Certification Plan and a Security Evaluation Report as well as a sample Accreditation Statement and sensitivity classification scheme. A discussion of recertification and reaccreditation and its relation to change control is also included. The Guideline also relates certification and accreditation to risk analysis, EDP audit, validation, verification and testing (VV&T), and the system life cycle. A comprehensive list of references is included.

400,711

FIPS PUB 105 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.

Guideline for Software Documentation Management. Category: Software. Subcategory: Documentation.

Federal information processing standards publication (Final).
P. Wray, S. Pakin, and A. J. Neumann. 6 Jun 84, 33p
Prepared in cooperation with Pakin (S.) and Associates, Inc., Chicago, IL.

Three ring FIPS binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Documentation, *Management, Guidelines, Computer programs, Policies, Standards, Planning, Distributing, *Computer software management, *Computer software.

This Guideline can assist managers in establishing policies and procedures for effective preparation, distribution, control, and maintenance of documentation which will aid in the re-use, transfer, conversion, correction, and enhancement of computer programs. It outlines policies, procedures, and applicable standards and provides checklists in support of documentation policies, and procedures. It also includes references to relevant standards, guidelines, and the literature and a glossary of terms. Adequate software documentation, together with the computer programs themselves, provide software product packages that can be transferred and used by people other than the originators of the programs.

400,712

FIPS PUB 106 PC A02/MF A01
National Bureau of Standards, Gaithersburg, MD.

Guideline on Software Maintenance. Category: Software. Subcategory: Software Maintenance.

Federal information processing standards,
R. Martin, and W. Osborne. 15 Jun 84, 25p
Three ring vinyl FIPS binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: Computer systems programs, Standards, Policies, *Federal Information Processing Standards, *Computer software maintenance, Software engineering, Software tools, Software lifecycle, Guidelines.

The need for a strong, disciplined, clearly-defined approach to software maintenance is presented. Emphasis is placed on the maintainability of the software and the need for consideration of software maintenance throughout the lifecycle of a software system. The need to plan, develop, use, and maintain a software system with future software maintenance in mind is stressed. The conclusion is drawn that improvements in an organization's software maintenance efforts will come primarily as a result of the institution and enforcement of software maintenance policies, standards, procedures, and techniques.

400,713

FIPS PUB 8-5 PC A06/MF A01
National Bureau of Standards, Gaithersburg, MD.

Metropolitan Statistical Areas (Including CMSAs (Consolidated Metropolitan Statistical Areas), PMSAs (Primary Metropolitan Statistical Areas), and NECMAs (New England County Metropolitan Areas)). Category: Data Standards and Guidelines. Subcategory: Representations and Codes.

Federal information processing standards (Final),
H. Tom. 31 Oct 84, 103p
Supersedes FIPS PUB 8-4.
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Data processing, *Standards, Identifying, Coding, Urban areas, *Standard metropolitan statistical areas, *Federal Information Processing Standards, Counties, Metropolitan areas.

This standard specifies names, principal components, and identification codes for the Metropolitan Statistical Areas (MSAs) of the United States and Puerto Rico, including units called Consolidated Metropolitan Statistical Areas (CMSAs) and Primary Metropolitan Statistical Areas (PMSAs), and related units called New England County Metropolitan Areas (NECMAs). The general concept underlying the definitions of MSAs and related units is that of a geographic area consisting of a large population nucleus together with adjacent communities having a high degree of economic and social integration with that nucleus. This revision supersedes FIPS PUB 8-4 in its entirety.

400,714

PB84-138825 PC A03/MF A01
National Bureau of Standards, Washington, DC. Inst.

for Computer Sciences and Technology.
Proceedings of the LAN-Transport Workshop (4th) Held on October 27-28, 1983.
F. Nielsen. Nov 83, 47p NBSIR-83-2796
See also PB83-251348.

Keywords: *Computer networks, *Meetings, Standards, Specifications, *Protocols, *Local area networks, File transfer protocol.

The National Bureau of Standards Institute for Computer Sciences and Technology (ICST) has prepared specifications for the International Organization for Standardization's (ISO) Class 4 Transport Protocol. At the request of a number of companies, ICST organized a workshop series for implementors of these specifications using local area networking technology. The first workshop focused on implementation techniques and strategies so that a multivendor demonstration of these protocols can occur at a major computer conference in 1984 targeted for the NCC 1984. Primarily the details of CSMA/CD and Transport Class 4 were discussed and parameters were selected. A second workshop focused on token bus LANs and file transfer applications to be run at the targeted 1984 demonstration. Agreements on the specifics of the file transfer protocol were reached at the third workshop. This report documents the fourth workshop in the series of LAN-Transport workshops. The fourth workshop covered further refinements to the file transfer protocol, testing procedures, and demonstration details.

400,715

PB84-162189 PC A04/MF A01
National Bureau of Standards, Washington, DC.

Computer Science and Technology: Guide on Data Models in the Selection and Use of Database Management Systems.

Final rept.,
L. J. Gallagher, and J. M. Draper. Jan 84, 74p NBS-SP-500-108
Also available from Supt. of Docs. as SN003-003-02543-7. Library of Congress catalog card no. 83-600630.

Keywords: *Computer programming, *Information systems, User needs, Data processing, Programming languages, *Data base management systems, Relational data bases.

Selecting a database management system involves matching users' requirements and the capabilities of available products. One way to simplify this task is to define data models identifying both data structures and the operations on those structures. In the past every commercial product has implemented its own data model. Now technical committee X3H2 of the American National Standards Institute is working on specifications for two models that are similar but not identical to many existing products. In addition to the issue of data models, prospective buyers of database software need to consider features that affect daily operations. Existing hardware and operating systems sometimes limit the choice to a few commercial products. Systems also vary widely in their facilities for backup and recovery, bulk loading, scheme manipulation, concurrency control, and report writers.

400,716

PB84-167725 PC A03/MF A01
National Bureau of Standards, Washington, DC. Inst.

for Computer Sciences and Technology.
Computer Science and Technology: Selection of Microcomputer Systems.

Final rept.,
J. Barkley, D. Gilbert, and A. Hankinson. Mar 84, 34p NBS-SP-500-112
Also available from Supt. of Docs. as SN003-003-02553-4. Library of Congress catalog card no. 84-601010.

Keywords: *Microcomputers, *Computers, Equipment specifications, Evaluation.

This document is chiefly aimed at providing assistance to non-technical users in evaluating the applicability of microcomputer-based systems in addressing their needs and choosing appropriate systems. However, technical users providing related support to their organizations should also find the material useful. Similarly, while focussed for Federal users of administrative/

management applications, there is general applicability to other environments.

400,717

PB84-171305 PC A19/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Guide to Available Mathematical Software,
R. F. Boisvert, S. E. Howe, and D. K. Kahaner. Jan 84, 441p NBSIR-84-2824

Keywords: *Computer systems programs, *Catalogs(Publications), Applications of mathematics, Statistical analysis, Computer programs, Libraries.

The second edition of the Guide to Available Mathematical Software (GAMS) provides summary documentation of software available to NBS staff on a variety of computers. The fifteen libraries documented in GAMS are: BMDP, CMLIB, (containing three dozen public-domain packages), DATAPAC, IMSL, INVAR, MATHWARE, MATLAB, MINITAB, NAG, PDELIB, PLOD, PORT, SLDGL, SPECTRLAN, STATLIB. GAMS is based on an extensive problem-oriented scheme for classifying software for mathematical computations including special functions, linear algebra, optimization, differentiation and integration, differential and integral equations, and statistics and probability. The document contains the classification scheme, a catalog of software organized by class, a dictionary of the software, library references, and an index.

400,718

PB84-176494 PC A03/MF A01
National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.
Assessment of Techniques for Evaluating Computer Systems for Federal Agency Procurements.
Final rept.,
H. Letmanyi. Mar 84, 39p NBS-SP-500-113
Also available from Supt. of Docs. as SN003-003-02561-5. Prepared in cooperation with MITRE Corp., McLean, VA. Library of Congress catalog card no. 84-601012.

Keywords: *Computer programs, *Assessments, *Ratings, *Computer systems programs, *Computer systems hardware, Aquisition, Bench marks, Microcomputers, National government, Main frame computers.

The primary purpose of this document is the identification and qualitative assessment of computer system evaluation techniques for use during acquisition of computer systems. Also addressed is the identification of several criteria by which these alternative evaluation techniques may be compared and selected. The concepts presented in this study are applicable to all sizes of general purpose computers, from microcomputers to mainframes. Embedded or single-purpose computers, such as those used in weapon systems, have been excluded.

400,719

PB84-178029 PC A03/MF A01
National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.
Comparing Software Development Methodologies for Ada (Trade Name): A Study Plan.
Final rept.,
P. Freeman, A. I. Wasserman, and R. C. Houghton, Jr. Mar 84, 38p NBSIR-84-2827
Contract AJPO-83-27
Prepared in cooperation with California Univ., Irvine, and California Univ., San Francisco.

Keywords: *Computer systems programs, Maintenance, *Computer software, Ada codes, Computer software maintenance.

A study plan is presented that concentrates on the impact of alternative development methodologies on the maintainability of Ada code. The basic elements of the study include: (1) experts in each of several methods create Ada implementation for a specific problem, (2) each implementation is modified by each of several maintenance teams, and (3) the impact of the methodology on the maintainability of the resulting Ada-coded systems is evaluated and reported.

400,720

PB84-178037 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Overview of Artificial Intelligence and Robotics. Volume 1. Artificial Intelligence. Part A - The Core Ingredients,
W. B. Gevarier. Feb 84, 75p NBSIR-83-2799
See also PB83-217547.

Keywords: *Artificial intelligence, *Robots, Heuristic methods, Cognition, Computers, Speech recognition, Speech, *Expert systems, Speech synthesis.

Artificial Intelligence (AI) is an emerging technology that has recently attracted considerable attention. Many applications are now under development. The goal of Artificial Intelligence is focused on developing computational approaches to intelligent behavior. This goal is so broad--covering virtually all aspects of human cognitive activity--that substantial confusion has arisen as to the actual nature of AI, its current status and its future capability. This volume, the first in a series of NBS/NASA reports on the subject, attempts to address these concerns. Thus, this report endeavors to clarify what AI is, the foundations on which it rests, the techniques utilized, applications, the participants and, finally, AI's state-of-the-art and future trends. It is anticipated that this report will prove useful to government and private engineering and research managers, potential users, and others who will be affected by this field as it unfolds.

400,721

PB84-178821 PC A07/MF A01
SoHaR, Inc., Los Angeles, CA.
Microcomputers: introduction to Features and Uses.
Final rept.,
M. Hecht, H. Hecht, and L. Press. Mar 84, 148p
NBS-SP-500-110
Grant NB82SB-C-A1654
Also available from Supt. of Docs. as SN003-003-02560-7. Library of Congress catalog card no. 84-601005.

Keywords: *Microcomputers, Computer programming, Dictionaries, Bibliographies.

This document is an introduction to microcomputers and their uses in the Federal government. Basic concepts in microcomputers are discussed, and their uses by clerical, administrative, professional, and technical Federal personnel are described. The motivations, costs, and risks of microcomputer use are identified, and recommendations for successful implementations are provided. Appendices contain a glossary and annotated bibliography.

400,722

PB84-211796 CP T19
National Bureau of Standards (NEL), Washington, DC. Statistical Engineering Div.
DATAPLOT: An Interactive High-Level Language for Graphics, Non-Linear Fitting, Data Analysis, and Mathematics, Version 84/7.
Software,
J. J. Filliben. Jul 84, mag tape NBS/DF-84/003
Supersedes PB83-215574.
Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB82-181462, PB82-181470, PB82-181504, PB82-181488, PB82-181496, PB84-214063 and PB84-214055.

Keywords: *Software, *Computer graphics, *Mathematics, *Statistics, *Plotting, *Data analysis, *Curve fitting, *Modeling, Magnetic tapes, Fortran-77, *Dataplot programming language.

DATAPLOT is a high-level (free-format English-like syntax) language for: (1) graphics (continuous or discrete); (2) fitting (linear or non-linear); (3) general data analysis; (4) mathematics. It was developed originally in 1977 in response to data analysis problems encountered at the National Bureau of Standards. It is a valuable tool not only for 'raw' graphics, but also for manuscript preparation, modeling, data analysis, data summarization, and mathematical analysis. DATAPLOT may be run either in batch or interactively, although it was primarily designed for (and is most effectively used in) an interactive environment. DATAPLOT is virtually machine and device independent...Software De-

scription: This software was developed on a DEC VAX 11/780 under the VMS operating system. However, due to its modular design and underlying ANSI FORTRAN code, DATAPLOT is portable to a wide variety of computers. Approximately 300K bytes (overlay) or 2.5MB (non-overlay) of memory are required. Test problems are included with the package.

400,723

PB84-214055 PC A06/MF A01
National Bureau of Standards (NEL), Washington, DC. Statistical Engineering Div.
DATAPLOT - Introduction and Overview,
J. J. Filliben. Jun 84, 117p NBS-SP-667, NBS/DF-84/003B
For system on magnetic tape, see PB84-211796.

Keywords: *Computer graphics, *Programming languages, Computer programming, Specifications, Plotting, Manuals, Source programs, Reprints, *DATAPLOT programming language.

DATAPLOT is a high-level (free-format English-like syntax) language for graphics (continuous or discrete), fitting (linear or non-linear), general data analysis and mathematics. The purpose of this manual is to give the analyst a broad overview of the structure, capabilities, and features of the DATAPLOT language. The features and capabilities described are for version 84/7 of DATAPLOT. Most (but not all) descriptions also hold for prior versions.

400,724

PB84-214063 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC. Statistical Engineering Div.
DATAPLOT - Implementation Tapes Guide,
J. J. Filliben. Jul 84, 79p NBS/DF-84/003A
For system on magnetic tape, see PB84-211796. Supersedes PB82-191685.

Keywords: *Computer graphics, *Programming languages, Computer programming, Specifications, Plotting, Source programs, *DATAPLOT programming language.

DATAPLOT is a high-level (free-format English-like syntax) language for graphics (continuous or discrete), fitting (linear or non-linear), general data analysis and mathematics. The DATAPLOT Implementation Tapes Guide provides instruction and guidance for implementing DATAPLOT.

400,725

PB84-216456 PC A05/MF A01
Computer Corp. of America, Cambridge, MA.
Logical Database Processor Interface Specifications.
Final rept.,
F. A. Manola. Mar 84, 93p CCA-83-11, NBS-GCR-84-461
Contract NB79SBCA-0086
See also PB83-163394.

Keywords: *Standards, Specifications, Computer networks, *Data base management systems, Computer architecture, Data models, Schema, Query languages, Data definition languages, Tree models.

This report describes the interface specifications and processing functions of the logical Database Processor (LDBP) component of a DBMS component architecture developed by Computer Corporation of America for the National Bureau of Standards. The component architecture is intended to serve as a potential framework for developing DBMS standards. The LDBP component serves to implement the DBMS logical data model, and provides access to DBMS metadata for all components. The LDBP interface provides a common target for the development of DBMS user language facilities.

Field 9—ELECTRONICS AND ELECTRICAL ENGINEERING

Group 9B—Computers

400,726

PB84-217033 PC A03/MF A01
National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.
Document Interchange Format,
J. E. Knoerdel, and S. W. Watkins. Apr 84, 41p
NBSIR-84-2836
Sponsored in part by Department of the Navy, Washington, DC.

Keywords: *Data processing, Computer codes, Standards, *Text processing, *Word processing, Interchange format.

In the absence of standards, both the private and public sectors have addressed document interchange among different vendors' text processing systems in a number of ways. In an attempt to solve this interchange problem with respect to encoding of control functions for the Department of the Navy, a project was originated by the Office of the Under Secretary of the Navy for Financial Management to determine the formatting requirements of the Department of the Navy and to translate those requirements to a representation that would be supported by text processing system providers. The encoded representation of the formatting control functions has become known as the Document Interchange Format (DIF). This paper describes the overall approach taken by the DIF and then provides definitions for and implementation details for DIF. The body of the paper is intended for overall understanding and as such is intended for managers and technical staff. Then, there are a number of appendices provided which are specifically written for those implementing DIF.

400,727

PB84-217116 PC A09/MF A01
Computer Corp. of America, Cambridge, MA.
Tree Query Language Flat (TQLF) Specifications.
Final rept.,
F. Manola, and A. Pirotte. Mar 84, 180p CCA-83-05, NBS-GCR-83-455
Contract NB79-SBCA-0086
See also PB83-163394.

Keywords: *Standards, *Data base management systems, TQLF programming language, Query languages, Data models, Computer architecture, Tree models, Relational data bases.

TQLF is a high-level language for defining, accessing, and manipulating data in tree (hierarchical) model databases. TQLF has similarities to both the SQL and QUEL query languages, and was developed within the context of a program to develop a family of data models and database languages for those models. The intent is to provide maximum commonality among members of the family, so as to reduce difficulties when changing from one model to another. TQLF is the member of the family corresponding to the trees data model. NQLF and RQLF are other members of the family corresponding respectively to the network and relational data models.

400,728

PB84-217124 PC A03/MF A01
Computer Corp. of America, Cambridge, MA.
Model-Model Mappings and Conversion in a Family of Data Model Specifications.
Final rept.,
F. A. Manola. Mar 84, 50p CCA-83-14, NBS-GCR-84-464
Contract NB79-SBCA-0086
See also PB83-163394.

Keywords: *Standards, Specifications, *Data base management systems, Data models, Schema, Tree models, Computer architecture, Data translation, Relational data base.

This report describes methods for transforming between data descriptions in different data models of the family of data model specifications developed by Computer Corporation of America for the National Bureau of Standards. The data models include the network, tree, and relational data models. In addition, guidelines are presented for converting databases corresponding to one of these data models to databases corresponding to another such model.

400,729

PB84-217405 PC A07/MF A01
Computer Corp. of America, Cambridge, MA.
Relational Query Language Flat (RQLF) Specifications.
Final rept.,
F. A. Manola, and A. Pirotte. Mar 84, 137p CCA-83/06, NBS/GCR-83/454
Contract NB79-SBCA-0086
See also PB83-163394.

Keywords: *Computer languages, Computer networks, *Data base management systems, *Relational data bases, High level languages, Query languages, ROLF programming languages, Data models.

ROLF is a high-level language for defining accessing, and manipulating data in relational databases. ROLF has similarities to both the SQL and QUEL query languages, and was developed within the context of a program to develop a family of data models and database languages for those models. The intent is to provide maximum commonality among members of the family so as to reduce difficulties when changing from one model to another. ROLF is the member of the family corresponding members of the family corresponding respectively to the tree and network data models.

400,730

PB84-217504 PC A03/MF A01
Software Systems Technology, Inc., College Park, MD.
Performance Evaluation of Database Systems: A Benchmark Methodology.
Final rept.,
S. B. Yao, and A. R. Hevner. May 84, 46p NBS/GCR-84/467
Contract NB82-SBCA-1645
See also PB84-217512.

Keywords: Minicomputers, Microcomputers, Performance evaluation, *Relational data bases, *Data bases, *Benchmarks.

This report presents a generalized performance analysis methodology for the benchmarking of database systems. This methodology discusses criteria to be used in the design, execution, and analysis of a database system benchmark. This is a generalized methodology that can apply to any possible database system. By presenting a wide variety of possible considerations in the design and implementation of the benchmark, it is intended to make this methodology applicable to the evaluation, or to the comparison of several systems.

400,731

PB84-217512 PC A09/MF A01
Software Systems Technology, Inc., College Park, MD.
Analysis of Three Database System Architectures Using Benchmarks.
Final rept.,
S. B. Yao, and A. R. Hevner. 9 May 84, 182p NBS/GCR-84/468
Contract NB82-SBCA-1645
See also PB84-217504.

Keywords: Minicomputers, Microcomputers, Performance evaluation, *Relational data bases, *Data bases, Computer architecture, *Benchmarks.

This report tests a newly designed benchmarking methodology (see related document), which evaluates the performance of database management systems, by applying it to three different database systems representative of current microcomputer, minicomputer, and database machine architectures. These experiments serve to demonstrate the viability of the methodology, and provide performance measures which characterize today's relational database systems under these environments. Finally, this report reaches conclusions, based upon the results of the benchmark experiments, which span the three architectural classes. Observations are made about the performance of each type of system architecture, rather than comparing three commercial database systems.

400,732

PB84-217538 PC A09/MF A01
Computer Corp. of America, Cambridge, MA.
Network Query Language Flat (NQLF) Specifications.
Final rept.,
F. A. Manola, and A. Pirotte. Mar 84, 185p CCA-83/04, NBS/GCR-83/456
Contract NB79-SBCA-0086
See also PB83-163394.

Keywords: *Computer networks, *Data base management systems, Query languages, Data definition languages, Data models, Relational data bases, Computer architecture.

NQLF is a high-level language for defining accessing, and manipulating data in network model databases. NQLF has similarities to both the SQL and QUEL query languages, and was developed within the context of a program to develop a family of data models and database languages for those models. The intent is to provide maximum commonality among members of the family, so as to reduce difficulties when changing from one model to another. NQLF is the member of the family corresponding to the network data model. TQLF and RQLF are other members of the family corresponding respectively to the tree and relational data models.

400,733

PB84-217546 PC A04/MF A01
Computer Corp. of America, Cambridge, MA.
Distributed Database Components in a DBMS (Database Management System) Component Architecture.
Final rept.,
F. A. Manola. Mar 84, 75p CCA-83/13, NBS/GCR-84/463
Contract NB79-SBCA-0086
See also PB83-163394.

Keywords: *Standards, *Data base management systems, *Distributed data bases, Query languages, Computer architecture.

This report describes preliminary specifications and processing functions for distributed database processing components to be added to the DBMS component architecture developed by Computer Corporation of America for the National Bureau of Standards. The component architecture is intended to serve as a potential framework for developing DBMS standards. Functions to be performed by the additional components include distributed query processing, concurrency control, and recovery.

400,734

PB84-217561 PC A05/MF A01
Computer Corp. of America, Cambridge, MA.
Physical Database Processor Preliminary Interface Specifications.
Final rept.,
F. A. Manola. Mar 84, 77p CCA-83/12, NBS/GCR-84/462
Contract NB79-SBCA-0086
See also PB83-163394.

Keywords: *Standards, Specifications, *Data base management systems, Data models, Schema, Query languages, Data definition languages, Relational data bases, Computer architecture.

This report describes preliminary interfaces specifications and processing functions of the Physical Database Processor (PDBP) component of a DBMS component architecture developed by Computer Corporation of America for the National Bureau of Standards. The component architecture is intended to serve as a potential framework for the developing DBMS standards. The PDBP supports storage structure objects and operations for other components of the architecture. The report also describes tradeoffs involved in choosing various storage structures to support DBMS operations.

400,735
PB84-217785 PC A11/MF A01
 National Bureau of Standards, Washington, DC. Systems Components Div.

Proceedings of the National Bureau of Standards/National Security Agency Workshop on Standardization Issues for Optical Digital Data Disk (OD3) Technology Held at Gaithersburg, Maryland on June 1-3, 1983.

Final rept.,
 J. B. Freedman. Apr 84, 242p NBS/SP-500/111
 Also available from Supt. of Docs as SN003-003-02573-9. Library of Congress catalog card no. 84-601025. Sponsored in part by National Security Agency/Central Security Service, Fort George G. Meade, MD.

Keywords: *Standards, Standardization, *Optical storage, *Disk recording systems, Data transfer.

This report constitutes the proceedings of the National Bureau of Standards/National Security Agency jointly-sponsored Workshop on Standardization Issues for Optical Digital Data Disk (OD) Technology, held in Gaithersburg, Maryland, June 1-3, 1983. The objective of this workshop is to promote discussion and interchange among current and potential OD users and suppliers, regarding the prospects for OD data interchange standardization. The workshop presentations include definitions of the physical, dimensional, optoelectrical, quality and data transfer characteristics of OD media, as related to the drive performance. A range of OD applications and their standards' requirements are also described. The various methods currently used for estimating media life expectancies and the potential for standardized terminologies and procedures for such assessments are discussed.

400,736
PB84-217819 PC A03/MF A01
 System Development Corp., McLean, VA.

Computer Science and Technology: Overview of Computer Security Certification and Accreditation.

Final rept. Jan 81-Sep 82,
 Z. G. Ruthberg, and W. Neugent. Apr 84, 26p NBS/SP-500/109
 Contract NB80-SBCA-0323
 Also available from Supt. of Docs as SN003-003-02567-4. Library of Congress catalog card no. 84-601002. See also FIPS-PUB-102.

Keywords: *Security, Secure communications, *Computer security, *Data processing security, Computer information security, Federal information processing standards.

This overview summarizes how to establish and carry out a program and a technical process for computer security certification and accreditation of sensitive computer applications. The overview identifies and briefly describes the steps involved in performing computer security certification and accreditation; it identifies and briefly discusses important issues in managing a computer security certification and accreditation program; and it identifies and briefly describes the principal functional roles needed within an organization to carry out such a program. Recertification and reaccreditation and its relation to change control are also touched upon. A discussion of evaluation techniques to be used for certification includes risk analysis, EDP audit, VV&T (verification, validation, and testing), and security safeguard reviews. The relation of these to the system lifecycle is indicated.

400,737
PB84-217843 PC A04/MF A01
 National Bureau of Standards, Washington, DC. Systems and Software Technology Div.

Introduction to Software Packages.
 Final rept.,
 S. Frankel. Apr 84, 61p NBS/SP-500/114
 Also available from Supt. of Docs as SN003-003-02569-1. Library of Congress catalog card no. 84-601045.

Keywords: Computer programs, Purchasing, Selection, *Computer software, *Computer applications, Software engineering.

This document provides an introduction to applications software packages. It encourages the use of software packages as an alternative to in-house development and directs potential users of software packages to sources of useful information. Application areas which

are currently supported by software packages are reviewed and the benefits of software package use versus in-house development are discussed. This document includes an annotated list of publications which may be useful to potential users of software packages in searching for a package to perform a specific application, and in critically evaluating the merits of different packages.

400,738
PB84-217892 PC A04/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.

Modular Data Acquisition and Display Software System for a Laboratory Environment.

Final rept.,
 L. Kaetzel, J. Grimes, and P. Brown. May 84, 63p NBS/TN-1188
 Also available from Supt. of Docs as SN003-003-02589-5. Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Laboratory equipment, Experimental data, Data acquisition, Data processing, Minicomputers, *Computer software, Multiprogramming, MADS system, Building materials, Phase change materials.

This report describes the processes involved in acquiring and analyzing experimental laboratory data using a medium sized computer in a multi-programming environment with a modular software system. Research involving Phase Change Materials and Calorimetric Performance measurements in building research are used as case studies to describe the functional capabilities and operational procedures of the system. The software system consists of computer programs which allow the researcher to collect, store, and analyze data graphically.

400,739
PB84-221738 Not available NTIS
 National Bureau of Standards, Washington, DC.

Cataloging Statistical Software: Current Efforts by NBS (National Bureau of Standards) and the Committee on Statistical Algorithms.

Final rept.,
 S. E. Howe. 1983, 15p
 Pub. in Proceedings of American Statistical Association, Statistical Computing Section, Toronto, Canada, August 15-18, 1983, p45-50.

Keywords: Algorithms, Linear algebra, Special functions, *Computer software, *Data base management systems, Relational data bases.

In the second phase of a project to organize and publicize the mathematical and statistical software available to scientists at the National Bureau of Standards, the new edition of the Guide to Available Mathematical Software (GAMS) is being produced. In addition to the approximately 2500 subroutines documented in the first edition of GAMS (including IMSL, NAG, PORT, and approximately three dozen high-quality public-domain packages), the second edition describes more subroutines, stand-alone program libraries (e.g., BMDP) and interactive systems (e.g., Minitab). GAMS is based on an extensive problem-oriented scheme for classifying software for statistical computations, as well as other mathematical computations of interest to statisticians, including special functions, linear algebra (e.g., LINPACK), integrals, differential equations, and optimization. The GAMS data are maintained on-line using a relational data base management system, and are accessed via an on-line query system based on the classification scheme. A hard-copy version of GAMS is forthcoming. The GAMS effort is being coordinated with the efforts of the Committee on Statistical Algorithms, Statistical Computing Section, ASA, to document both software and algorithms.

400,740
PB84-222850 PC A22/MF A01
 National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.

Specification of a Transport Protocol for Computer Communications. Volume 1. Overview and Services. Volume 2. Class 2 Protocol. Volume 3. Class 4 Protocol.

Final rept.
 Jun 84, 509p NBSIR-84-2880-VOLS-1/3, NBS/DF-84/005A
 For system on magnetic tape, see PB84-222918. See also PB84-222868.

Keywords: *Standards, *Telecommunication, Operating systems(Computers), *Data communications,

*Transport protocols, UNIX operating systems, C programming language, Software.

The tape contains the source code for the NBS implementation of ISO Scenario Interpreter and Exception Generator; suite of approximately 250 test scenarios; and documentation thereof. The source code is in the C language and the resulting software has been executed in a UNIX environment on a PDP-11/70.

400,741
PB84-222868 PC A07/MF A01
 National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.

Specification of a Transport Protocol for Computer Communications. Volume 4. Service Specifications. Volume 5. Guidance for the Implementor. Volume 6. Guidance for Implementation Selection.

Final rept.
 Jun 84, 135p NBSIR-84-2880-VOLS-4/5, NBS/DF-84/005B
 For system on magnetic tape, see PB84-222918. See also PB84-222850, and PB84-222876.

Keywords: *Standards, *Telecommunication, Operating systems(Computers), *Data communications, *Transport protocols, UNIX operating systems, PDP-11/70 computers, C programming language, Software.

The tape contains the source code for the NBS implementation of ISO Scenario Interpreter and Exception Generator; suite of approximately 250 test scenarios; and documentation thereof. The source code is in the C language and the resulting software has been executed in a UNIX environment on a PDP-11/70.

400,742
PB84-222876 PC A14/MF A01
 National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.

Specification of a Transport Protocol for Computer Communications. Volume 7. Testing OSI Protocols - A Compendium of Papers. Volume 8. User's Guide to the Testing System for Implementations of the ICST Transport Protocol. Volume 9. A Test Suite for Implementations of the ICST Transport Protocol. Volume 10. Specification of a Remote Scenario Interpreter for Implementations of the ICST Transport Protocol.

Final rept.
 Jun 84, 301p NBSIR-84-2880-VOLS-7/10, NBS/DF-84/005C
 For system on magnetic tape, see PB84-222918. See also PB84-222868.

Keywords: *Standards, *Telecommunications, Operating systems(Computers), *Data communications, *Transport protocols, UNIX operating systems, C programming language, Software.

The tape contains the source code for the NBS implementation of ISO Scenario Interpreter and Exception Generator; suite of approximately 250 test scenarios; and documentation thereof. The source code is in the C language and the resulting software has been executed in a UNIX environment on a PDP-11/70.

400,743
PB84-222918 CP T14
 National Bureau of Standards, Washington, DC. Inst. for Computer Sciences and Technology.

NBS/ISO (National Bureau of Standards/International Organization for Standardization) Transport Protocol and Testing Tools.

Software,
 R. J. Linn. 1 Mar 84, mag tape NBS/DF-84/005
 Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer products if you have questions. Price includes PB84-222850, PB84-222868, and PB84-222876.

Keywords: *Software, *Telecommunication, Operating systems(Computers), Standards, Magnetic tape, *Data communications, *Transport protocols, UNIX operating systems, C programming language, PDP-11/70 computers.

The tape contains the source code for the NBS implementation of ISO Scenario Interpreter and Exception Generator; suite of approximately 250 test scenarios; and documentation thereof. The source code is in the C language and the resulting software has been executed in a UNIX environment on a PDP-11/70..Soft-

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ware Description: The system is written in the C programming language for implementation on a DEC PDP 11/70 computer using the UNIX V. 6 modified operating system. The computer memory requirement is 64K words/process.

400,744

PB84-223312 Not available NTIS
National Bureau of Standards, Washington, DC.

Operation of a Superconducting Analog-to-Digital Converter at Short Conversion Times.

Final rept.,

R. L. Kautz, and F. L. Lloyd. May 83, 4p

Sponsored in part by Office of Naval Research, Arlington, VA.

Pub. in IEEE Transactions on Magnetics MAG-19, n3 p1186-1189 May 83.

Keywords: *Analog to digital converters, Josephson junctions, Superconductors, Accuracy, Performance, Tests, Reprints, SQUID devices.

The accuracy of a six-bit superconducting analog-to-digital converter has been tested at short conversion times. The accuracy was found to be good for conversion times down to 0.5 ns but significant errors were observed at a conversion time of 0.1 ns. These errors can be understood in terms of unwanted switching events that occur when the mode boundary separating two flux states is crossed rapidly.

400,745

PB84-223411 Not available NTIS
National Bureau of Standards, Washington, DC.

Design Limitations for Superconducting A/D Converters.

Final rept.,

C. A. Hamilton, and F. L. Lloyd. Nov 81, 6p

Sponsored in part by Office of Naval Research, Arlington, VA.

Pub. in IEEE Transactions on Magnetics MAG-17, n6 p3414-3419 Nov 81.

Keywords: *Analog to digital converters, Josephson junctions, Superconductors, Performance, Design, Reprints, SQUID devices.

This paper reviews the principal of A/D conversion using superconducting quantum interference and describes the results obtained with this technique. At an accuracy of four or six bits, the design of such converters is straightforward. Higher accuracy requires careful consideration of numerous design constraints including critical current uncertainty, power supply regulation, turn-on-delay, signal line crosstalk, and the threshold curve critical points. The implications of these constraints are analyzed with respect to an example design for an 8-bit converter.

400,746

PB84-223551 PC A04/MF A01
McCabe and Associates, Inc., Columbia, MD.

Computer Science and Technology. Structured Testing: A Software Testing Methodology Using the Cyclomatic Complexity Metric.

Final rept.,

T. J. McCabe. Dec 82, 75p NBS/SP-500/99

Also available from Supt. of Docs as SN003-003-02456-2. Library of Congress catalog card no. 82-600651.

Keywords: *Computer programming, Fortran, *Structured programming, *Software engineering, Software metrics.

Various applications of the Structured Testing methodology are presented. The philosophy of the technique is to avoid programs that are inherently untestable by first measuring and limiting program complexity. Part 1 defines and develops a program complexity measure. Part 2 discusses the complexity measure in the second phase of the methodology which is used to quantify and proceduralize the testing process. Part 3 illustrates how to apply the techniques during maintenance to identify the code that must be retested after making a modification.

400,747

PB84-223593 PC A05/MF A01

Fiorello, Shaw and Associates, McLean, VA.

Standards for Commercially Emerging Technologies: A Preliminary Cost-Benefit Assessment for the Optical Digital Data Disk (OD3) Technology for Mass Data Storage Applications.

Final rept.,

M. Fiorello. Apr 84, 88p NBS/GCR-84/469

Keywords: *Standards, *Benefit cost analysis, *Data storage, Assessments, Technology, Cost analysis, Forecasting, *Optical digital data disk.

This report presents a preliminary cost-benefit impact assessment of promulgating information processing standards for the commercially emerging Optical Digital Data Disk (OD sup 3) technology, as applied to machine readable information. The Federal Government perspective is emphasized. The analysis includes: estimates of the market penetration of the OD sup 3 technology; basic models of how standards can affect technology innovation and diffusion; and, a preliminary assessment of the cost-benefit to the Federal Government.

400,748

PB84-224062 Not available NTIS
National Bureau of Standards, Washington, DC.

Trouble on the Line - Finding Faults in Local Area Networks.

Final rept.,

R. J. Crosson. 24 Mar 83, 5p

Pub. in Proceedings of Workshop Performance Evaluation Local Area Networks, Program Working Papers, Worcester Polytechnic Institute, Worcester, MA., May 24-25, 1983, 5p Jun 83.

Keywords: *Telecommunication, *Computer networks, *Computer communications, *Communication networks, Failure analysis.

In February, 1976, the National Bureau of Standards began designing a local area network to interconnect computers and terminals. Subsequent operation of the NBSNET illuminated two types of failures which can occur in such a system; total and limited service disruption. Methods have been developed for dealing with total disruption failure modes. Dealing with limited failure modes is the goal of a current automation project and a plan to design increased intelligence into NBSNET equipment.

400,749

PB84-224823 Not available NTIS
National Bureau of Standards, Washington, DC.

Wideband Local Nets Enter the Computer Arena.

Final rept.,

W. E. Burr, and R. J. Carpenter. 3 May 84, 6p

Pub. in Electronics, v57 n9 p145-150, 3 May 84.

Keywords: *Computer networks, Standards, *Local area networks, Computer communications, Data communications.

Three commercial wideband LAN's are being offered for mainframes and supercomputers, and a standard for a fourth has been drafted.

400,750

PB84-225333 Not available NTIS
National Bureau of Standards, Washington, DC.

Operating NBSNET.

Final rept.,

R. J. Crosson. Apr 84, 6p

Pub. in Proceedings of Annual Federal DP Expo and Conference (10th), Washington, DC., April 17-19, 1984, p1-6.

Keywords: *Computer networks, *Local area networks, Data communications, Computer communications.

NBSNET is a local area network at the National Bureau of Standards with branches in Gaithersburg, Maryland, and Boulder, Colorado. Each branch consists of segments which have a total of over 500 individual connections. Each user connection is customized to the specific type of equipment being connected, permitting many types of devices to be used. The lack of adherence to established interconnection standards, or the lack of standards altogether, has increased the level of support necessary to connect equipment. Experience has shown the need for well designed, comprehensive, industry-wide standards. As

use of the system has increased, the need for diagnostic techniques and tools has become more evident.

400,751

PB84-232867 PC A03/MF A01

National Bureau of Standards, Washington, DC. Systems and Network Architecture Div.

Proceedings of the LAN-Transport Workshop (5th) Held on March 8-9, 1984,

M. A. Wallace. Mar 84, 34p NBSIR-84/2855

See also PB84-138825.

Keywords: *Computer networks, *Meetings, Standards, Specifications, *Protocols, *Local area networks, File transfer protocol.

The National Bureau of Standards Institute for Computer Sciences and Technology (ICST) has prepared specifications for the International Organization for Standardization's (ISO) Class 4 Transport Protocol. At the request of a number of companies, ICST organized a workshop series for implementors of these specifications using local area networking technology. The first workshop focused on implementation techniques and strategies so that a multivendor demonstration of these protocols can occur at a major computer conference in 1984 targeted for the NCC 1984. Primarily the details of CSMA/CD and Transport Class 4 were discussed and parameters were selected. A second workshop focused on token bus LANs and file transfer applications to be run at the targeted 1984 demonstration. Agreements on the specifics of the file transfer protocol were reached at the third workshop. The fourth workshop covered further refinements to the file transfer protocol, testing procedures, and demonstration details. This report documents the fifth workshop in the series of LAN/Transport workshops. The fifth workshop defined the File Transfer Protocol (FTP) testing schedule and minimum vendors tests, made minor adjustments to the FTP and reached agreements on participation in the HIS and BCS demonstrations.

400,752

PB84-242536 Not available NTIS
National Bureau of Standards, Washington, DC.

XERROR: The SLATEC Error-Handling Package.

Final rept.,

R. E. Jones, and D. K. Kahaner. 1983, 7p

See also DE82-015494.

Pub. in Software Practice Experience 13, p251-257 1983.

Keywords: *Errors, Subroutine libraries, Fortran, Reprints, XERROR computer programs, Portability.

The XERROR package is a collection of portable Fortran routines for processing of errors that occur in other routines. It was developed as the error-handling package for the SLATEC Common Mathematical Library, which is currently in use at a number of U.S. Department of Energy and other facilities. This paper describes how to use the package, from the viewpoint of the writer of library routines that need to call the XERROR package to handle errors, and from the viewpoint of the user of those library routines.

400,753

PB84-245802 Not available NTIS
National Bureau of Standards, Washington, DC.

Software Development Tools.

Final rept.,

R. C. Houghton, Jr. May 83, 8p

Pub. in Computer 16, n5 p63-70 May 83.

Keywords: Computer systems programs, Computer programming, Performance evaluation, Reprints, *Software tools, Software engineering.

An analysis of the various types and capabilities of software development tools is presented along with percentage profiles and actual tool memberships. These charts and tables can be used for overview information and also as a means to determine tools of interest for a given category. A listing of tool information from the NBS Software Tools Database, also contained in the report, can then be used for additional information about specific tools.

400,754

PB85-100154 Not available NTIS
National Bureau of Standards, Washington, DC.
Linear Programming Model for Optimal Computer Network Protocol Design.
Final rept.,
J. F. Heafner, and F. H. Nielsen. 1980, 7p
Pub. in Proceedings of the Conference AFIPS, 1980 Computer Conference, Anaheim, CA, May 19-22, 1980, p855-861.

Keywords: *Computer networks, *Linear programming, Mathematical models, Optimization, Design, Standards, Protocols.

The ability to widely intercommunicate using networks of heterogeneous computers requires defining and adopting standards for computer network protocols. The International Organization for Standardization has developed a reference model which specifies the range of functions of a hierarchical set of network protocols. The need is generally recognized for a multiplicity of protocols at a given layer within the model's hierarchy. An outstanding problem is to determine a small set of protocols that together satisfy the requirements of a broad spectrum of applications. One step-wise approach to specifying these protocols is to determine just what protocol service features are, how to derive them, then how to match them with applications in order to define the needed protocol families. These steps give rise to a number of technical subproblems. A research approach to one subproblem is described here. This paper presents an analytical model to be jointly used by the applications builder and protocol designer to define optimal protocols for a given application category and protocol family.

400,755

PB85-104693 Not available NTIS
National Bureau of Standards, Washington, DC.
Process Standards for Software Engineering.
Final rept.,
M. A. Branstad, and P. B. Powell. 1981, 4p
Pub. in Proceedings of Software Engineering Standards Applied workshop, San Francisco, CA, August 18-20, 1981, p15-18.

Keywords: Data processing, Standards, Computers, Effectiveness, Quality, Productivity, *Software engineering, National government, National Bureau of Standards.

ICST, within NBS, is responsible for automated data processing standards for the Federal Government. The major objective of these standards is to foster the economic and effective use of computers within the Government. Software engineering standards and guidelines focus upon facilitating an increased level of software quality and productivity. The approach concentrates on the development process.

400,756

PB85-109148 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Selected NBSNET Software.
Interim rept.,
M. Strawbridge, S. Schooley, R. Crosson, and J. Sokol, Jr. Sep 84, 111p NBSIR-84/2902

Keywords: Interfaces, Personality, *Computer software, *Communications networks, National Bureau of Standards, Protocols.

NBSNET is a local area communications network at the National Bureau of Standards. Ethernet-like in its design, it has operated successfully since 1979, supporting terminal-computer and computer-computer communications. Devices physically connect to NBSNET through RS-232-C interfaces; each being customized to the device being served. Customization primarily involves modifying the control program, called a 'personality', for each interface. Each personality is divided into modules which implement, among other things, the network's internal protocol and the external device communications protocol. Three external device protocols are used. A listing of some typical personality modules is supplied.

400,757

PB85-110120 Not available NTIS
National Bureau of Standards, Washington, DC.
Description of a Planned Federal Information Processing Standard for Transport Protocol.
Final rept.,
J. F. Heafner, and R. P. Blanc. 1981, 9p
Pub. in Proceedings of Data Community Symposium (7th), Mexico City, Mexico, October 27-29, 1981, p2-10.

Keywords: *Computer networks, *Standards, Design, Services, Specifications, Procurement, Interfaces, *Federal information processing standards, Intercommunication systems, Transport, Protocols, Government agencies.

The National Bureau of Standards has developed service and design specifications for transport and session protocols for use in computer system and network procurements. These protocols reside in layers four and five of the International Organization for Standardization's (ISO) Reference Model for Open Systems Interconnection. This paper describes the services, interfaces, and internal behavior of the transport protocol. The transport (and session) protocol specifications were derived from the most recent developments within ISO on these protocols. Specific features were selected based on the needs of the agencies of the Federal Government within the United States, but they are consistent with the needs of any large organization engaged in the procurement or development of networks of heterogeneous computer systems.

400,758

PB85-111763 Not available NTIS
National Bureau of Standards, Washington, DC.
Inverted View of Software Development Tools.
Final rept.,
R. C. Houghton, Jr. 1981, 13p
Pub. in Proceedings of Annual Technical Symposium (20th), Washington DC Chapter of ACM, College Park, MD., June 18, 1981, p45-52.

Keywords: *Software, *Meetings, *Classifications, *Computer programs.

Traditional classification schemes for software tools are reviewed and critiqued according to their ability to uniquely classify modern software tools. An approach based on the inversion of these schemes is presented and is shown to be more effective in classifying tools.

400,759

PB85-115566 Not available NTIS
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
Network Protocol Design: Model Relationships, Heuristic Feature Specification and Analytical Extensions.
Final rept.,
R. P. Davis. 1983, 8p
Sponsored in part by National Bureau of Standards, Washington, DC.
Pub. in Computers and Industrial Engineering 7, n3 p209-216 1983.

Keywords: *Computer networks, Design, Mathematical models, Heuristic methods, Specifications, Reprints, Protocols, Relationships.

This paper presents a brief description of the network protocol design problem, and a mathematical model which has been developed to assist in the specification of protocol features. Heuristic solutions to the feature specification problem are described in the context of a design process and computational results from such heuristics are presented. Finally, analytical issues appropriate to the feature specification model, and their utility, are identified.

400,760

PB85-115657 Not available NTIS
National Bureau of Standards, Washington, DC.
Syntax of Interactive Command Languages: A Framework for Design.
Final rept.,
I. T. Hardy, Jr. 1982, 11p
Pub. in Software Pract. Exper. 12, n1 p67-75 Jan 82.

Keywords: *Computer programs, Syntax, Text editor, Reprints, *Command language, *Interactive systems.

Various qualities of simple command languages, such as ease of use and flexibility, are defined. Certain

design attributes--namely style, structure and level of abstraction--are described for command languages, and these attributes are shown to strongly influence the defined qualities. Three existing text editors' command languages are used as examples of how a rather simple analysis of attributes can reveal a language's potential qualities and its appropriateness for any given group of users.

400,761

PB85-122000 PC A09/MF A01
National Bureau of Standards, Gaithersburg, MD. Center for Programming Science and Technology.
Selection and Use of General-Purpose Programming Languages - Program Examples. Volume 2.
Final rept.,
J. V. Cugini. Oct 84, 185p NBS/SP-500/117/2
See also PB85-122018. Also available from Supt. of Docs as SN003-003-02613-1. Library of Congress catalog card no. 84-601120.

Keywords: *Programming languages, Selection, Use, Examples, Programming, Alternatives, ADA programming language, Basic programming language, Cobol programming language, Fortran programming language, PASCAL programming language, PL/I programming language.

Given that conventional programming is the appropriate technique for a particular application, the choice among the various languages becomes an important issue. There a great number of selection criteria, not all of which depend directly on the language itself. Broadly speaking, the criteria are based on (1) the language and its implementation, (2) the application to be programmed, and (3) the user's existing facilities and software. This study presents a survey of selection factors for the major general-purpose languages: Ada, BASIC, C, COBOL, FORTRAN, Pascal, and PL/I. The factors covered include not only the logical operations within each language, but also the advantages and disadvantages stemming from the current computing environment, e.g., software packages, microcomputers, and standards. The criteria associated with the application and the user's facilities are explained. Finally, there is a set of program examples to illustrate the features of the various languages. This volume includes the program examples. Volume 1 contains the discussion of language selection criteria.

400,762

PB85-122018 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD. Center for Programming Science and Technology.
Selection and Use of General-Purpose Programming Languages - Overview. Volume 1.
Final rept.,
J. V. Cugini. Oct 84, 82p NBS/SP-500/117/1
See also PB85-122000. Also available from Supt. of Docs as SN003-003-026123. Library of Congress catalog card no. 84-601119.

Keywords: *Programming languages, Selection, Use, Criteria, Surveys, Programming, Alternatives, ADA programming language, BASIC programming language, Cobol programming language, Fortran programming language, PASCAL programming language, PL/I programming language.

Given that conventional programming is the appropriate technique for a particular application, the choice among the various languages becomes an important issue. There are a great number of selection criteria, not all of which depend directly on the language itself. Broadly speaking, the criteria are based on (1) the language and its implementation, (2) the application to be programmed, and (3) the user's existing facilities and software. This study presents a survey of selection factors for the major general-purpose languages: Ada, BASIC, C, COBOL, FORTRAN, Pascal, and PL/I. The factors covered include not only the logical operations within each language, but also the advantages and disadvantages stemming from the current computing environment, e.g., software packages, microcomputers, and standards. The criteria associated with the application and the user's facilities are explained. Finally, there is a set of program examples to illustrate the features of the various languages. This volume contains the discussion of language selection criteria. Volume 2 comprises the program examples.

Field 9—ELECTRONICS AND ELECTRICAL ENGINEERING

Group 9B—Computers

400,763

PB85-128502 PC A02/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Diamonds and Diamond Sorting.
E. Bromberg, and F. Sullivan. Sep 84, 24p NBSIR-84/2936

Keywords: *Sorting routines, Subroutines, Algorithms, Fortran, Parallel programming, Vector processors.

The present paper describes and analyzes the Diamond sort algorithm. The algorithm is designed for parallel operations, which makes it well suited to vector-computer architecture. The instruction sequences are fixed, without any branches. The algorithm therefore has a fixed complexity determined solely by the number of elements to be sorted, rather than by any pattern of distribution of element values. The Diamond sort is of special interest not only because of the unusual arrangement of its steps, but also because it introduces the concept of a Diamond as a set with a specific kind of partial ordering that is closely linked to the halving principle, which is used in the sort procedure.

400,764

PB85-128916 Not available NTIS
National Bureau of Standards, Washington, DC.
Processing Data Model Abstractions.
Final rept.,
W. T. Hardgrave, and D. R. Deutsch. Jan 81, 2p
Pub. in Proceedings of Data Abstraction, Databases and Conceptual Modelling, Pingree Park, CO, June 23, 1980, SIGART Newsletter n74 p126-127 Jan 81.

Keywords: Artificial intelligence, Programming languages, *Data abstraction, Data base management, Data structures.

Data abstraction is an important topic in the three fields of artificial intelligence, database management and programming languages. This paper briefly discusses some problems shared by the three fields and describes the ongoing NBS Abstract Data Models research project. This competency building initiative is concerned with the application of set-theoretic mathematical formalisms to the specification of both syntax and semantics of data models for database management systems.

400,765

PB85-128932 Not available NTIS
National Bureau of Standards, Washington, DC.
Modified CAMAC System for High Speed Burst Data Acquisition.
Final rept.,
J. Glaab, W. Schaeffer, E. Johnson, and J. Degnan. Feb 81, 12p
Pub. in Institute of Electrical and Electronics Engineers on Nuclear Science NS-28, n1 p341-352 Feb 81.

Keywords: Data acquisition, Laser beams, Reprints, *CAMAC system, HSCC(High Speed Crate Controllers), HSC(High Speed Cache), High altitude.

A highly modified CAMAC Data Acquisition System has been developed and flown to acquire and pre-process multichannel 1 MHz data sample bursts with no deadtime for a high altitude (130,000 ft.) balloon experiment. A multiwavelength laser is fired at 10 pps, and 300 microsec of continuous 1 microsec samples are obtained in 6 independent data channels for each shot.

400,766

PB85-134039 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Diamond: A Sorting Method for Vector Machines.
Final rept.,
H. K. Brock, B. J. Brooks, and F. Sullivan. 1981, 11p
Pub. in Bit 21, n2 p142-152 1981.

Keywords: *Sorting routines, Algorithms, Reprints, Vector processors, Computational complexity.

In this paper the authors present a non-contingent method of the Batcher type which they call Diamond Sort. The algorithm makes use of the 'perfect shuffle' and also processes of 'unshuffling' and 'block-shuffling' are used. The asymptotic complexity of the algorithm is $O(N(\log N) \sup 2)$. The implementation of the algorithm on the CYBER 200 system is described. Timing tests comparing Diamond Sort with Stone's version of the Batcher method are provided, along with operation counts for both.

400,767

PB85-135473 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
ISO Presentation Layer 6 Protocol Issues.
Final rept.,
J. F. Heafner, and H. M. Wood. 1980, 5p
Pub. in Proceedings International Communications Conference, Seattle, WA, June 8-12, 1980, Part 1, Section 5.2 p1-5.

Keywords: *Computer networks, *Protocol(Computers), Data structures.

Production use of heterogeneous computer networks occasions the need to shield the user from operational differences in data access, reconfiguration, and transmission. This paper discusses the technical problems and the progress related to the development of network protocols of the presentation layer--the layer responsible for resolving differences in data format. Levels of difficulty are distinguished with respect to both the data structure and the data mapping functions. Inherent data incompatibilities are identified and methods to circumvent them are noted. This is followed by a discussion of some vanguard protocols and their closeness of fit to the description of the presentation layer. Lastly, the paper describes the technical problems attendant to realizing presentation layer protocol standards, and then presents the status of ongoing programs to develop them.

400,768

PB85-135481 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Toward the Extraction of Service Features from Definitive Documents on High-Level, Network Protocols.
Final rept.,
J. F. Heafner, F. H. Nielsen, and M. W. Shiveley. 1980, 8p
Pub. in Proceedings of National Computer Conference, Anaheim, CA, May 19-22, 1980, p863-870 1980.

Keywords: *Computer networks, *Standards, Design, *Protocol (Computers).

The need is widely recognized for computer network protocol standards as prerequisite to effective use of networking potential. Current network protocols, designed by computer scientists, focus on the support of specific applications of local concern. These applications are not necessarily known to represent mainstream governmental and industrial applications in distributed information processing. Accordingly, procedures are needed to ensure that emerging protocol standards are functionally compatible with application requirements. This implies the need to determine, with respect to significant applications, just what constitutes a sufficient service for a given protocol. The first step in this determination, and the subject of this paper, is that of identifying protocol service features. Then, features can be associated with application needs. The objective in identifying features can be stated thusly: Given a protocol specification document written in English, devise a set of rules to extract service features. This method must be repeatable.

400,769

PB85-137735 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD. Systems and Network Architecture Div.
IEEE (Institute of Electrical and Electronics Engineers) 802.4 Token Bus Network Simulation.
J. L. Archambault. Oct 84, 78p NBSIR-84/2966

Keywords: *Computer networks, Performance evaluation, Standards, Simulation, Graphs(Charts), Token bus networks, Local area networks.

A discrete event simulation of token bus networks has been designed and implemented at the National Bureau of Standards, and used to analyze the performance of local area networks compliant with the IEEE 802.4 specifications. The model measures the utilization of the network, the rotation time, the waiting time of the data packets, and the queue lengths in the Medium Access Control sublayer. This paper presents the model, and studies the sensitivity of these variables to the offered load, the packet length, the target rotation times, and the number of stations.

400,770

PB85-140275 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Beyond Floating-Point.
Final rept.,
C. W. Clenshaw, and F. W. J. Olver. Apr 84, 18p
Pub. in Jnl. of the Association for Computing Machinery 31, n2 p319-328 Apr 84.

Keywords: *Arithmetic, Error analysis, Exponential functions, Iteration, Reprints, Floating point arithmetic, Fixed point arithmetic, Computer applications.

A new number system is proposed for computer arithmetic, based on iterated exponential functions. The main advantage is to eradicate overflow and underflow, but there are several other advantages, and these are described and discussed.

400,771

PB85-140754 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Federal Standards in Risk Analysis and Contingency Planning.
Final rept.,
S. K. Reed, and S. W. Katzke. 1980, 3p
Pub. in Data Manage. 18, n1 p20-22 Jan 80.

Keywords: *Standards, Data processing security, Reprints, *Federal information processing standards, Risk analysis, Contingency planning, Computer security.

Working under the mandate of Public Law 89-306, the Institute for Computer Sciences and Technology (ICST) provides Federal Information Processing Standards for Federal agencies to apply in the selection, acquisition, and utilization of computer hardware and software. A topic of special concern, especially relevant to utilization, but which to some extent also needs to be considered in selection and acquisition, is computer security. For this reason, standards must be provided for the physical, administrative and technical safeguards which address security. While some of these are for hardware and software, others are in areas which cannot be defined as either but fall into the category of procedures and supporting services. Two such areas are risk analysis and contingency planning.

400,772

PB85-141356 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Design and Engineering of a Performance Measurement Center for a Local Area Network.
Final rept.,
D. P. Stokesberry, and R. Rosenthal. 1980, 6p
Sponsored by Institute of Electrical and Electronics Engineers, Inc., New York.
Pub. in Proceedings of Computer Networking Symposium, Gaithersburg, MD., December 10, 1980, p110-115 1980.

Keywords: *Computer networks, Performance, Measurement, Design, Distributed computer systems.

The design and implementation of a performance measurement center for a local area network, using a carrier sense multiple access protocol with collision detection, is described. Performance measurements on this type of network require specialized equipment and techniques to gather and analyze the data. This is particularly true for fully distributed networks where there is no central control facility. Network performance is measured in terms of message delay, channel thruput, message overhead, network stability and fairness under a variety of traffic load conditions. NBSnet, a fully distributed local network in operation at the National Bureau of Standards, has been used as a model for the design process.

400,773

PB85-141497 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Guide to Better Software.
Final rept.,
D. R. Wallace. Oct 84, 4p
Pub. in Government Data Systems 13, n5 p40-43 Sep/Oct 84.

Keywords: Quality control, Proving, Tests, Reprints, *Computer software, Computer software maintenance, Computer program verification, Validation.

The 'Guideline for Lifecycle Validation, Verification, and Testing of Computer Software' presents a methodology to be used throughout the software lifecycle to ensure the production and maintenance of quality software. The guideline suggests a combination of verification and testing techniques to arrive at recommended level of validation, verification, and testing tailored to the needs of a specific project. The guideline is a basic reference addressed to managers, developers, verifiers, maintainers, and end users.

400,774
PB85-142297 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
National Bureau of Standards and the National Standard Reference Data System.
 Final rept.,
 H. J. White. 1981, 5p
 Pub. in AIChE Symposium Series 77, n203 p39-43 1981.

Keywords: Reprints, *National Standard Reference Data System.

The National Standard Reference Data System was conceived as a decentralized national effort to provide critically evaluated reference data to the scientific and technical communities of the United States. Financial support and execution were expected to involve a variety of Government and private agencies. NBS was made responsible for overall planning and coordination. The Office of Standard Reference Data is the program management office within NBS. The current program in the National Standard Reference Data System and the activities of the Office of Standard Reference Data are reviewed briefly with emphasis on those activities which appear to be of particular interest to chemical engineers.

400,775
PB85-143550 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Security in Computer Communication Systems.
 Final rept.,
 H. M. Wood, and I. W. Cotton. 1983, 41p
 Pub. in Computer Communications, Volume 1: Principles, p369-409 1983.

Keywords: *Computer communications, Security, Computer networks, Cryptology, Control, Reprints, Access.

The growing recognition of the need for computer and communications security has resulted in the design, development, and installation of 'patches', packages, and even new operating systems intended to provide higher degrees of data and systems protection. With the increased utilization of computer networks and current developments in the area of network operating systems the requirements for security in networking environments are also coming under investigation. While research and development are still ongoing in the area, it is vital to ensure that requirements for the security and integrity of data are well specified and that mechanisms for achieving the needed levels of systems protection are included in the design of networking systems. This chapter reviews methods and mechanisms that may be used to achieve required degrees of computer network security. Such methods include those aimed primarily at communications security (e.g., data encryption techniques), as well as access control techniques (e.g., authentication an authorization checking), physical security, and procedural controls. Emphasis is placed on those aspects of security that particularly relate to the communications environment in computer networks. Many references to the open literature are included in order to guide the interested reader into the rapidly growing area of computer communications security.

400,776
PB85-143634 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Fortran 77 Portability.
 Final rept.,
 J. Larmouth. 1981, 47p
 Pub. in Software-Pract. and Exper. 11, n10 p1071-1117 Oct 81.

Keywords: Reprints, *Computer program portability, Fortran 77 programming language.

The study focuses upon those aspects of Fortran 77 that are likely to be of interest when the final product is to be shared among users on different equipment. The material is intended to compliment the X3.9-1978

standard, and should be read in conjunction with that document.

400,777
PB85-144426 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Personal Number Cruncher.
 Final rept.,
 S. Haber. 1963, 4p
 Pub. in Proceedings of Technical Symposium (22nd) of the Washington, DC. Chapter of the ACM, Gaithersburg, MD., June 23, 1983, pA.1.1-A.1.4.

Keywords: *Numerical analysis, Computation, Personal computers, Benchmarks.

An account is given of the author's use of an inexpensive personal computer in consulting and research in numerical analysis. The effects on his work are described. The construction of a speed-measuring benchmark program, designed to be specifically applicable to the author's typical computations, is described. Results of applying this benchmark to a number of computers are given.

400,778
PB85-145217 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
User-Oriented Data Communication Performance Parameters.
 Final rept.,
 D. S. Grubb, M. D. Abrams, and N. B. Seitz. 1981, 10p
 Pub. in Proceedings of International Conference, Paris, France, September 14-16, 1981, Performance of Data Communication Systems and their Applications, p145-154.

Keywords: Performance, Networks, Standards, Telecommunication, *Computer networks, Computer communications, User needs.

This paper is a discussion of a newly developed set of parameters that define data communication performance from an end user viewpoint and in system independent terms. The parameters are the subject of a proposed American National Standard. Where possible, actual text from the proposed standard is used.

400,779
PB85-145225 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Authentication Using the Federal Data Encryption Standard.
 Final rept.,
 M. E. Smid. 1981, 6p
 Pub. in Proceedings of Natl. Electronics Conference, Chicago, IL., October 26-28, 1981, v35 p296-301.

Keywords: *Authentication, Algorithms, Standards, Cryptology, *Data encryption, Federal Data Encryption Standards, Data integrity, Electronic funds transfer.

The Federal Data Encryption Standard (DES) cryptographic algorithm can be used to authenticate the integrity of data by detecting unauthorized modifications. DES authentication algorithms are similar to those for data encryption, but authentication algorithms permit data to be transmitted or stored in an unencrypted form. Authentication algorithms differ from error detecting codes in that authentication algorithms detect intentional modifications as well as accidental alterations. These algorithms have several communications and data storage applications.

400,780
PB85-145258 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
NBS (National Bureau of Standards) Calibration Service for A/D and D/A Converters.
 Final rept.,

T. M. Souders, and D. R. Flach. 1981, 14p
 Pub. in Proceedings of Digest of Papers - International Test Conference, Philadelphia, PA., October 27-29, 1981, IEEE (Institute of Electrical and Electronics Engineers) Cat. No. 81-CH1957-0, p290-303.

Keywords: *Analog to digital converters, *Digital to analog converters, Calibrating, Data converters, Measurement, Linearity, Amplification, Tests, Errors, Quality control, Reprints.

An NBS calibration service for high performance 12- to 18-bit analog-to-digital converters (ADC's) and digital-to-analog converters (DAC's) is described. The service offers comprehensive measurements of linearity, dif-

ferential linearity, gain, offset, and rms input noise (for ADC's), with systematic uncertainties as low as 3 ppm. Measurements are made at a minimum of 1024 different codewords. The measurement approach, design features, test programs, and data reduction techniques are discussed as are the methods of error estimation and quality control.

400,781
PB85-147957 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Observations on Data Element Naming Conventions.
 Final rept.,
 J. J. Newton. 1984, 5p
 Pub. in Proceedings of Trends and Applications 1984, Making Database Work, Gaithersburg, MD., May 23-24, 1984, p153-157.

Keywords: Data processing, Standards, *Data elements, Naming systems, Data base management.

Data element naming conventions are an increasing concern of data administrators. Names in the past have been based on two differing philosophies of data organization. Three systems which have been used provide a basis of discussion; the issue of software independence must also be considered. Some rules for good names can be defined as a contribution to the establishment of naming conventions.

400,782
PB85-151769 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Report on the Status of the Development of the IEEE (Institute of Electrical and Electronics Engineers) Standard for Software Verification Plans (P1012).
 Final rept.,
 R. U. Fujii, D. R. Wallace, and M. Edwards. Oct 84, 8p
 Pub. in Proceedings of Software Engineering Standards Application Workshop (3rd), San Francisco, CA., October 2-4, 1984, p100-107.

Keywords: *Standards, Verifying, Development, *Computer software, *Computer program verification, Software lifecycle, Software engineering, IEEE standards.

The proposed IEEE Standard for Software Verification Plans (SVP) will be a member of IEEE's software engineering family of standards. This paper represents an interim stage of the proposed SVP standard. The final form is scheduled for ballot by IEEE in 1985. It will provide the user with a format and content for software verification plans. It will establish a minimum set of verification tasks to be performed for critical software during each phase of the lifecycle. The SVP standard will also provide for optional verification tasks based upon individual program needs. The SVP standard will provide adequate guidance to ensure that the SVP provides for proper management checkpoints and audits, including written results of executing the SVP.

400,783
PB85-151801 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Language Independent Superstructure for Implementing Real-Time Control Systems.
 Final rept.,
 A. J. Barbera, M. L. Fitzgerald, J. S. Albus, and L. S. Haynes. 1984, 12p
 Sponsored by Maryland Univ., College Park.
 Pub. in Proceedings of Workshop on High-Level Computer Architecture, Los Angeles, CA., May 21-25, 1984, p7.28-7.39.

Keywords: Robots, *Control systems, Computer software, Software tools, Real time, Computerized control systems.

It is the purpose of the system superstructure described in this paper to create an environment that eases the user's development of software. Techniques and software tools are described that help organize a system into a very structured and modular framework that is conducive to interfacing, upgrading, partitioning onto multiple computer systems, and debugging. A system dictionary is described that, together with the modular superstructure, allows the creation of a highly interactive environment where single programs or any level of aggregation of programs can be executed and where any variable or aggregation of

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variables can be examined, traced, displayed, or modified.

400,784

PB85-155794 PC A04/MF A01
Software Systems Technology, Inc., College Park, MD.
Computer Science and Technology: A Guide to Performance Evaluation of Database Systems.
Final rept.,
D. R. Benigni, S. B. Yao, and A. R. Hevner. Dec 84, 58p NBS/SP-500/118
See also PB84-217504. Also available from Supt. of Docs as SN003-003-02624-7. Library of Congress catalog card no. 84-601144.

Keywords: Performance evaluation, Microcomputers, Minicomputers, *Data bases, *Relational data bases, *Benchmarks.

This guide presents a generalized performance analysis methodology for the benchmarking of database systems. The methodology identifies criteria to be utilized in the design, execution, and analysis of a database system benchmark. This generalized methodology can apply to most database system designs. In addition, presenting a wide variety of possible considerations in the design and implementation of the benchmark, this methodology can be applied to the evaluation of either a single system with several configurations, or to the comparison of several systems.

400,785

No bibliographic entry for this abstract number.

400,786

PB85-165850 PC A15/MF A01
National Bureau of Standards, Gaithersburg, MD. Inst. for Computer Sciences and Technology.
Future Information Technology, 1984 Telecommunications.
Final rept.,
P. Kay, and P. Powell. Dec 84, 343p NBS/SP-500/119

Also available from Supt. of Docs as SN003-003-02626-3. Library of Congress catalog card no. 84-601149. Prepared in cooperation with Little (Arthur D.), Inc., Cambridge, MA., Aurora Associates, Inc., Washington, DC., TITAN Systems, Inc., McLean, VA., and International Data Corp., McLean, VA.

Keywords: *Telecommunication, Technology, Computer networks, Management, Information, Trends, Forecasting, Data processing security, Divestiture.

This document, the second in a series, focuses on telecommunications technology and related areas in computer organizations. It contains four primary parts: the telecommunications forecast through 1999, three perspectives on the divestiture of AT&T, a discussion of the general impacts of technology on computer security, and the management implications of the trends in information technology. Additionally, it contains the summary of an industry workshop on this forecast, a brief update of the 1983 forecast, and a glossary of terms. This forecast is a companion to 'Future Information Processing Technology - 1983' which contains fifteen year projections of computer hardware and software.

400,787

PB85-170587 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Civil Engineering Standards for the Computer Age.
Final rept.,
R. Wright. May 84, 1p
Pub. in Civil Engineering Magazine, 7p May 84.

Keywords: *Civil engineering, *Standards, Interfaces, Reprints, Computer applications, Expert systems.

As computer aids permeate civil engineering practice we may expect two major changes in civil engineering standards: expert computer systems will succeed printed paper as the medium for expression and use of standards, and new areas of standardization will promote the effectiveness, reliability and economy of computer aids. Civil engineers are alerted to opportunities and needs to participate in the evolution of civil engineering standards.

9C. Electrical and Electronic Engineering

400,788

PB83-104521 PC A02/MF A01
National Bureau of Standards, Washington, DC.
Measurement of Electromagnetic Radiation from Electric-Rail Cars,
John W. Adams. Aug 82, 23p NBSIR-82-1669
Sponsored in part by Transportation Systems Center, Cambridge, MA.

Keywords: *Electromagnetic radiation, Measurement, Electromagnetic interference, Rapid transit railways, Electric railroads, Railroad cars.

Existing Electromagnetic Compatibility (EMC) standards are not directly applicable for measuring Electromagnetic Interference (EMI) from an electric-rail vehicle. This report describes a measurement system and procedure that have potential for making the needed improvements. This system and procedure need further evaluation, use, and improvement before they could be considered for general use. The problems that were considered are discussed, and those that need additional work are given. Sample measured data from a Metropolitan Atlanta Rapid Transit Authority (MARTA) rail car are given. The measurements were performed at the Department of Transportation Test Center near Pueblo, Colorado.

400,789

PB84-137322 PC A03/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, October - December 1982,
J. F. Mayo-Wells. Jul 83, 27p NBSIR-83-2719
See also PB83-241158.

Keywords: *Electrical engineering, *Electronics, *Metrology, Semiconductors(Materials), Signals, Electromagnetic interference.

This is the third issue of an abstract bulletin to be issued quarterly by the Center for Electronics and Electrical Engineering, National Bureau of Standards. This issue covers the work of the Center's programs for the first quarter of Federal fiscal year 1983. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

400,790

PB84-218056 PC A02/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, April - June 1983,
J. F. Mayo-Wells. Jun 84, 19p NBSIR-84/2857/2
See also PB83-244160 and PB84-219716.

Keywords: *Electrical engineering, *Electronics, *Metrology, Semiconductors(Materials), Signals, Electromagnetic interference.

This is the third issue of a quarterly abstract journal covering the work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This

issue of the CEEE Technical Progress Bulletin covers the second quarter of calendar year 1983. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

400,791

PB84-219716 PC A02/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, July - September 1983,
J. F. Mayo-Wells. Jun 84, 16p NBSIR-84/2857/3
See also PB83-241158 and PB84-218056.

Keywords: *Electrical engineering, *Electronics, *Metrology, Semiconductors(Materials), Signals, Electromagnetic interference.

This is the fourth issue of a quarterly abstract journal covering the work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the CEEE Technical Progress Bulletin covers the third quarter of calendar year 1983. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

400,792

PB84-221043 Not available NTIS
National Bureau of Standards, Washington, DC.
Direct Measurements of Interfacial Contact Resistance, End Contact Resistance, and Interfacial Contact Layer Uniformity.
Final rept.,
S. J. Proctor, L. W. Linholm, and J. A. Mazer. Nov 83, 8p
Pub. in IEEE Transactions on Electron Devices ED-30, n11 p1535-1542 Nov 83.

Keywords: *Electric contacts, Integrated circuits, Semiconductor devices, Tests, Microelectronics, Electrical resistance, Reprints.

A four-terminal microelectronic test structure and test method is described for electrically determining the degree of uniformity of the interfacial layer in metal-semiconductor contacts and for directly measuring the interfacial contact resistance. A two-dimensional resistor network model is used to obtain the relationship between the specific contact resistance and the measured interfacial contact resistance for contacts with a uniform interfacial layer. A new six-terminal test structure is used for the direct measurement of end contact resistance and the subsequent determination of front contact resistance. A methodology is described for reducing the effects of both contact-window mask misalignment and parasitic resistance associated with these measurements. Measurement results are given for 98.5% Al/1.5% Si and 100% Al contacts on n-type silicon.

400,793

PB84-221266 Not available NTIS
National Bureau of Standards, Washington, DC.
Theoretical and Experimental Analysis of Coupling Characteristics of Dual TEM Cells.
Final rept.,
P. F. Wilson, D. C. Chang, M. T. Ma, and M. L. Crawford. 1983, 5p
Pub. in Institute of Electrical and Electronics Engineers, International Electromagnetic Compatibility held at Washington, DC. on August 23-25, 1983, p513-517 1983.

Keywords: *Electromagnetic shielding, Effectiveness, TEM cells.

A standardized method for quantitatively evaluating a test material's shielding effectiveness is a topic of widespread interest to the electromagnetic interference community. Field penetration through materials may significantly affect the designed performance of devices contained inside the material. To take advantage of the known properties of a TEM cell, a shielding effectiveness measurement procedure based on coupling power between a pair of TEM cells via material laden aperture is being proposed in industry. No theoretical basis, however, has been formulated to provide guidelines for properly designing such a dual TEM cell structure and for interpreting the measured results. To gain a better understanding of the structure's basic properties, the theoretical analysis and experimental results of an unloaded aperture case (with no material present) are presented.

400,794
PB84-222785 PC A02/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Electronics and Electrical Engineering.
**Center for Electronics and Electrical Engineering
 Technical Progress Bulletin Covering Center Pro-
 grams, January-March 1984 with 1984 CEEE
 Events Calendar.**
 J. F. Mayo-Wells. May 84, 20p NBSIR-84/2877/1
 See also PB84-137322.

Keywords: *Electrical engineering, *Electronics, *Metrology, Semiconductors(Materials), Signals, Electromagnetic interference, Antennas, Standard reference materials.

This is the sixth issue of a quarterly abstract journal covering the work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the Center for Electronics and Electrical Engineering Technical Progress Bulletin covers the first quarter of calendar year 1984. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

400,795
PB84-223684 PC A02/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Electronics and Electrical Engineering.
**Center for Electronics and Electrical Engineering
 Technical Progress Bulletin Covering Center Pro-
 grams, October-December 1983 with 1984 CEEE
 Events Calendar.**
 J. F. Mayo-Wells. Apr 84, 22p NBSIR-84/2857/4
 See also PB83-241158.

Keywords: *Electrical engineering, *Electronics, *Metrology, Semiconductors(Materials), Signals, Electromagnetic interference, Antennas, Standard reference materials.

This is the fifth issue of a quarterly abstract journal covering the work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the Center for Electronics and Electrical Engineering Technical Progress Bulletin covers the fourth quarter of calendar year 1983. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

400,796
PB84-223908 Not available NTIS
 National Bureau of Standards, Washington, DC.
Radiated EMI Instrumentation Errors.
 Final rept.,
 H. E. Taggart. Oct 82, 10p
 Pub. in EMC Technology, v1 n4 p26-35 Oct 82.

Keywords: *Electromagnetic interference, Instruments, Errors, Antennas, Calibrating, Reprints.

The purpose of this article is to address the various types of instrumentation errors that can be encountered when performing EMI measurements. The various type of errors associated with the instrumentation will be discussed and suggestions made as to how they can be reduced. Since the instrumentation consists of basically an antenna connected to a receiver, the errors associated with the antenna, the receiver, and connecting cables will be addressed. Calibration errors associated with the various parts of an EMI measuring system are discussed. These include: (1) antenna calibration errors (loops, monopoles, and dipoles) (2) receiver calibration errors (rf voltmeter, attenuator, and linearity), (3) mismatch errors (antenna and receiver) and (4) antenna ground effect errors. A table summarizing these errors is included in the conclusions.

400,797
PB84-227313 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Shielding Effectiveness (SE) Measurement Tech-
 niques.**
 Final rept.,
 A. R. Ondrejka, and J. W. Adams. Apr 84, 8p
 Pub. in Proceedings of IEEE Natl. Symp. Electromagnetic Compatibility, San Antonio, TX, Apr 24-26, 1984, IEEE Cat. No. 84CH2035-4, p249-256.

Keywords: *Electromagnetic shielding, Effectiveness, Measurement, Time domain.

Five methods of measuring shielding effectiveness of a lossy material are compared. Comparative measure-

ment data is shown, and insights are offered as to why the results do or do not agree. This is a preliminary analysis, not a definitive work.

400,798
PB84-231224 PC A02/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Electronics and Electrical Engineering.
**Center for Electronics and Electrical Engineering
 Technical Progress Bulletin Covering Center Pro-
 grams, January-March 1983.**
 J. F. Mayo-Wells. Jun 84, 17p NBSIR-84/2857/1
 See also PB84-137322.

Keywords: *Electrical engineering, *Electronics, *Metrology, Microwaves, Semiconductors(Semiconductors), Gallium arsenides, Signal processing, Superconductors, Electric power, Laser materials, Fiber optics, Antennas, Electromagnetic interference, Semiconductor devices, Electromagnetic noise, National Bureau of Standards.

This is the second issue of a quarterly abstract journal covering the work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the CEEE Technical Progress Bulletin covers the first quarter of calendar year 1983. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

400,799
PB84-239334 Not available NTIS
 National Bureau of Standards, Washington, DC.
Effects of Thermal Insulation Penetrating Electrical Boxes.
 Final rept.,
 J. R. Clifton, R. W. Beausoliel, and W. J. Meese.
 1982, 21p
 Pub. in American Society for Testing Materials 779, p241-261 1982.

Keywords: *Thermal insulation, *Electric outlets, *Switchgear, Hazards, Corrosion, Reprints.

When residential walls are retrofitted with 'foamed-in' urea-formaldehyde or 'blown-in' cellulose thermal insulations, the insulation may enter electrical outlet and switch boxes. The effects of these thermal insulations on electrical components such as outlet and switch boxes were studied.

400,800
PB85-129013 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Discussion of 82 WM 255-8 Reconstruction of High
 Impulse Voltages Considering the Step Response
 of the Measuring System.**
 Final rept.,
 R. E. Hebner, and J. N. Hagler. May 82, 2p
 Pub. in Institute of Electrical and Electronics Engineers Transactions on Power Apparatus and Systems 101,p4134-4155 May 82.

Keywords: High voltage, Convolution integrals, Response, Algorithms, Pulsation, Reprints, *Pulse measurement.

This discussion requests from the authors of the original paper further information about the accuracy of and the distinctions between the two deconvolution algorithms described in the original paper.

400,801
PB85-147999 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO.
 Electromagnetic Fields Div.
**Error Analysis of Radiation Characteristics of an
 Unknown Interference Source Based on Power
 Measurements.**
 Final rept.,
 M. T. Ma. 1984, 6p
 Pub. in Proceedings of the 1984 International Symposium on Electromagnetic Compatibility, Tokyo, Japan, October 16-18, 1984, p39-44.

Keywords: *Radiofrequency interference, Error analysis, Power measurement, TEM cells, Electrically small sources.

Theoretical derivations for analyzing the uncertainties in the source parameters and radiation characteristics of an unknown electrically small interference source, extracted from the power measurements made inside a transverse electromagnetic (TEM) cell are given. Numerical examples with assumed unbiased and biased measurement errors, and for the worst case are also presented.

9D. Information Theory

400,802
PB84-246057 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Universal Test Sets for the Standard Encryption
 Algorithm.**
 Final rept.,
 J. Gait. Apr 82, 4p
 Pub. in IEEE Transactions on Reliability R-31, n1 p5-8
 Apr 82.

Keywords: *Cryptology, *Test sets, Algorithms, Reprints.

This paper describes the test sets that were devised at the United States National Bureau of Standards (NBS) for hardware implementations of the standard encryption algorithm. These tests consist of a validation test set, which is being used at NBS to certify the correctness of vendors' implementations of the algorithm, and a maintenance test set, which can be used to ensure reliability in the operation of such encryption devices in the field. Each of these test sets is universal in the sense that the tests are independent of any particular hardware implementation of the algorithm, but depend only on the abstract definition of the encryption function itself.

9E. Subsystems

400,803
PB83-119776 PC A02/MF A01
 National Bureau of Standards, Boulder, CO. National Engineering Lab.
**Bibliography of the NBS Electromagnetic Fields
 Division Publications,**
 Kathryn A. Gibson, and Charles K. S. Miller. Aug 82,
 20p NBSIR-82-1673

Keywords: *Bibliographies, *Antennas, *Electromagnetic fields, Electromagnetic interference, Electromagnetic noise, Metrology, Radiation hazards, Electromagnetic properties.

This bibliography lists the publications of the personnel of the NBS Electromagnetic Fields Division in the period from January 1980 through December 1981.

400,804
PB83-125625 PC A05/MF A01
 National Bureau of Standards, Boulder, CO. National Engineering Lab.
**Computation of Antenna Side-Lobe Coupling in
 the Near Field Using Approximate Far-Field Data,**
 Michael H. Francis, and Arthur D. Yaghjian. Aug 82,
 85p NBSIR-82-1674
 Sponsored in part by Electromagnetic Compatibility Analysis Center, Annapolis, MD.

Keywords: *Coupled antennas, Computation, Loss, Sidelobes, Near field, CUPLNF computer program, CUPLZ computer program, Computer applications.

Computer programs, in particular CUPLNF and CUPLZ, are presently in existence to calculate the coupling loss between two antennas provided that the amplitude and phase of the far field are available. However, for many antennas the complex far field is not known accurately. In such cases it is nevertheless possible to specify approximate far fields from a knowledge of the side-lobe level of each antenna along the axis of separation, and the electrical size of each antenna. To determine the effectiveness of using approximate side-lobe level data instead of the detailed far fields, we chose as our test antennas two hypothetical, linearly polarized, uniformly illuminated circular antennas for which the exact far fields are given by a simple analytic expression. The exact far fields are supplied to the program CUPLNF to compute the exact near-field coupling loss. Approximate fields are supplied to a new program ENVLP developed for the purpose of computing the approximate near-field coupling loss.

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400,805

PB83-233999 PC A03/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.

Approximate Formulas for the Far Fields and Gain of Open-Ended Rectangular Waveguide,
Arthur D. Yaghjian. May 83, 40p NBSIR-83-1689

Keywords: *Waveguides, *Far field, Antenna radiation patterns, Amplification, Approximation, Diffraction.

Approximate formulas are derived for the far field and gain of standard, open-ended, unflanged, rectangular waveguide probes operating within their recommended usable bandwidth of frequencies. (Such probes are commonly used in making probe-corrected near-field antenna measurements.) The formulas, which yield forward far-field power patterns and on-axis gains of X-band and larger waveguide probes to within about 2 dB and 0.2 dB accuracy, respectively, assume (sin theta - cos theta) azimuthal angular dependence and an E-plane pattern given by the traditional aperture integration of the TE₁₀ mode E- and H-fields in the Stratton-Chu equations.

400,806

PB84-101948 PC A04/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.

Handbook for Broadband Isotropic Antenna System. Volume 1. Operation Manual,
W. D. Bensema. Jul 83, 74p NBSIR-83-1693

Keywords: *Broadband antennas, Microcomputers, Maintenance, Isothopy, Electromagnetic interference, Measurement, Field strength.

The manual describes the equipment operation and maintenance procedures to support the broadband isotropic* antenna system developed by the National Bureau of Standards for making EMI measurements in the frequency range from 10 kHz to 18 GHz. The system uses isotropic broadband antennas, a low power microcomputer, antenna switching units, commercially available receivers, and associated cabling. The system automatically switches antenna elements, computes the total scalar sum of the existing field strength, and automatically logs time, frequency, signal strength, and system configuration. The system reduces the number of personnel required to make searches for EMI, and includes a mode for unmanned monitoring.

400,807

PB84-216506 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC. Semiconductor Devices and Circuits Div.

NMOS Test Chip for a Course in Semiconductor Parameter Measurements,
K. P. Roenker, and L. W. Linholm. Apr 84, 50p NBSIR-84-2822
Prepared in cooperation with Cincinnati Univ., OH.

Keywords: *Integrated circuits, *Microelectronics, Measurement, Tests.

This report describes an NMOS test chip, NBS-40, which was developed to be used in graduate level electronics engineering courses involving semiconductor parameter measurements associated with the fabrication of integrated circuits. The 35 test structures included in the test chip and their use in materials, device, and process parameter measurements are described. Details of the silicon gate NMOS process used in the chip fabrication are also provided.

400,808

PB84-217835 PC A06/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Theory of Near-Field Phased Arrays for Electromagnetic Susceptibility Testing,
D. A. Hill. Feb 84, 112p NBS/TN-1072
Also available from Supt. of Docs as SN003-003-02559-3.

Keywords: *Phased arrays, *Antennas, *Electromagnetic fields, Feasibility, Huygens principle, Electromagnetic testing, Plane waves, *Electromagnetic susceptibility, Near field.

The feasibility of using a near-field array for electromagnetic susceptibility testing is studied. The basic objective is to control the element weightings such that a plane wave is generated within the test volume. The

basic theory is developed for arbitrary array geometries, and numerical results are obtained for finite planar arrays. A general near-field array synthesis technique is developed, and the technique minimizes the mean square error in the test volume while constraining the array excitations. The constraint prevents large currents and is useful in minimizing the fields outside the test volume. The basic idea looks promising, but some practical considerations, such as bandwidth and angular scanning limitations, require further theoretical and experimental investigation.

400,809

PB84-221654 Not available NTIS
National Bureau of Standards, Washington, DC.

Thermal Evaluation of VLSI Packages Using Test Chips: A Critical Review.

Final rept.,
F. F. Oettinger. Feb 84, 11p
Pub. in Solid State Technology, p169-179 Feb 84.

Keywords: *Thermal measurement, *Integrated circuits, Nondestructive tests, Semiconductor junctions, Reprints, Very large scale integration, Test chips.

The design, analysis, and utilization of test chips for the thermal evaluation of VLSI packages are discussed. The factors that determine the thermal performance of microelectronic devices are the circuit type, the fabrication technology, the die size, the die attachment method, the package and heat dissipater design, and the ambient environment. Thermal test chips are extensively used in characterizing new package designs for VLSI chips in the 1 to 10 W range. The information discussed should allow the engineer to rationally choose a particular test chip design and to understand the implications of measurements to thermally characterize a particular chip-package system.

400,810

PB84-221662 Not available NTIS
National Bureau of Standards, Washington, DC.

8-Bit Superconducting A/D Converter.
Final rept.,
C. A. Hamilton, and F. L. Lloyd. May 83, 3p
Sponsored in part by Office of Naval Research, Washington, DC.
Pub. in Institute of Electrical and Electronics Engineers Transactions on Magnetics MAG-19, n3 p1259-1261 May 83.

Keywords: *Analog to digital converters, Superconductivity, Reprints, SQUID devices.

The design, fabrication and testing of a superconducting 8-bit converter are presented. Experimental results show essentially monotonic output code at conversion rates of a few megahertz. An algorithm for automatic adjustment and potential problems of higher speed operation are discussed.

400,811

PB84-223817 Not available NTIS
National Bureau of Standards, Washington, DC.

Source of E and H Fields for Antenna Factor Calibration (A Loop Cell).

Final rept.,
R. G. FitzGerrell. May 84, 8p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electromagnetic Compatibility EMC-26, n2 p58-65 May 84.

Keywords: *Calibrating, Antennas, Electric fields, Magnetic fields, Tests, Reprints, *Antenna factors.

The loop cell is fabricated using two intersecting metal sheets joined at the intersection and forming a 36 deg angle. A section of a loop is mounted between two coaxial panel jacks, one on each sheet located at a distance equal to the loop radius from the intersection. A known current through this section of electrically small loop produces calculable E and H fields between the sheets in the plane of the loop. These known fields may be used to determine the antenna factor of small E and H antennas placed in the field if the mutual impedance due to the antenna images in the sheets is negligible and the antenna is not close to the open edges of the cell. Measured and calculated antenna factors agree within + or - 2 dB between 0.25 MHz and 1000 MHz.

400,812

PB84-224864 Not available NTIS
National Bureau of Standards, Washington, DC.

Antenna Gain Measurements by an Extended Version of the NBS (National Bureau of Standards) Extrapolation Method.

Final rept.,
A. G. Repjar, A. C. Newell, and R. C. Baird. 1982, 3p
Pub. in Proceedings of Conference on Precision Electromagnetic Measurements, CPEM Digest 1982, Boulder, Colorado, June 28-July 1, 1982, IEEE Cat. No. 82CH1737-6, pF-7-F-9.

Keywords: *Antennas, Microwave antennas, Gain, Calibrating, Measurement, Ground clutter.

A General Extrapolation Technique which eliminates the effects of ground reflections in absolute gain measurements is described. It uses the Extrapolation Method developed at NBS which, in its present form, uses only amplitude versus distance data. However, for broadbeam antennas such as those encountered below 1 GHz, ground reflections may produce unwanted oscillations in the amplitude versus distance data. Hence the data are not amenable to the curve fitting procedure of the Extrapolation Method. This problem can be overcome by including phase versus distance information to negate the effects of ground reflections.

400,813

PB84-226182 Not available NTIS
National Bureau of Standards, Washington, DC.

Chaos in Josephson Circuits.
Final rept.,
R. L. Kautz. May 83, 10p
Sponsored in part by Office of Naval Research, Arlington, VA.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics MAG-19, n3 p465-474 May 83.

Keywords: *Josephson junctions, Superconductivity, Reprints, Chaos, Fractals.

Chaotic behavior in Josephson circuits is reviewed using the rf-driven junction as an example. Topics include the effect of chaos on the I-V characteristic, the period doubling route to chaos, and power spectra for the chaotic state. Liapunov exponents and the fractal geometry of strange attractors are also discussed.

400,814

PB84-227115 Not available NTIS
National Bureau of Standards, Washington, DC.

Power Gain of a SQUID (Superconducting Quantum Interference Device) Amplifier.

Final rept.,
D. G. McDonald. 1 Mar 84, 3p
Pub. in Applied Physics Letters, v44 n5 p558-566, 1 Mar 84.

Keywords: *Microwave amplifiers, *Power gain, Superconductors, Reprints, *SQUID devices.

The power gain of a dc superconducting quantum interference device (SQUID) amplifier, with tuned input and output circuits, is computed as a function of the current and magnetic biases. A gain of 20300 is found at 1.5 GHz and 3470 at 3.0 GHz, implying a frequency dependence to the gain of approximately 1/(omega squared). The gain, as derived from the resistively shunted junction model, is compared with the gain of a simplified model based on the dc magnetic response (V sub phi). This comparison shows that the (V sub phi) description of the SQUID can lead to large errors.

400,815

PB84-243864 Not available NTIS
National Bureau of Standards, Washington, DC.

Efficient Computation of Antenna Coupling and Fields Within the Near-Field Region.

Final rept.,
A. D. Yaghjian. Jan 82, 16p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Antennas and Propagation AP-30, n1 p113-128 Jan 82.

Keywords: *Antenna radiation patterns, Antennas, Electromagnetic fields, Computation, Electromagnetic interference, Reprints, Computer applications, Near field.

The theory, techniques, details of the important equations, and description of two computer programs are

presented for calculating efficiently the mutual coupling at a single frequency between any two antennas arbitrarily oriented and separated in free space. Both programs emphasize efficiency and generality, and require, basically, the complex electric far field of each antenna, and the Eulerian angles designating the relative orientation of each antenna. Multiple reflections between the antennas are neglected but no other restrictive assumptions are involved. If an electric field component is desired instead of coupling, the receiving antenna is replaced by a virtual antenna with uniform far field.

400,816

PB84-244938 Not available NTIS
National Bureau of Standards, Washington, DC.
Some Recent Near-Field Antenna Measurements at NBS (National Bureau of Standards).
Final rept.,
C. F. Stubenrauch, and A. C. Newell. Nov 80, 6p
Microwave J., Vol. 23, No. 11, pp. 37-42 (Nov. 1980).
Pub. in Microwave Jnl., p37-42 Nov 82.

Keywords: *Antenna radiation patterns, Measurement, Antennas, Electromagnetic fields, Scanning, Antenna lobes, Far field, Reprints.

The paper discusses three measurements recently completed at National Bureau of Standards (NBS) using near-field techniques. The first was a planar scan of a prototype microstrip array of a type used in satellite-borne synthetic aperture radars. The second topic consists of recent results obtained with probe corrected measurements made on a cylinder. The final section describes a hybrid technique which employs both planar and cylindrical scanning to allow sidelobes to be measured to greater angles off boresight than permitted by either planar or cylindrical scanning above.

400,817

PB85-105963 PC A04/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
Comparison of Measured and Calculated Mutual Coupling in the Near Field between Microwave Antennas,
C. F. Stubenrauch, and M. H. Francis. Jun 84, 57p
NBSIR-84/3010

Keywords: *Microwave antennas, Coupled antennas, Measurement, Antennas, Electromagnetic fields, Losses, Antenna radiation patterns.

Measurements of near-field mutual coupling were performed between two moderate sized microwave antennas and compared to coupling calculated using recently developed computer programs. Input data for the programs are the complex far-field radiation patterns of the antennas. Experimentally determined and calculated coupling as a function of both transverse displacement and separation agree closely except for a constant offset observed in some cases. In addition, coupling values computed using a program which approximates the far-field radiation patterns were compared to experiment and found to be satisfactory.

400,818

PB85-128148 PC A02/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Preliminary Investigation into Using the Sun as a Source for G/T (Gain to System Noise Temperature) Measurements.
W. C. Daywitt. Aug 84, 23p NBSIR-84/3015

Keywords: *Microwave antennas, *Solar radio emission, Microwaves, Atmospheric attenuation, Sun, Error analysis, Correction, Electromagnetic noise, Amplification, Atmospheric correction, Earth terminal measurement system, G/T.

This report describes a preliminary investigation into determining the solar flux density, the atmospheric correction factor, and the star shape correction factor for use in G/T measurements above 5 GHz. An estimate of errors is also included. Preliminary results show: an improved algorithm for determining diffusive and refractive attenuation; a viable technique for estimating the solar flux density from daily AFGL flux density measurements and a centimeter/millimeter wave spectrum function; and the possibility of reducing star shape correction factor errors by use of an effective solar rf diameter.

400,819

PB85-129252 Not available NTIS
National Bureau of Standards, Washington, DC.
Relatively Short Cylindrical Broadband Antenna with Tapered Resistive Loading for Picosecond Pulse Measurements.
Final rept.,
M. Kanda. 1978, 9p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation 26, n3 439-447 May 78.

Keywords: *Broadband antennas, Measurement, Continuous radiation, Reprints, Picosecond pulses.

A relatively short cylindrical antenna with continuously tapered resistive loading has been studied for the purpose of picosecond pulse and extremely broadband CW measurements. The antenna considered is a non-conducting (glass) cylinder with continuously deposited, tapered, resistive loading. The characteristics of the antenna have been examined theoretically and experimentally. The current distributions on the antenna are numerically calculated using the method of moments. Using these current distributions, other quantities, such as input impedance, near-field and far-field radiation patterns, and radiation efficiency, are also numerically calculated and compared with the results using Wu-King's current distribution. Agreement is relatively good except at high frequencies. To verify the theoretical results, several resistive loaded antennas are fabricated, and their picosecond pulse and extremely broadband CW receiving characteristics are analyzed for the frequency range between 5 kHz and 5 GHz.

400,820

PB85-129278 Not available NTIS
National Bureau of Standards, Washington, DC.
Off-Line, Built-In Test Techniques for VLSI (Very Large Scale Integrated) Circuits.
Final rept.,
M. G. Buehler, and M. W. Sievers. 1982, 14p
Pub. in Computer 15, n6 p69-82 Jun 82.

Keywords: *Integrated circuits, Comparators, Reprints, *Built in test equipment, Very large scale integration.

Very large scale integrated (VLSI) circuits make possible the use of additional on-chip circuits for improving the testability of the entire circuit. This effort presents a study of the trade-offs in using five off-line, built-in test techniques: self-oscillation, self-comparison, partition, scan path, and built-in logic block observer (BILBO). The techniques were studied by applying them to the test of a two-bit adder with ripple carry. The relative merits of each technique are compared with respect to (a) whether the test generator and test analyzer are on- or off-chip, (b) the number of gates (transistors) needed to implement the test circuitry, (c) fault coverage, (d) self-testability, and (e) applicability to VLSI circuits. Highlights reveal that the self-oscillation test technique requires the fewest components to implement the test circuitry, is applicable to the highest speed circuitry, but has less than 100 percent fault coverage.

400,821

PB85-129328 Not available NTIS
National Bureau of Standards, Washington, DC.
Two-Port Network Representation Based on a Unsymmetry Factor, with Applications to Coaxial Measurement.
Final rept.,
A. Millea. 1971, 4p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Instrumentation and Measurement 20, n2 p123-126 May 71.

Keywords: *Network synthesis, Equivalent circuits, Measurement, Reprints, Two ports.

A network representation for linear, passive and reciprocal two-port devices is described, using as parameters the longitudinal impedance z , the transverse admittance y and the unsymmetry factor k . This representation offers certain advantages in connection with high-frequency and microwave impedance measurements.

400,822

PB85-133999 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Characteristics of a Linear Antenna with Tapered Resistive and Capacitive Loading.
Final rept.,
M. Kanda. 1980, 4p
Pub. in APS. Int. Symp. Dig. Antennas and Propag., Univ. Laval, Quebec, Canada, June 2-6, 1980, IEEE Cat. No. 80-CH1557-8, p696-699.

Keywords: *Antennas, Linear systems, Load impedance.

The characteristics of a linear antenna with resistive and capacitive loading are investigated theoretically and experimentally. To implement the real part of impedance loading, the antenna element was made by depositing a tapered thin-film alloy on a glass rod. To achieve the imaginary part of impedance loading, the deposited thin-film alloy on the glass rod was cut by an argon laser to form a segmented antenna. The current distribution, the impedance, the far-field radiation pattern and the transfer function of a linear antenna with tapered resistive and capacitive loading are presented.

400,823

PB85-141455 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Probe Correction in Spherical Near-Field Scanning, Viewed as an Ideal Probe Measuring an Effective Field.
Final rept.,
R. C. Wittmann. 1984, 4p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Proceedings of the IEEE Antennas and Propagation Society, 1984 International Symposium, Boston, MA, Jun 25-28, 1984 p674-677.

Keywords: *Electromagnetic fields, Antennas, Measurement, Scanning, Probes, Corrections, Near field.

In order to reduce measurement and computation complexity, most probe-corrected, spherical near-field scanning facilities use a special 'symmetric' probe, the output of which exhibits a $\cos(\chi) - \sin(\chi)$ dependence as the probe is rotated about its axis by an angle, χ . We show here that such a probe is mathematically equivalent to ideal dipole probes measuring an effective field. Computational efficiency and structural simplicity result since much of the effort concerns the calculation of the effective field, and this may be done with a no probe correction algorithm.

400,824

PB85-142230 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Time Domain Sensors for Radiated Impulsive EMI Measurements.
Final rept.,
M. Kanda, and F. X. Ries. Sep 82, 6p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) International Symposium on Electromagnetic Compatibility, Santa Clara, CA., September, 8-10, 1982, p296-301.

Keywords: *Electromagnetic interference, *Antennas, Field strength, Detectors, Measurement, Transfer functions, Time domain.

The purpose of this paper is to review various sensors and radiators commonly used for time domain antenna measurements. For electric field strength measurements, linear antennas loaded nonuniformly and continuously with resistance, or both resistance and capacitance are discussed. Also a conical antenna and an asymptotic conical antenna are discussed from the standpoint of an improved characteristic. For an improved directivity, various types of TEM horns are discussed, e.g., a conducting TEM horn, a CALSPAN antenna, and a resistively loaded TEM horn.

400,825

PB85-142933 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Role of Test Chips in Coordinating Logic and Circuit Design and Layout Aids for VLSI.
Final rept.,
M. G. Buehler, and L. W. Linholm. 1981, 7p
Pub. in Solid State Technology 24, n9 p68-74 Sep 81.

Keywords: *Integrated circuits, Simulation, Design, Reprints, Test chips, Very large scale integration.

Field 9—ELECTRONICS AND ELECTRICAL ENGINEERING

Group 9E—Subsystems

The paper emphasizes the need for multipurpose test chips and comprehensive procedures for use in supplying accurate input data to both logic and circuit simulators and chip layout aids. It is shown that the location of test structures within test chips is critical in obtaining representative data, because geometrical distortions introduced during the photomasking process can lead to significant intrachip parameter variations. In order to transfer test chip designs quickly, accurately, and economically, a commonly accepted portable chip layout notation and commonly accepted parametric tester language are needed. In order to measure test chips more accurately and more rapidly, parametric testers with improved architecture need to be developed in conjunction with innovative test structures with on-chip signal conditioning.

400,826
PB85-142966 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Transients in a Resistively Loaded Loop Antenna.
Final rept.,
M. Kanda. Oct 84, 5p
Pub. in Proceedings of International Symposium on Electromagnetic Compatibility, Tokyo, Japan, October 16-18, 1984, IEEE (Institute of Electrical and Electronics Engineers) Cat. No. 84-CH2097-4, p286-290.

Keywords: *Loop antennas, Transients, Loading(Electronics).

Transient characteristics of a loop antenna loaded uniformly with a resistive material are analyzed. The current distribution of the antenna is obtained by the use of the Fourier series expansion technique. It is found that the distortion of the transient waveforms due to a resonance of a loop antenna can be reduced and the received transient waveforms can be tailored by resistive loading.

400,827
PB85-143519 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Conversion Gain in mm-Wave Quasiparticle Heterodyne Mixers.
Final rept.,
T. M. Shen, P. L. Richards, R. E. Harris, and F. L. Lloyd. 1980, 3p
See also AD-A100 128.
Pub. in Applied Physics Letters 36, n9 p777-779, 1 May 80.

Keywords: *Microwave equipment, *Josephson junctions, Heterodyning, Millimeter waves, Radio astronomy, Radio receivers, Cryogenics, Reprints, *Mixers(Electronics).

The rapid onset of quasiparticle tunneling current in superconductor-insulator-superconductor (Josephson) junctions at voltages above the full energy gap has been used in previous experiments for millimeter wave heterodyne mixing. Very low mixer noise temperatures have been observed, but with low conversion efficiency so that the noise in available IF amplifiers strongly dominates the total receiver noise. J. R. Tucker has recently predicted that mixing can occur with conversion gain when such a mixer is operated in the quantum limit. In this letter the authors report the observation of stable mixing with significant conversion gain and with noise temperatures comparable with the photon noise limit. (Double-sideband, L sup -1 = 1.40 + or - 0.14 at 36 GHz, T sub M = or < 1.5 K).

400,828
PB85-143592 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Characteristics of Iris-Fed Millimeter-Wave Rectangular Microstrip Patch Antennas.
Final rept.,
M. Kanda, D. C. Chang, and D. H. Greenlee. 1982, 3p
See also PB84-134634.
Pub. in Proceedings of Antennas and Propagation Society Symposium, Albuquerque, NM, May 24-28, 1982, IEEE Catalog No. 82-CH1783-0, p293-295.

Keywords: *Microwave antennas, Antenna radiation patterns, Impedance, Antenna feeds, Irises(Mechanical apertures), Microstrip antennas.

This paper describes the characteristics of iris-fed millimeter-wave rectangular microstrip patch antennas. A theoretical model is given to describe the iris-fed patch antenna based on aperture coupling to cavities. The impedance and antenna power patterns are given.

400,829
PB85-148013 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Arrays of Discrete Elements.
Final rept.,
M. T. Ma. 1984, 34p
Pub. in Antenna Engineering Handbook, Second Edition, Chapter 3, p3 -1--3-34 1984.

Keywords: *Antenna arrays, Endfire arrays, Yagi antennas, Reprints, Antenna design.

This is an invited contribution, as Chapter 3, to Second Edition, Antenna Engineering Handbook to be published by McGraw-Hill Book Company.

9F. Telemetry

400,830
PB84-218361 PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Error Analysis for the Use of Presently Available Lunar Radio Flux Data in Broadbeam Antenna-System Measurements,
W. C. Daywitt. Feb 84, 39p NBS/TN-1073
Also available from Supt. of Docs as SN003-003-02555-1.

Keywords: *Error analysis, *Antennas, *Lunar communications, *Flux density, Temperature, Radio communications.

Simple, precise expressions for lunar diameter, average brightness temperature, flux density, and shape factor are presented. An analysis of the relationship between these parameters and corresponding errors are included. For broadbeam (HPBW>d) antennas, results show that flux density and shape factor can be determined with errors less than 13 percent and 0.4 percent respectively at frequencies below 10 GHz. Extension of the analysis to higher frequencies is indicated.

10. ENERGY CONVERSION (NON-PROPULSIVE)

10A. Conversion Techniques

400,831
PB84-154780 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Materials Research Activities at the National Bureau of Standards (1975-1982) Pertaining to Active Solar Heating and Cooling Systems,
C. W. C. Yancey. Nov 83, 75p NBSIR-83-2782
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Solar heating, Thermal insulation, Heat storage, Materials, Heat transfer, Solar collectors, Working fluids, Solar cooling systems, Solar heating systems.

A summary of the solar energy materials-related research projects conducted by the National Bureau of Standards, for the U.S. Department of Energy, since 1975 is presented. Research studies concerned with materials that are utilized in the collector, transport and storage subsystems are summarized. Materials research areas covered by the documentation include: cover plates, absorber coatings, thermal insulation, sealants, containment materials, heat transfer fluids, hoses and storage media materials. The primary objectives, scope and principal results of the various studies are presented. The relationship between test

results and subsequent consensus standard adoption or revision is drawn where applicable.

400,832
PB84-165299 PC A07/MF A01
Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Mechanical Engineering.
Solar Collector Test Procedures: Development of a Method to Refer Measured Efficiencies to Standardized Test Conditions.
Final rept. 1977-80,
W. C. Thomas. Feb 84, 150p VPI-E-80-23, NBS-GCR-84-459
Grant NBS-G8-9022

Keywords: Tests, Efficiency, Performance tests, *Solar collectors.

An analytical procedure has been developed for referring collector efficiency measurements, obtained under different test conditions, to a common, or 'standard' set of conditions. The procedure applies to flat-plate liquid-type collectors of conventional tube-in-sheet design. The basic Hottel-Whillier-Bliss theory is used with appropriate extensions to account for serpentine flow configurations and glazing materials with high infrared transmittance. The procedure includes a systematic method for deriving two invariant collector parameters directly from ASHRAE Standard 93-77 test results. The two parameters selected are the plate absorptance and back loss coefficient. A set of standard conditions is recommended which corresponds to favorable test conditions.

400,833
PB84-167675 PC A05/MF A01
National Bureau of Standards, Washington, DC.
Demand Limiting Algorithms for Energy Management and Control Systems,
C. Park. Feb 84, 89p NBSIR-84-2826
Sponsored in part by Department of Energy, Washington, DC. Office of Building and Community Systems, and Civil Engineering Lab. (Navy), Port Hueneme, CA.

Keywords: *Electric power demand, Office buildings, Commercial buildings, Control equipment, Load control, Algorithms, Computer programs, *Energy management, Load management.

Demand limiting control is one of popular control strategies for electrical energy management in Energy Management and Control Systems (EMCS) in commercial/office buildings. The purpose of demand limiting is to maintain the peak demand level below a predetermined limit by shedding nonessential loads in a building during the peak demand period. In this present report, description of fixed interval metering and sliding window metering for electrical demands are included. Demand limiting calculation procedures discussed are the ideal rate, the predictive, and the instantaneous rate methods. Demand limiting algorithms, which were developed based on available information, are presented. Computer program listings of demand limiting control algorithms in Fortran 77 and an open-loop computer simulation result are included in the appendices.

400,834
PB84-203348 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Evaluation of Thermal Energy Conservation Schemes for an Experimental Masonry Building.
Final rept.,
P. S. Gujral, R. J. Clark, and D. M. Burch. Jul 82, 43p NBS/BSS-137
Library of Congress catalog card no. 81-600175. Prepared in cooperation with Skidmore, Owings and Merrill, Chicago, IL., and King Abdulaziz Univ., Jeddah (Saudi Arabia).Color illustrations reproduced in black and white.

Keywords: *Solar energy, *Cooling, *Heating, *Buildings, Space heating, Ventilation, Heat transfer, Masonry, *Energy conservation, *Passive solar heating, Space cooling.

A one-room masonry building with exterior polystyrene rigid board insulation was built within a large environmental chamber at the National Bureau of Standards. Various climatic conditions were simulated within the chamber, and the transient thermal response of the test building was monitored. Three schemes (night cooling using a ceiling-mounted valance cooling coil, natural ventilation night cooling, and passive solar

heating) were investigated with regard to energy conservation. The test results indicated that these operating practices resulted in a considerable reduction in energy consumption for space heating and cooling. The measured performance of the test building compared favorably with the corresponding performance obtained with an analytic model.

400,835
PB85-108488 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Evaluation of Infrared Reflectance as a Technique for Measuring Absorber Materials Degradation, D. Waksman, and W. E. Roberts. Sep 84, 47p
NBSIR-84/2916
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Antireflection coatings, Reflectance, Measurement, Degradation, Infrared spectra, *Solar absorbers, Solar collectors.

Current ASTM standards concerned with the durability and reliability of absorptive coatings rely on integrated solar absorbance and emittance as the primary methods for assessing changes in absorber optical performance resulting from environmental exposure. This study was undertaken to determine if infrared reflectance measurements are a more sensitive technique for detecting absorber materials degradation. Spectral measurements were made to identify factors that could affect the reproducibility of infrared reflectance measurements and to compare their ability to detect changes with currently used methods for absorber materials. Recommendations are made concerning the use and limitations of infrared reflectance measurements for this purpose.

400,836
PB85-113603 PC A08/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
NBS (National Bureau of Standards) Solar Collector Durability/Reliability Test Program: Final Report, D. Waksman, W. C. Thomas, and E. R. Streed. Sep 84, 153p NBS/TN-1196
Also available from Supt. of Docs as SN003-003-02611-5. Sponsored in part by Department of Energy, Washington, DC. Prepared in cooperation with Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering. Errata sheet inserted. See also PB81-166571.

Keywords: *Performance tests, Quality assurance, Reliability, Durability, Deterioration, Degradation, Project planning, *Solar collectors.

In this research, eight different types of flat-plate solar collectors were exposed outdoors at four sites located in different climatic regions. Small scale cover and absorber materials coupon specimens consisting of samples taken from a collector of each of the eight types used and a number of additional materials were exposed concurrently with the full-size collectors. Periodic measurements were made of collector and materials performance as a function of outdoor exposure time. Indoor laboratory aging tests were conducted concurrently on specimens of the same materials to provide a basis for comparison with the outdoor exposure tests. This report presents the results obtained in this test program. Recommendations are made regarding the use and limitations of performance measurements and environmental exposure tests for assessing the durability of solar collectors and absorber and cover materials.

400,837
PB85-119469 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Measurement Techniques for Evaluating Solar Reflector Materials. Final rept., J. C. Richmond. Sep 84, 74p NBS/GCR-84/475
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Solar reflectors, *Materials, Measurement, Evaluation, Service life, Performance tests, Manufacturing, Bibliographies, Mirrors.

Solar reflector materials are used to concentrate the terrestrial solar irradiance on a solar receiver in order to increase the temperature of the working fluid in a

solar energy system. To ensure acceptable performance and service life of the materials used in reflectors, data must be available prior to the design, construction and use of reflectors. These data must be generated by reliable measurement techniques. This report assesses the current state-of-the-art of technology associated with the manufacture and evaluation of solar reflector materials and includes an identification of numerous research needs and a bibliography of 124 relevant documents.

400,838
PB85-120715 Not available NTIS
National Bureau of Standards, Washington, DC.
Influence of Degree Day Base Temperature on Building Energy Prediction. Final rept., D. Nall, and E. Arens. 1979, 15p
Pub. in American Society of Heating, Refrigerating and Air-Conditioning Engineers Transactions 85, pt. 1 p707-721 1979.

Keywords: *Buildings, Temperature, Analysis(Mathematics), Predictions, Climate, Standards, Reprints, *Energy consumption, *Energy forecasts, Degree days.

This report investigates the use of base temperatures other than the traditional 65F (18.3C) value as an improvement to the degree day method of predicting energy consumption in buildings. Evidence of building balance point temperatures other than 65F (18.3C) from monitored buildings is presented. Methods of calculating base temperatures are evaluated, and the thermal behavior of one building is analyzed for different climates. Finally, the application of degree days of varying bases to the creation of climate zones for use with building energy standards is discussed.

400,839
PB85-146868 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Multi-Year Plan for Experimental Systems Research—Passive and Hybrid Solar Energy Program, J. Greenberg. Nov 84, 53p NBSIR-84/2972
Contract DE-A101-76PR06010

Keywords: *Solar energy, *Research management, Project planning, Facilities, Economic factors, Performance, Buildings, Passive solar heating systems, Passive solar cooling systems, Hybrid systems.

This report addresses the development of a multi-year plan for Experimental Systems Research focused at gaining the necessary knowledge to advance the understanding of passive and hybrid solar energy technology. This understanding includes the ability to acquire building performance data under controlled conditions so that the fundamental mechanism of the driving forces that effect change, along with the resulting change, can be studied. It includes the process whereby through a series of working meetings and exchange of correspondence, a list of candidate research areas were identified for both heating and cooling technologies. These research areas are defined and ranked and a resulting list of priorities established. This report articulates the results of this effort and details the recommended Experimental Systems Research Activities for solar passive and hybrid technologies for FY85 and beyond.

10B. Power Sources

400,840
PB84-223932 Not available NTIS
National Bureau of Standards, Washington, DC.
Commercial Photovoltaic Measurement Workshop Proceedings. Final rept., H. A. Schafft, and S. Hogan. Nov 82, 20p
Sponsored in part by Solar Energy Research Inst., Golden, CO. See also DE82-003754.
Pub. in Solar Cells, v7 n1-2 p3-22 Nov 82.

Keywords: *Solar cells, *Photovoltaic cells, *Measurement, Symposia, Silicon, Quality assurance, Photoconductivity, Standards, Reprints.

A workshop was held to provide the photovoltaics industry and others with a vehicle to examine the status and the needs for the development of measurements and standards for flat-plate solar cells, modules, and

systems. Over 80 participants from the photovoltaics community took part in presentations and discussions on the following topics: measurement equipment needs, interactions with customers of photovoltaic products, quality assurance, silicon materials characterization, solar data, reference cells, cell and module output measurements, module certification, and the role of the Government in measurements. This report includes the presentations given, the results of the discussion sessions, and overview and assessment statements.

400,841
PB85-104651 Not available NTIS
National Bureau of Standards, Washington, DC.
Electro-Oxidation of Hydrogen on Mo-W Carbide Alloy Catalysts in Acid Electrolyte. Final rept., A. J. McAlister, and M. I. Cohen. 1980, 4p
Pub. in Electrochimica Acta 25, n12 p1685-1688 1980.

Keywords: *Electrochemistry, *Oxidation, *Hydrogen, *Fuel cells, Catalysts, Electrolytes, Carbides, Acids, Reprints.

The rates of anodic oxidation of H₂ in acid electrolyte on WC and on the isostructural ternary alloy Mo(1-x)WxC, with Mo occupying 70 to 80% of the metal sites, have been compared experimentally. The ternary catalyzes the reaction as effectively as WC, by the same mechanism, and is equally tolerant of CO entrained in the H₂ feed. Evidence is presented which indicates that proton discharge is rate limiting on these carbides, and that their performance is limited by scarcity of active sites and hence open to improvement by appropriate preparative technique.

400,842
PB85-129435 Not available NTIS
National Bureau of Standards, Washington, DC.
Semiconductor Equipment and Materials Institute Specification for Solar Cell Silicon. Final rept., R. I. Scace. 1983, 2p
Pub. in Solar Cells 7, p77-78 1982-83.

Keywords: *Silicon, Specifications, Solar cells, Reprints.

The specification for solar cell silicon slices under development by the Semiconductor Equipment and Materials Institute is described. The specification covers physical and dimensional but not electrical attributes of the material. Work to establish standardized dimensions of slices is continuing.

400,843
PB85-145266 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Certification Program for Photovoltaic Modules. Final rept., D. B. Thomas. 1982, 3p
Sponsored by Solar Energy Research Inst., Golden, CO.
Pub. in Solar Cells: Their Science Technology, Applic., and Econ. 7, n1-2 p183-185 Nov 82.

Keywords: *Photovoltaic cells, Evaluation, Laboratories, Solar cells, Tests, Test facilities, Quality assurance, Reprints, *Certification, Accreditation.

A brief discussion of the basic concepts of product certification is presented followed by a discussion of prerequisites for a proposed certification program for photovoltaic modules. One independent approved laboratory would serve as the certifier for the program with additional laboratories being approved if they are warranted by a demand for additional testing services. If the module certification program eventually needs a large number of laboratories for this type of testing, the approved laboratory program should be replaced by an accreditation program such as the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the Department of Commerce.

Field 10—ENERGY CONVERSION (NON-PROPULSIVE)

Group 10B—Power Sources

400,844

PB85-145274 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Approved Laboratory Program for Photovoltaic Reference Cell Development.

Final rept.,
D. B. Thomas. 1982, 4p
Sponsored by Solar Energy Research Inst., Golden, CO.
Pub. in *Solar Cells: Their Science Technology, Appl., and Econ.* 7, n1-2 p131-134 Nov 82.

Keywords: *Photovoltaic cells, Fabrication, Laboratories, Calibrating, Solar cells, Verification inspection, Test facilities, Tests, Evaluation, Reprints, Certification.

A program is proposed for establishing at least one approved laboratory for the fabrication, calibration, and certification of photovoltaic reference cells used in measuring the electrical output of solar cells and modules. The approved laboratory would be evaluated by NBS and monitored for proficiency by using a reference laboratory for reference cell verification testing.

10C. Energy Storage

400,845

PB84-224740 Not available NTIS
National Bureau of Standards, Washington, DC.
Polyacetylene as an Electrode in Solid State Batteries.

Final rept.,
C. K. Chiang. 1983, 2p
Pub. in *Solid State Ionics* 9 and 10, p445-446 1983.

Keywords: *Electrodes, *Solid state devices, *Electric batteries, Additives, Ions, Conductivity, Reprints, *Polyethynylene, *Solid state batteries.

Highly conducting polyacetylene can be used as an electrode in a solid state cell. The solid electrode processes are the doping and the undoping of the polymer by the mobile ions. The solid state doping and the emf of the Na/(CH)_x cell are examined. The emf of the Na/(CH)_x cell versus concentration curve resembles that of Li/TiS₂.

400,846

PB85-111201 PC A13/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Phase Change Thermal Energy Storage and the Model Building Codes.

Final rept.,
J. Greenberg, and B. C. Reeder. Aug 84, 294p
NBSIR-84/2909
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Building codes, *Heating systems, *Cooling systems, Solar energy, Latent heat, Plumbing, Heat of fusion, Hydrates, Thermochemistry, Design criteria, Performance evaluation, *Thermal energy storage equipment, *Phase change materials.

Thermal energy systems using phase change materials are currently being developed and used for storing energy collected by solar and other means. This report is intended to bridge the gap between those who design and install phase change thermal storage devices and the building code official who evaluates these devices for code compliance. The initial pages of this report describe the more commonly accepted phase change materials and systems, present a taxonomy which is applicable to building construction, and describe the interface between the various model codes and the more advanced phase change system configurations. The report continues with an analysis of the model codes with a specific orientation to phase change thermal energy storage systems. The analysis is structured according to building, mechanical, and plumbing issues with topics relevant to phase change systems identified and specific code provisions applicable to each topic listed. To facilitate use by code officials in evaluating a system for compliance with a specific document, the appendix cross references relevant topics according to individual model code requirements.

400,847

PB85-146876 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Evaluation of Ettringite and Related Compounds for Use in Solar Energy Storage.

Progress rept.,
L. J. Struble, and P. W. Brown. Oct 84, 46p NBSIR-84/2942
Sponsored by Department of Energy, Washington, DC. Office of Solar Heat Technologies.

Keywords: *Solar energy, *Energy storage, *Synthesis(Chemistry), Performance evaluation, Phase transformation, Enthalpy, Specific heat, Temperature, *Phase change materials, *Latent heat storage, *Ettringite.

This report describes an investigation of ettringite and related phases for potential application in solar energy storage. The specific objective is to evaluate the potential of ettringite dehydration and rehydration as a phase change for energy storage. Synthesis procedures have been developed, and a number of ettringite-type phases have been prepared. The heat capacity of each phase was approximately 0.3 calories per gram per degree Celsius. Studies of the dehydration of these phases at atmospheric pressure indicate that the material has good potential as a phase change material for solar energy storage. Dehydration occurred at temperatures in the range between approximately 30C and 55C, with changes in enthalpy ranging between 100 and 240 calories per gram sample. In addition, ettringite was found to have a reversible hydrothermal reaction at approximately 50C, with an enthalpy change of approximately 4 calories per gram sample. Future work during the remainder of this program will involve completing the work described in the present progress report.

400,849

PB84-225564 Not available NTIS
National Bureau of Standards, Washington, DC.
Development of High-Strength, Acrylic Resin-Compatible Adhesive Cements.

Final rept.,
G. M. Brauer, J. W. Stansbury, and H. Argentar. Mar 83, 5p
Sponsored in part by National Inst. of Dental Research, Bethesda, MD.
Pub. in *Jnl. of Dental Research*, v62 n3 p366-370 Mar 83.

Keywords: *Adhesives, *Dental materials, *Acrylic resins, Performance evaluation, Chelating agents, Reprints.

The reaction of vanillate esters dissolved in chelating agents with zinc oxide yields hard cementitious materials. Hexyl vanillate-EBA (o-ethoxybenzoic acid) mixed with ZnO-Al₂O₃-hydrogenated rosin gives a high-strength, low water-soluble cement that does not inhibit polymerization and adheres to non-precious metals and composites.

11B. Ceramics, Refractories, and Glasses

400,850

PB84-218809 Not available NTIS
National Bureau of Standards, Washington, DC.
Critical Evaluation of Fracture Mechanics Techniques for Brittle Materials.

Final rept.,
S. W. Freiman. 1983, 19p
Sponsored in part by Office of Naval Research, Arlington, VA.
Pub. in *Fracture Mechanics of Ceramics* 6, p27-45 1983.

Keywords: *Ceramics, *Brittleness, Crack propagation, Toughness, Tests, Reprints, *Fracture(Mechanics), Fracture toughness.

A significant number of techniques for determining the crack growth resistance of brittle materials have been developed in recent years. Many of these are intended for both the determination of critical values of fracture toughness, as well as obtaining subcritical crack growth data. Positive and negative aspects of test geometries including double torsion, double cantilever beam, notched beam, short rod, indentation, etc., are presented. The effects of loading procedures, e.g. constant load, load relaxation, constant loading rate, on subcritical crack growth curves are discussed. The microstructure of polycrystalline ceramics is shown to significantly affect measured values of crack growth parameters. The parameter K_{sub IC} is commonly determined using most fracture mechanics techniques. The question 'Is K_{sub IC} a unique materials' constant, or is it dependent on specimen geometry, loading rate, environment, etc.' is discussed.

400,851

PB84-222686 Not available NTIS
National Bureau of Standards, Washington, DC.
Structural Reliability of Yttria-Doped Hot-Pressed Silicon Nitride at Elevated Temperatures.

Final rept.,
S. M. Wiederhorn, and N. J. Tighe. Dec 83, 6p
Sponsored in part by Air Force Office of Scientific Research, Bolling AFB, DC. See also PB83-192666.
Pub. in *Jnl. of the American Ceramic Society*, v66 n12 p884-889 Dec 84.

Keywords: *Silicon nitrides, Ceramics, Creep properties, Fracture(Materials), Mechanical properties, Reprints.

The strength of yttria-doped, hot-pressed silicon nitride was investigated as a function of temperature and applied load. Data collected at 1200C are presented in the form of a strength degradation diagram for an applied load of 350 MPa. At this temperature, the behavior of the yttria-doped material is found to be superior to that of magnesia-doped silicon nitride, in which creep results in the formation of microcracks that lead to strength degradation. By contrast, the yttria-doped material does not suffer from microcrack formation, or strength degradation at 1200C. At higher temperatures strength degradation does occur, and as a consequence, an upper limit of 1200C is recommended for

11. MATERIALS

11A. Adhesives and Seals

400,848

PB84-217215 Not available NTIS
National Bureau of Standards, Washington, DC.
Adhesive Bonding by Surface Initiation of Polymerization.

Final rept.,
R. L. Bowen, E. N. Cobb, and D. N. Misra. Mar 84, 4p
Sponsored in part by American Dental Association, Chicago, IL.
Pub. in *Industrial and Engineering Chemistry, Product Research and Development*, p78-81 Mar 84.

Keywords: *Polymerization, *Adhesive bonding, *Surfaces, Composite materials, Dental materials, Chemical bonds, Reprints, Glycine/N-(tolyl), Methacrylic acid/glycidyl, Methacrylic acid/hydroxyethyl.

Strong adhesion between composites and dentin or enamel is obtained by the sequential applications of ferric oxalate, NTG-GMA (adduct of N(p-tolyl)glycine and glycidyl methacrylate), and PMDM (adduct of hydroxyethyl methacrylate and pyromellitic dianhydride). Bond-strength measurements, hardening-time tests, SEM observations, and other methods were used for the purpose of gaining an understanding of the essential mechanisms. So far, the evidence leads to the following working hypotheses. The aqueous Fe₂(C₂O₄)₃ solution apparently rebuilds the surface to provide a hard, microporous structure contiguous with the apatite-collagen substrate. The observed 'spontaneous' polymerization may be initiated by radicals produced by redox reactions involving the reduction of ferric ions. Complexation by NTG-GMA might promote this reaction and, together with the intimate adsorption of PMDM, provide proximal methacrylate groups for polymerization that propagates outward from this surface.

yttria-doped, hot-pressed silicon nitride in structural applications.

400,852
PB84-222827 Not available NTIS
 National Bureau of Standards, Washington, DC.
Effects of Chemical Environments on Slow Crack Growth in Glasses and Ceramics.
 Final rept.,
 S. W. Freiman. 10 Jun 84, 5p
 Pub. in Jnl. of Geophysical Research, v89 nB6 p4072-4076, 10 Jun 84.

Keywords: *Ceramics, *Glass, Crack propagation, Stress corrosion, Reprints, Fracture(Mechanics).

This paper presents a review of our current understanding of environmentally induced slow crack growth in glasses, single crystals and polycrystalline ceramics. It is shown that the rate of crack growth is controlled by the chemical activity of the active species in the environment as well as by the stress intensity at the crack tip. A recently developed molecular model of stress induced chemical reaction between vitreous silica and water is described. The implications of this model for the effects of other chemical species on crack growth are discussed. Finally, the complications introduced by the presence of grain boundaries in polycrystalline ceramics are pointed out.

400,853
PB84-223213 Not available NTIS
 National Bureau of Standards, Washington, DC.
Lifetime Predictions for Solar Glasses.
 Final rept.,
 S. W. Freiman, A. C. Gonzalez, and S. M. Wiederhorn. Apr 84, 3p
 Contract DE-AC04-76DP00789
 Pub. in American Ceramic Society Bulletin 63, n4 p597-599 Apr 84.

Keywords: *Glass, *Mirrors, Solar energy, Crack propagation, Fractures(Materials), Life(Durability), Predictions.

Crack growth and strength data of three candidate glass compositions for solar mirrors were used to estimate allowable stress levels for a lifetime of 20 years. Crack growth data were obtained by both double cantilever beam and stressing rate techniques. Based on the lower bound to 95 percent confidence bands associated with the lifetime prediction curves, allowable stresses for the mirrors range from about 6 MPa (0.9 KSi) to about 9 MPa (1.3 KSi). Because the crack growth and strength data were collected in water, this estimate of the allowable stresses is considered to be conservative.

400,854
PB84-224799 Not available NTIS
 National Bureau of Standards, Washington, DC.
Universal Fatigue Curves for Ceramics Using Indentation Flaws.
 Final rept.,
 H. Multhopp, R. F. Cook, and B. R. Lawn. 1983, 2p
 Sponsored in part by Office of Naval Research, Arlington, VA.
 Pub. in Jnl. of Materials Science Letters 2, p683-684 1983.

Keywords: *Ceramics, *Fatigue(Materials), Silicon carbides, Aluminum oxide, Glass, Microstructure, Comparison, Reprints.

A scheme for constructing universal fatigue curves for ceramics, using an indentation technique, is described. Three materials, silicon carbide, alumina, and a glass ceramic, are studied. The data are plotted using reduced variables in a way particularly useful for material intercomparisons. The scatter in the data provide a simple indicator of microstructural effects in the flaw response.

400,855
PB84-245810 Not available NTIS
 National Bureau of Standards, Washington, DC.
Analysis of Thermally Generated Microstresses in Polycrystalline Beryllium Due to the Presence of Beryllium Oxide Inclusions.
 Final rept.,
 T. A. Hahn, and R. W. Armstrong. 1982, 12p
 Pub. in Proceedings of International Thermal Expansion Symposium (7th), p195-206 1982.

Keywords: *Beryllium, Thermal stresses, Inclusions, Beryllium oxides, Plastic flow, Dislocations(Materials).

In polycrystalline hexagonal beryllium (Be), the microstresses due to the relatively small thermal expansion anisotropy were previously estimated, on an ideal elastic basis, to be comparable to those stresses measured for the general yield and fracture strengths of bulk Be material. Commercial beryllium materials normally contain inclusions of (hexagonal) beryllium oxide (BeO), and the mismatch of expansivity between these materials is now shown to be capable of producing even larger elastic microstresses which should produce additional localized yielded and fracture zones within the material. Despite the fact that the BeO inclusions are in compression, both compressive and tensile stresses are generated in the surrounding shell of Be material. The plastic zone size is estimated to be as much as ten times larger than an inclusion diameter so that an important parameter affecting the nature of plastic flow and cracking around an inclusion should be the polycrystal grain size. These several considerations are described on the basis of plasticity and dislocation models which are proposed for the material behavior.

400,856
PB84-246024 Not available NTIS
 National Bureau of Standards, Washington, DC.
Application of Controlled Pore Glass in Solid Phase Biochemistry.
 Final rept.,
 W. Haller. 1983, 63p
 Pub. in Chemical Solid Phase Biochemistry: Analytical Synthetic Aspects (Chapter 11), p535-597 May 83.

Keywords: *Chemical analysis, *Biochemistry, *Porous materials, *Glasses, Adsorption, Chromatographic analysis, Solid phases, Utilization, Permeability, Reprints.

The use of porous glass in such biochemical applications as permeation-, adsorption-, affinity-chromatography, support for radioimmunoassays, extracorporeal perfusion is reviewed. The preparation of porous glasses as well as its physical, chemical and structural background is described.

400,857
PB85-102713 Not available NTIS
 National Bureau of Standards, Washington, DC.
Prigogine-Defay Ratio for Inhomogeneous Systems with a Single Internal Parameter.
 Final rept.,
 P. K. Gupta, and J. W. Haus. 1977, 5p
 Pub. in Jnl. of Non-Crystalline Solids 24, n2 p291-295 1977.

Keywords: *Glass, *Free energy, Reprints.

The authors develop the free energy for an inhomogeneous system with a single internal parameter. Under the restrictive condition of an infinite quenched state, it is shown that the Prigogine-Defay ratio, $(\Delta C_p)/(\Delta K_T)/TV(\Delta\alpha)^2$, is greater than unity for this system.

400,858
PB85-104800 Not available NTIS
 National Bureau of Standards, Washington, DC.
Inhomogeneity Contribution to the Electrical Properties of Y-Doped CeO₂ Ceramics: Comparison of AC and DC Measurements.
 Final rept.,
 C. K. Chiang, J. R. Bethin, A. L. Dragoo, A. D. Franklin, and K. F. Young. 1982, 7p
 Pub. in Jnl. of the Electrochemical Society 129, n9 p2113-2119 Sep 82.

Keywords: *Ceramics, *Electrical properties, *Additives, Transport properties, Grain boundaries, Reprints, *Impedance spectroscopy.

The impedance of ceramic specimens of $Ce(1-x)Y(x)O(2-x/2)$, with x near 0.1 or 0.2, was measured at frequencies from 10 Hz to 13 MHz, at temperatures from about 250C to 800C, and in oxygen partial pressures from 0.02 MPa to about 10 Pa (0.2 to about .0001 atm). The frequency dependence of that part of the impedance attributable to the bulk of the specimen reveals two relaxations, one arising from the intrinsic transport properties internal to the crystal grains and the other from inhomogeneities. The inhomogeneity impedance is sensitive to how the ceramic was prepared. For ceramics made by sintering mixed oxides, the ratio of the inhomogeneity resistance to the intrinsic resistance is roughly proportional to the closed porosity, but cannot be accounted for on the basis of simple dispersed-pore models. For ceramics made by

sintering chemically coprecipitated carbonates from trichloroacetate solution, the inhomogeneity capacitance is significantly larger than for mixed oxide ceramics, and may reflect the chemistry of the grain boundaries.

400,859
PB85-113074 PC E99
 Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials.
 Aug 84, 484p-in 6v
 Set includes PB85-113082 through PB85-113132.

No abstract available.

400,860
PB85-113082 PC A05/MF A01
 Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials. Volume 1. Summary and Conclusions.
 Planning rept. no. 19 (Final).
 Aug 84, 79p CRA-684-VOL-1, NBS/GCR-84/470/1
 Contract NB82-SBCA-1637
 See also Volume 2, PB85-113090.
 Also available in set of 6 reports PC E99, PB85-113074.

Keywords: *Ceramics, Technology assessment, Economic analysis, Engines, Capacitors, Gas detectors, Cutting tools, Integrated optics.

The six volumes, of which this volume is a part, constitute a technology and economic assessment of advanced ceramic materials. Volumes 2 thru 6 examine specific applications. These applications are heat engines, capacitors, integrated optics, gas sensors, and cutting tools. The assessments include current and projected trends in technological advances and the economic impacts in terms of rate and directions of growth of the relevant markets. Volume 1 contains the summary and conclusions.

400,861
PB85-113090 PC A06/MF A01
 Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials. Volume 2. A Case Study of Ceramics in Heat Engine Applications.
 Planning rept. no. 19 (Final).
 Aug 84, 103p CRA-684-VOL-2, NBS/GCR-84/470/2
 Contract NB82-SBCA-1637
 See also Volume 1, PB85-113082, and Volume 3, PB85-113108.
 Also available in set of 6 reports PC E99, PB85-113074.

Keywords: *Ceramics, *Engines, Technology assessment, Economic analysis, Marketing, Social effect, Processing.

The report contains three chapters in addition to this introductory chapter. Chapter 2 provides an overview of the technological issues involved in the application of ceramics to heat engines. Chapter 3 contains a discussion of the market for heat engines and components. The final chapter presents an assessment of the potential social benefits of the use of ceramics in heat engines.

400,862
PB85-113108 PC A05/MF A01
 Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials. Volume 3. A Case Study of Ceramic Capacitors.
 Planning rept. no. 19 (Final).
 Aug 84, 90p CRA-684-VOL-3, NBS/GCR-84/470/3
 Contract NB82-SBCA-1637
 See also Volume 2, PB85-113090, and Volume 4, PB85-113116.
 Also available in set of 6 reports PC E99, PB85-113074.

Keywords: *Ceramics, *Ceramic capacitors, Technology assessment, Economic analysis, Industries.

This report is organized into five chapters including this introductory chapter. Chapter 2 discusses the technologies used in producing ceramic capacitors. Chapter 3 analyzes the U.S. multilayer ceramic capacitor industry. Chapter 4 draws on information in Chapters 2 and 3 to assess the economic benefits of anticipated future

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technological advance in multilayer ceramic capacitors. The major findings of the study, including a discussion of the primary measurement-related barriers, are presented in Chapter 5.

400,863

PB85-113116 PC A04/MF A01
Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials. Volume 4. A Case Study of Integrated Optic Devices.
Planning rept. no. 19 (Final).
Aug 84, 66p CRA-684-VOL-4, NBS/GCR-84/470/4
Contract NB82-SBCA-1637
See also Volume 3, PB85-113108, and Volume 5, PB85-113124.
Also available in set of 6 reports PC E99, PB85-113074.

Keywords: *Ceramics, Technology assessment, Social effect, Industries, Economic analysis, Fiber optics, Electrooptics, *Foreign technology, *Integrated optics.

The six volumes, of which this volume is a part, constitute a technology and economic assessment of advanced ceramic materials. Volumes 2 thru 6 examine specific applications. These applications are heat engines, capacitors, integrated optics, gas sensors, and cutting tools. The assessments include current and projected trends in technological advances and the economic impacts in terms of rate and directions of growth of the relevant markets. Volume 1 contains the summary and conclusions.

400,864

PB85-113124 PC A04/MF A01
Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials. Volume 5. A Case Study of Ceramic Toxic and Combustible Gas Sensors.
Planning rept. no. 19 (Final).
Aug 84, 67p CRA-684-VOL-5, NBS/GCR-84/470/5
Contract NB82-SBCA-1637
See also Volume 4, PB85-113116, and Volume 6, PB85-113132.
Also available in set of 6 reports PC E99, PB85-113074.

Keywords: *Gas detectors, *Ceramics, Reviews, Technology assessment, Industries, Economic analysis.

The report contains three additional chapters in addition to this introductory chapter. Chapter 2 provides an overview of ceramic sensors. The third chapter provides a brief background discussion of ceramic gas sensor technology. Chapter 4 discusses the world ceramic industry and the potential economic impacts of technological change.

400,865

PB85-113132 PC A05/MF A01
Charles River Associates, Inc., Boston, MA.
Technological and Economic Assessment of Advanced Ceramic Materials. Volume 6. A Case Study of Ceramic Cutting Tools.
Planning rept. no. 19 (Final).
Aug 84, 79p CRA-684-VOL-6, NBS/GCR-84/470/6
Contract NB82-SBCA-1637
See also Volume 5, PB85-113124.
Also available in set of 6 reports PC E99, PB85-113074.

Keywords: *Ceramics, *Cutting tools, Technology assessment, Industries, Social effect, Economic analysis.

Chapter 2 provides a background discussion of advanced ceramic cutting tool technology and draws conclusions concerning the major technical barriers to commercial diffusion of these tools. Chapter 3 provides an overview of the advanced ceramic cutting tool industry. The purpose of this chapter is to provide background material for discussions of the potential benefits of advanced ceramic cutting tools and international competitiveness that follow in Chapter 4. The final chapter presents an analysis of the potential social (economy-wide) benefits of advanced ceramic cutting tools.

400,866

PB85-120665 Not available NTIS
National Bureau of Standards, Washington, DC.
Role of Ceramics in Energy Systems.
Final rept.,
J. B. Wachtman, S. J. Schneider, and A. D. Franklin.
1975, 54p
Sponsored in part by Energy Research and Development Administration, Washington, DC.
Pub. in Proc. Ceramics for Energy Applications, Columbus, Ohio, p11-64, 24 Nov 75.

Keywords: *Ceramics, *Tests, Electric batteries, Coal gasification, Fuel cells, *Energy systems, Coal liquefaction.

The National Plan for Energy Research, Development, and Demonstration put forth by the Energy Research and Development Administration calls for a massive increase in the use of coal and for the maximum possible electrification. These plans imply the rapid development of a synthetic liquid and gaseous fuel industry based on coal, and for improvements in the generation of electricity in the form of new topping cycles (e.g., MHD) and load-following techniques (e.g., fuels cells or base-load generation with battery storage). Electrification of autos will require battery development. In coal gasification, ceramics as chamber liners will encounter hot, moist, highly corrosive atmospheres, with possibly severe erosion problems. Fuel cells and batteries offer some opportunities for ceramics to function in exotic ways, as electrocatalysts to replace noble metals in the reduction of oxygen or as O(-2) and Na(+1) ion conductors. The major problems, however, have to do with maintaining mechanical and chemical integrity in use and with the development of fabrication methods capable of optimizing electrical and mechanical properties at reasonable cost.

400,867

PB85-124311 Not available NTIS
National Bureau of Standards, Washington, DC.
Creep Cavitation and Crack Growth in Silicon Nitride.
Final rept.,
N. J. Tighe, S. M. Wiederhorn, T. J. Chuang, and C. L. McDaniel. 1984, 18p
Sponsored in part by Army Materials and Mechanics Research Center, Watertown, MA., Department of Energy, Oak Ridge, TN., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Paper in Deformation of Ceramics II, p587-604 1984.

Keywords: *Silicon nitrides, *Creep properties, *Crack propagation, *Cavities, Additives, Electron microscopy, Plastic deformation, Reprints.

Cavities and microcracks occur in hot-pressed MgO doped and Y2O3 doped Si3N4 during high temperature creep. Specimens selected from static load experiments at 1200C and 1300C were examined by transmission electron microscopy. In the MgO doped Si3N4 an amorphous MgO:SiO2 phase, which bonded the grains, softened and cavitated readily at 1200 C leading to a creep exponent of 4.2. In the Y2O3 doped Si3N4 a crystalline yttrium-silica-oxynitride phase bonded the Si3N4 grains. Cavitation started at the triple junctions where these phases were present. Crack-like cavities also started at triple junctions and grew between the Si3N4 grains. The nucleation and growth stages of creep cavitation in both materials are related to failure mechanisms.

400,868

PB85-128783 Not available NTIS
National Bureau of Standards, Washington, DC.
Probabilistic Framework for Structural Design.
Final rept.,
S. W. Wiederhorn. 1983, 29p
Pub. in Fracture Mechanics of Ceramics 5, p197-226 1983.

Keywords: *Ceramics, Crack propagation, Structural design, Reprints.

Recent experiments on structural ceramics at elevated temperatures suggest that time dependent processes such as creep crack growth, cavitation and pit formation have an important influence on the long term reliability of these materials. Since these processes are inherently stochastic, fracture mechanics based theories of structural reliability are not as useful at elevated temperatures as they are at low temperatures. In this paper, an alternative approach to structural design at

elevated temperatures is recommended. Although, the approach is probabilistic in nature and suggests the use of probability density functions to describe the time evolution of strength, concepts of fracture mechanics can be factored into the approach.

400,869

PB85-128833 Not available NTIS
National Bureau of Standards, Washington, DC.
Indentation Crack as a Model Surface Flaw.
Final rept.,
B. R. Lawn. 1983, 25p
Pub. in Fracture Mechanics of Ceramics 5, p1-25 1983.

Keywords: *Ceramics, *Cracks, Defects, Nondestructive tests, Reprints, Fracture(Mechanics).

Recent developments in sharp-indenter fracture techniques for the controlled study of strength-related properties of ceramics and glasses are reviewed. The mechanics of 'radial-median' crack evolution are first outlined, thereby establishing the base for a model surface flaw. The response of such cracks to subsequent tensile loading is then described. A key point in the analysis is the vital role played by residual contact stresses in the radial crack growth to failure. Major consideration is given to applications in two areas of strength analysis: flaw characterization and materials evaluation. For the first, surface-stress states associated with multiple-contact processes (e.g. machining), mirror fractography and flaw detection by acoustic wave scattering are topics in which residual-stress effects are manifest. For the second area, the use of indentation flaws for determining basic fracture parameters, such as toughness and crack-velocity exponent, is given special emphasis.

400,870

PB85-129377 Not available NTIS
National Bureau of Standards, Washington, DC.
Analysis of Oxide and Oxide/Matrix Interfaces in Silicon Nitride.
Final rept.,
N. J. Tighe. 1983, 12p
See also PB83-178699.
Pub. in Adv. Ceram. 6, p151-162 1983.

Keywords: *Silicon nitrides, Interfaces, Oxides, Crack propagation, Creep rupture strength, Ceramics, Reprints.

In order to understand the strength and microstructural changes that are produced during oxidation, it is necessary to examine the oxide scale, the oxide/silicon nitride interface, and the silicon nitride below the oxide/matrix interface. In the present study, these three interfacial layers were removed and analyzed by using transmission electron microscopy, light microscopy, X-ray energy analysis, and X-ray diffraction.

400,871

PB85-137412 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Brittle Fracture and Toughening Mechanisms in Ceramics.
Final rept.,
S. M. Wiederhorn. 1984, 30p
Pub. in Annual Review of Materials and Science 14, p373-403 1984.

Keywords: *Ceramics, *Brittle fracturing, Brittleness, Crack propagation, Cracks, Toughness, Reprints.

The paper discusses the fracture of ceramic materials from a fundamental point of view. Treating ceramics as completely brittle materials, the importance of cohesive forces to crack growth is noted. Applications of brittle fracture theory to toughening mechanisms are discussed and evaluated.

400,872

PB85-140689 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Chemical Degradation of Castable Refractories in Coal Gasification Process Environments.
Final rept.,
C. R. Robbins, and F. A. Mauer. 1981, 11p
Pub. in Jnl. of Materials for Energy Systems 3, n1 p32-42 Jun 81.

Keywords: *Coal gasification, *Castable refractories, *Degradation, X ray diffraction, Pilot plants, Laboratories, Reprints.

Reactions and transformations that result in chemical degradation of castable refractories used as liners for coal gasification reactors have been studied. In addition to phase analysis of laboratory and pilot plant specimens by conventional x-ray powder diffraction, a new test method was developed that permits changes in the phase composition to be observed without removing the specimen from the test atmosphere. Frequent changes in the bonding phases, and intervals in which a bonding phase was in transition were observed in the case of the high purity castable refractory. The silica-containing refractory, on the other hand, formed bonding phase which were stable in steam over a large range of temperatures and pressures.

400,873
PB85-140945 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Effect of Sliding Friction Forces on the Strength of Brittle Materials.
Final rept.,
B. R. Lawn, S. M. Wiederhorn, and D. E. Roberts.
1984, 9p
Pub. in Jnl. of Materials Science 19, p2561-2569 1984.

Keywords: *Brittleness, *Sliding friction, Mathematical models, Mechanical properties, Strength, Reprints, Fracture(Mechanics).

A model is developed for the strength degradation of brittle surfaces in sliding contact with spherical indenters. The loss of strength is associated with the propagation of partial cone cracks in the wake of the indenter. Detailed fracture mechanics calculations are circumvented by working in the limit of ideal point-load contacts, with the key proposition that the crack dimensions remain insensitive to rotations of the cone axis relative to the specimen free surface. In this way the simple Roesler solution for classical, well-developed cone cracks may be retained as a convenient 'reference state' for a more general theoretical description, whereby the superposition of a tangential friction force onto the normal loading is accommodated via a straightforward coordinate transformation operation.

400,874
PB85-142321 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Temperature Dependence in Air of Fe₂+ Concentration and Its Relation to Electrical Conductivity in a Natural Eastern Coal Slag.
Final rept.,
G. S. White, W. R. Hosler, and T. J. Castellano.
1981, 4p
Pub. in Jnl. of the American Ceramic Society 64, n11 p649-652 Nov 81.

Keywords: *Slags, Electrical resistivity, Iron, Iron oxides, Coal, Reprints.

Ferrous iron concentration in a coal slag obtained from Bow, NH, was studied as a function of heat treatment in air. Results indicate that the concentration varies continuously between 1300 and 1600C; the slag becoming more oxidized as the temperature drops from 1600C. For lower temperatures at which the slag is solid or highly viscous, oxidation still occurs but at an extremely slow rate. An apparent chemical phase change occurs between 1300C and 900C when the coal slag is cooled slowly from temperatures above 1300C. No such change is observed for fast quenches. This interpretation is consistent with observed DC electrical conductivity data obtained from similar samples.

400,875
PB85-142867 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Revised ThO₂-Nb₂O₅ Phase Diagram.
Final rept.,
R. J. Cava, R. S. Roth, and D. B. Minor. 1981, 2p
Pub. in Jnl. of the American Ceramic Society 64, n4 p64-65 Apr 81.

Keywords: *Niobium oxides, *Thorium oxides, *Phase diagrams, *Crystal structure, Monoclinic lattices, Eutectics, X ray diffraction, Reprints.

The phase equilibrium diagram of the system ThO₂-Nb₂O₅ was redetermined near the composition Th₂Nb₂O₉. This phase was found to melt incongruently at 1362C, with a peritectic at about 64 mol % ThO₂. The eutectic was found at about 1350C and 63 mol % ThO₂. From single crystal and powder x-ray diffraction data, Th₂Nb₂O₉ was found to have a primitive mono-

clinic unit cell with $a = 6.711(1)$, $b = 25.254(5)$, $c = 7.757(1)A$, $\beta = 90.461(14)$ degrees.

400,876
PB85-143444 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Role of Water Vapor and Sulfur Compounds in Sodium Vaporization during Glass Melting.
Final rept.,
D. M. Sanders, M. E. Wilke, S. Hurwitz, and W. K. Haller. 1981, 6p
Pub. in Jnl. of the American Ceramic Society 64, n7 p399-404 1981.

Keywords: *Glass, Melting, Sodium, Vaporization, Alkali glass, Silica glass, Sodium hydroxide, Sodium sulfates, Water vapor, Reprints.

The influence of sulfur compounds on the vaporization of sodium from soda-lime-silica glass was investigated using the newly developed stirrable transpiration apparatus (STA). With increasing sulfur concentration in either the melt or the atmosphere above it, the sodium vapor density was found to increase until attaining the value found over pure sodium sulfate liquid. At that point, the sodium vapor density was independent of sulfur concentration-presumably due to separation of sodium sulfate liquid from the glass.

11C. Coating, Colorants, and Finishes

400,877
PB84-141787 PC A03/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Performance Criteria for Restoration Coatings for Porcelain Enamel Surfaces,
J. F. Seiler, and P. G. Campbell. Sep 83, 35p NBSIR-83-2781
See also PB82-252024. Sponsored in part by Department of Housing and Urban Development, Washington, DC. Div. of Energy, Building Technology and Standards.

Keywords: *Protective coatings, *Renovating, *Enamels, *Organic coatings, Field tests, Performance evaluation, Surfaces, Assessments.

In June 1982, the results of a laboratory-based study to develop interim performance criteria for restoration coatings for porcelain enamel surfaces were reported in NBSIR 82-2553, 'Development of Interim Performance Criteria for Restoration Coatings for Porcelain Enamel Surfaces'. Additional studies, consisting of a one-year field test of three of the five restoration coatings studied in the laboratory, were performed to assess the effectiveness of the interim performance criteria. The field test included periodic evaluation of the three restoration coatings applied to a total of nine bathtubs in public housing units in Alexandria, Virginia. The results of the field test were compared to the previous laboratory results and showed that the interim performance criteria were effective in selecting durable restoration coatings. This report presents the findings of the field test and includes the final performance criteria.

400,878
PB84-203447 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Second-Surface Mirror Standards of Spectral Specular Reflectance (SRM's (Standard Reference Materials) 2023, 2024, 2025).
Special pub. (Final),
J. C. Richmond, J. J. Hsia, V. R. Weidner, and D. B. Wilmering. Oct 82, 45p NBS/SP-260-79
Also available from Supt. of Docs as SN003-003-02447-3. Library of Congress catalog card no. 82-600615. Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Optical materials, *Mirrors, *Aluminum, Vacuum deposited coatings, Solar energy, Optical reflectometers, Calibration, Specular reflection, Standards, Concentrating mirrors, Reflectance.

NBS was requested by the Department of Energy to prepare, calibrate and disseminate standards of spectral specular reflectance for use in calibrating reflectometers used to evaluate the solar specular reflectance of concentrating mirrors used in solar energy systems. The mirror chosen was a second-surface mirror of

vacuum-deposited aluminum on optically polished vitreous quartz backed up with a second plate of ground and polished vitreous quartz cemented to the back of the mirror. Standards were prepared in two sizes, 51 x 51 mm, and 25 x 101 mm. The cost of developing and calibrating the standards was included in a contract issued by the Solar Energy Research Institute of Golden, Colorado, which is financed by the Department of Energy.

400,879
PB84-225416 Not available NTIS
National Bureau of Standards, Washington, DC.
Nondestructive Corrosion Detection Under Organic Films Using Infrared Thermography.
Final rept.,
M. E. McKnight, and J. W. Martin. 1982, 10p
Pub. in Proceedings of National SAMPE (Society for the Advancement of Material and Process Engineering) Tech. Conference (14th), Atlanta, GA., October 12-14, 1982, p349-358.

Keywords: *Nondestructive testing, *Protective coatings, *Corrosion, *Polymer films, *Infrared detectors, *Thermography, Organic coatings.

A rapid, nondestructive testing procedure, using infrared thermography, has been developed for detecting corroded and blistered areas under pigmented organic coatings on metallic substrates. Both invisible corroded areas under intact pigmented films, and corroded and blistered areas visible to the eye, can be detected, thus providing an early, accurate assessment of degradation. Software is being written to digitize the image and send the data to a computer for mathematical analysis, graphic display and storage. Modifications of the existing system are being considered to increase the resolution of the measurement.

400,880
PB85-104685 Not available NTIS
National Bureau of Standards, Washington, DC.
Pulsed Electrodeposition of Nickel Phosphorus Metallic Glass Alloys.
Final rept.,
D. S. Lashmore, and J. Weinroth. 1982, 5p
Pub. in Plating and Surface Finishing 69, n8 p72-76 Aug 82.

Keywords: *Wear resistance, *Nickel coatings, *Plating, *Nuclear magnetic resonance, Electron microscopy, Alloys, *Nickel phosphorus, *Metallic glass.

It is shown, by using bright field and dark field electron microscopy, in combination with nuclear magnetic resonance techniques, that pulsed electrodeposited nickel phosphorus alloys are not only metallic glasses but that they also exhibit at least two distinct amorphous structures (configurations) which depend on the deposition parameters. Alloys with a phosphorus content up to 41 atomic percent phosphorus have been produced, and their corresponding microhardness values depend on the deposition conditions and can be higher than 750 VHN(50) as deposited. Dry sliding wear measurements reveal a wear rate for these alloys comparable to hard chromium. Following a heat treatment of 400 C for 30 minutes, the wear rate for the nickel phosphorus alloys is found to be an order of magnitude lower than that found for hard chromium measured under identical conditions. Distinct differences between direct and pulsed processes revealed themselves in the NMR data, the wear data, and the microhardness data.

400,881
PB85-142784 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Optical-Properties of Black Chrome - A Model for Predicting the Effect of Exposure to Elevated Temperature.
Final rept.,
S. T. Wu, and L. W. Masters. 1982, 5p
Sponsored by Department of Energy, Washington, DC. Pub. in Jnl. of Coatings Technology 54, n691 p41-45 1982.

Keywords: Optical properties, Reprints, *Black chrome.

The paper summarizes the first phase of research to help meet the need for predictive models. The scope of this initial phase of research was to develop a model on predicting the effects of elevated temperature on the optical properties of black chrome. Oven aging tests were performed in the laboratory at temperatures

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of 150C, 200C, and 250C. The permanent change in optical properties was found to reach a maximum within only a few days after initiation of the exposure. The nature of the change in reflectance spectra was found to be a horizontal shift along the wavelength axis. The model was developed based on these findings. Reasonable numerical fits were made by applying the model to the test data.

400,882

PB85-144038 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Plating Standards and Specifications.
Final rept.,
F. Ogburn, and E. T. Clegg. 1984, 22p
Pub. in *Electroplating Engineering Handbook 4*, p263-284 1984.

Keywords: *Electrodeposited coatings, *Metal coatings, Standards, Specifications, Electroplating, Reprints.

The electrodeposited coating standards of the ISO, ASTM, SAE, and U.S. Government are discussed in some detail. The requirements of the specifications are reviewed and the coating thickness requirements are tabulated.

400,883

PB85-151686 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Strategy for Selection of Tribological Coatings.
Final rept.,
M. B. Peterson, and A. W. Ruff. 1984, 10p
Pub. in Proceedings of Meeting of the Mechanical Failures Group (37th), Gaithersburg, MD., May 10-12, 1983, p138-147 1984.

Keywords: *Coatings, Selection, Friction, Wear, Lubrication, *Tribology.

A strategy for the selection of a tribological coating is proposed. The important factor to consider is the tribological function of the coating. The most important functions are reduction of various modes of wear, retention of lubricant in the contact area, increase of lubricant load capacity, replacement or rebuilding of contact surfaces, and modification of the coefficient of friction. Once the required function needed in an application has been defined it is then possible to select compositions and properties which will accentuate each function. Specific laboratory tests can also be performed which rank the coatings as to their ability to perform each function. Examples are given here for important tribological functions. Over the past 10 years many new developments have been made in metallic coatings to improve their utilization for tribological purposes. These include composite and alloy coatings, new application techniques, simple cost effective application techniques, and precise composition and microstructure control. Examples are given here of advances in some of these areas.

11D. Composite Materials

400,884

PB84-219815 Not available NTIS
National Bureau of Standards, Washington, DC.
Adsorption of N,N-dimethyl-p-aminophenylacetic Acid on Hydroxyapatite.
Final rept.,
D. N. Misra. 1984, 10p
Sponsored in part by American Dental Association Health Foundation, Chicago, IL.
Pub. in Paper in Adsorption on and Surface Chemistry of Hydroxyapatite, p105-114 1984.

Keywords: *Dental materials, *Composite materials, Tensile strengths, Adsorption, Surfaces, Polymerization, Nitrogen organic compounds, Reprints, *Hydroxyapatite, *Acetic acid/N-N-dimethyl-aminophenyl.

The adsorptive properties of N,N-dimethyl-p-aminophenyl-acetic acid on hydroxyapatite have been investigated. It is a fast-acting amine polymerization accelerator, but tensile strengths of composites of resin filled with apatite show that it is not an effective coupling agent for a hydroxyapatite-dental resin composite.

400,885

PB84-222041 Not available NTIS
National Bureau of Standards, Washington, DC.
Cryogenic Properties of Filamentary-Reinforced Composites: An Update.
Final rept.,
M. B. Kasen. Dec 82, 33p
Sponsored in part by Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH. and Department of Energy, Washington, DC.
Pub. in *Annales Des Composite 2*, p33-65 Dec 82.

Keywords: *Cryogenics, *Composite materials, *Reinforcing materials, *Fibers, Mechanical properties, Thermal properties, Performance evaluation, Laminates, Reprints.

Progress since 1975 in understanding the effect of cryogenic temperatures on the mechanical, elastic, thermal and electrical properties of fiber-reinforced structural composites is reviewed. The two categories considered are relatively inexpensive laminates reinforced with woven fabric or random mat and the more expensive uniaxial laminates often reinforced with high-performance, advanced fibers. The status of fundamental research and of test method development is reviewed and directions of effective future research are considered.

400,886

PB84-223239 Not available NTIS
National Bureau of Standards, Washington, DC.
What Is Fatigue Damage.
Final rept.,
J. T. Fong. 1982, 24p
Pub. in American Society for Testing and Materials Special Technical Publication 775, p243-266 1982.

Keywords: *Fatigue tests, *Fatigue(Materials), *Composite materials, Fatigue life, Microstructure, Holography, Nondestructive tests, Neutron scattering, X ray diffraction, Annihilation reactions, Positrons, Mathematical models, Reprints.

A conceptual definition of fatigue damage is proposed to assist in the selection of measurement techniques and parameters for correlating damage with fatigue life. To illustrate the concept, a critical review of some typical damage parameters for composite materials is given. A survey of some new techniques for damage monitoring including the small angle neutron scattering (SANS) method, is presented and discussed. Pitfalls in damage modeling are illustrated with examples drawn from the literature. A summary of an ASTM E9.01 panel study on fatigue damage and research opportunities in the 1980's is presented.

400,887

PB84-223304 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Cryogenic Temperatures on the Mechanical Performance of Glass-Fabric-Reinforced Epoxy and Polyimide Matrix Laminates.
Final rept.,
M. B. Kasen, R. E. Schramm, and R. D. Kriz. Dec 82, 4p
Sponsored in part by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Proceedings of Int. Cryogenic Mater. Conf., Kobe, Japan, May 11-14, 1982, p269-272.

Keywords: *Composite materials, *Mechanical properties, *Epoxy laminates, *Polyimide resins, Insulation, Cryogenics, Reinforced plastics, Performance evaluation, Radiation shielding materials.

Radiation-resistant laminates are required for insulators and structural supports in the superconducting magnets of magnetic fusion energy systems. Glass-reinforced laminates fabricated with a polyimide matrix have a much higher tolerance to neutron and gamma radiation at 4 K than do laminates fabricated with an epoxy matrix. However, tests indicate that the mechanical performance of polyimide-matrix laminates is inferior to that of the epoxy type, while the elastic performance is superior. Fractographic studies show that the performance difference is due to a lower integrity of the polyimide-glass interface.

400,888

PB84-225523 Not available NTIS
National Bureau of Standards, Washington, DC.
Composites.
Final rept.,
M. B. Kasen. 1983, 52p
Pub. in *Materials at Low Temperatures*, Chapter 12, p413-464 1983.

Keywords: *Composite materials, *Cryogenics, Laminates, Mechanical properties, Ionizing radiation, Reprints.

A tutorial presentation is given for the usage of composite materials at cryogenic temperatures. Advantages of composite construction is discussed, and the terminology of the industry is reviewed. Emphasis is placed on the effect of cryogenic temperatures on the mechanical properties of the most used materials. Consideration is given to the fabrication of efficient joints between nonmetallic laminates and metallic structural parts. The effect of ionizing radiation combined with cryogenic temperatures is discussed. Recommendations are given for test methods that provide accurate information on mechanical performance at cryogenic temperatures.

400,889

PB84-227255 Not available NTIS
National Bureau of Standards, Washington, DC.
Harmonic Waves in a Periodically Laminated Medium.
Final rept.,
S. K. Datta, A. H. Shah, and H. M. Ledbetter. 1982, 10p
Sponsored in part by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Proceedings IUTAM Symp. Mechanics Composite Materials, Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, Aug 16-19, 1982. Paper in Mechanics of Composite Materials, Recent Advances, p207-216.

Keywords: *Laminates, *Harmonics, *Composite materials, *Wave propagation, Comparison, Fiber composites, Boron aluminum composites.

The authors present a stiffness method for studying harmonic-wave propagation in periodically laminated composite media. Together with Floquet's theory, they used the continuity of displacement and traction at the laminae interfaces. Deformation is assumed to be plane strain. Both isotropic and anisotropic (fiber-reinforced) laminates are considered. For comparison with observation, they considered a laminated boron-aluminum composite.

400,890

PB84-242924 Not available NTIS
National Bureau of Standards, Washington, DC.
Elastic Constants of Fiber-Reinforced Boron-Aluminum: Observation and Theory.
Final rept.,
S. K. Datta, and H. M. Ledbetter. Feb 83, 10p
Pub. in *International Jnl. of Solids and Structures*, v19 n10 p885-894 Feb 83.

Keywords: *Fiber composites, *Elastic properties, Composite materials, Laminates, Mathematical models, Reprints, *Boron reinforced composites, *Aluminum matrix composites, *Boron fibers, Numerical solution, Metal matrix composites.

Elastic constants were measured and calculated for a laminated, uniaxially fiber-reinforced boron-aluminum composite. Three theoretical models were considered: square-array, hexagonal-array, and random-distribution. By combining several existing theoretical studies on randomly distributed fibers, the authors derived relationships for predicting the full set of elastic constants for this model. The random-distribution model agrees best with observation, especially for off-diagonal elastic constants. Considering all nine elastic constants, observation and theory differ on the average by 6%. These discrepancies arise from three sources: experimental error propagation, limited applicability of a transverse-isotropic model to a laminated composite, and elastic anisotropy of boron fibers.

400,891
PB84-245828 Not available NTIS
National Bureau of Standards, Washington, DC.
Composites of Aluminum Alloys: Fabrication and Wear Behavior.
Final rept.,
M. Hosking, F. F. Portillo, R. Wunderlin, and R. Mehrabian. Feb 82, 22p
Pub. in Jnl. of Materials Science 17, n2 p477-498 Feb 82.

Keywords: *Particulate composites, Fabrication, Wear resistance, Friction factor, Composite fabrication, Composite materials, Vacuum melting, Forging, Microstructure, Wear, Reprints, *Aluminum matrix composites.

This paper describes processes for fabrication of aluminum alloy composites containing particulate non-metals, the net shape forming of these composites, their microstructure, their friction and wear behavior and mechanical properties. Composites to two wrought (2014 and 2024) and one cast (201) aluminum alloys containing 2 - 30 weight percent of Al₂O₃ and SiC particles in the size range of 1 micrometer to 142 micrometers were prepared. The compositing apparatus developed in this investigation consists of a vacuum induction melting system, a controlled mixing assembly and a special vibration system for addition of the non-metals. The non-metallic particles were added to a partially solid, vigorously agitated matrix alloy. The particles were then retained in the matrix until interface interaction, for example, the formation of MgAl₂O₄ spinel in the case of Al₂O₃ particles, was facilitated. These composites were solidified and subsequently reheated to above their liquidus temperature and formed into shape under high pressure in a closed die forging type of apparatus.

400,892
PB85-142438 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Young's Modulus and Internal Friction of a SiC-Particle-Reinforced Aluminum Composite.
Final rept.,
H. M. Ledbetter, and S. K. Datta. 1984, 6p
Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in Materials Science and Engineering 67, p25-30 1984.

Keywords: *Particulate composites, Silicon carbides, Aluminum alloys, Modulus of elasticity, Internal friction, Reprints, Aluminum matrix composites, Silicon carbide reinforced composites.

Using dynamic methods, the authors measured Young's modulus and the associated internal friction of a particle-reinforced composite in wrought plate form produced by powder metallurgy methods. The particles, 30% by volume, consisted of single crystals of alpha-SiC with sizes near 5 micrometers. The matrix consisted of aluminum alloy 6061 with original particle sizes near 20 micrometers.

400,893
PB85-142636 Not available NTIS
National Bureau of Standards, Boulder, CO.
Multiple Scattering of Elastic Waves and Effective Properties in Materials Containing Inclusions.
Final rept.,
S. K. Datta, and H. M. Ledbetter. 1984, 17p
Prepared in cooperation with Colorado Univ. at Boulder.
Pub. in Proceedings of Conference on Wave Propagation in Homogeneous Media and Ultrasonic Nondestructive Evaluation, San Antonio, TX, June 17-21, 1984, p123-139.

Keywords: *Composite materials, *Elastic properties, *Elastic scattering, *Alloys, Physical properties, Aluminum silicon alloys, Acoustic velocity.

Theoretically and experimentally, the authors studied plane-wave propagation in materials containing inclusions. The theory applies to any elastic inclusion in a homogeneous elastic isotropic matrix. Particles can be distributed homogeneously or nonhomogeneously. They assumed ellipsoid-shaped particles, oriented either randomly or aligned. Mainly they considered an SiC-particle-reinforced aluminum-alloy composite. But the authors give results also for a porous rock, where they consider both prolate-spheroid and oblate-spheroid voids. For all nine elastic constants, measurement and (nonhomogeneous) model agree within a few percent.

400,894
PB85-145449 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Method for Fabrication of Aluminum/Alumina Composites.
Final rept.,
B. F. Quigley, G. J. Abbaschian, R. Wunderlin, and R. Mehrabian. 1982, 8p
Pub. in Metallurgical Transactions, A: Physical Metallurgy and Materials 13A, n1 p93-100 Jan 82.

Keywords: *Fiber composites, Fabrication, Aluminum alloys, Aluminum oxide, Magnesium containing alloys, Solidification, Reprints, Metal matrix composites.

A new process was used to produce Al-Mg alloy composites containing discontinuous Al₂O₃ fibers. In the first step of the process, induced convection of the melt permits intimate contact between the fibers and the melt which invariably results in chemical interaction between the two. The presence of MgAl₂O₄ spinel on the fiber surface was confirmed. The composites produced contained randomly distributed fibers, and were further processed both to increase the volume fraction of fibers and to align them in two dimensions (planar random alignment). Examination of composite specimens fractured under tension indicated that the interfaces were strong enough to permit transfer of load from the matrix to the fiber. For example, modulus of elasticity and ultimate tensile strength of the alloy were improved approximately 50% and approximately 40% respectively by the addition of 23 v/o Al₂O₃ fibers.

11F. Metallurgy and Metallography

400,895
PB82-238080 PC A19/MF A01
National Bureau of Standards, Boulder, CO.
Materials Studies for Magnetic Fusion Energy Applications at Low Temperatures - V.
Technical repts.,
R. P. Reed, and N. J. Simon. May 82, 449p NBSIR-82-1667
See also Part 4, PB-282 444. Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Materials, *Cryogenics, *Superconducting magnetics, Stainless steels, Welded joints, Castings, Laminates, Composite materials, Mechanical properties.

The report contains results of a research program to produce material property data that will facilitate design and development of cryogenic structures for the superconducting magnets of magnetic fusion energy power plants and prototypes. The major portion of the program has been the evaluation of the low temperature mechanical and physical properties of stainless steel base metals, welds, and castings, with particular emphasis on the nitrogen-strengthened stainless steels. Stainless steels with manganese additions and other high manganese-steels have also been investigated. Work has been done on the production and standardization of nonmetallics, primarily industrial laminates, for low temperature applications and on the measurement of their properties at cryogenic temperatures.

400,896
PB83-240598 PC A07/MF A01
National Bureau of Standards, Boulder, CO.
Applied J-Integral in HY130 Tensile Panels and Implications for Fitness for Service Assessment,
D. T. Read. Aug 82, 129p NBSIR-82-1670
Sponsored in part by David W. Taylor Ship Research and Development Center, Annapolis, MD.

Keywords: *Cracks, Defects, Assessments, Yield, Residual stress, Stress concentration, Strains, Panels, *J integrals, *Fracture(Mechanics), Steel HY-130.

An experimental technique for direct evaluation of the J contour integral is described. Results are reported and discussed. Some fifteen cracked HY130 tensile panels were tested, including center-cracked, single-edge-cracked, double-edge-cracked, face-cracked, and part-through-cracked configurations. As crack size increased, the post-yield deformation pattern changed from gross section yielding, for very small cracks, to net section yielding, for larger cracks. Net section yielding was associated with much larger J-integral values than gross section yielding.

400,897
PB83-259630 PC A19/MF A01
National Bureau of Standards, Boulder, CO.
Materials Studies for Magnetic Fusion Energy Applications at Low Temperatures - VI.
Technical repts.,
R. P. Reed, and N. J. Simon. May 83, 434p NBSIR-83-1690
See also PB82-238080. Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Superconducting magnets, *Stainless steels, *Composite materials, *Cryogenics, Casting, Materials, Steels, Weldments, Laminates, Thermonuclear power plants, Technology transfer, *Magnetic fusion energy, Steel 304, Steel 310, Steel 316, Steel 18Cr 13Mn 3Ni, Steel 5Cr 26Mn.

The report contains results of a research program to produce material property data that will facilitate design and development of cryogenic structures for the superconducting magnets of magnetic fusion energy power plants and prototypes. The reports presented here summarize the sixth year of work on the low-temperature materials research program. Highlights of the results are presented first. Research results are given for the four main program areas: structural alloys, weldments and castings, nonmetallics, and technology transfer. Objectives, approaches, and achievements are summarized in an introduction to each program area. The major portion of the program has been the evaluation of the low-temperature mechanical and physical properties of stainless steel base metals, welds, and castings, with particular emphasis on the nitrogen-strengthened stainless steels. Developmental steels with manganese additions are also under investigation.

400,898
PB84-191311 PC A18/MF A01
National Bureau of Standards, Washington, DC.
Phase Diagrams of Uranium Alloys,
O. S. Ivanov, T. A. Badaeva, R. M. Sofronova, V. B. Kishenevskii, and N. P. Kushnir. c1983, 418p TT-76-52046
Trans. from mono. Diagrammy Sostoyaniya i Fazovyie Prevrashcheniya Splavov Urana, Moscow, 1972 by A. K. Dabir. Sponsored in part by National Science Foundation, Washington, DC.

Keywords: *Uranium alloys, *Phase diagrams, Phase transformations, Kinetics, Equilibrium, Translations, *Foreign technology.

This monograph presents a critical survey of the literature (through 1969) on the phase diagrams of binary, ternary and quaternary systems of uranium and the phase transformations of its alloys. It also reports original research by the author. The book examines the changes in the phase diagrams depending on the physico-chemical nature of the constituents. Data are presented on the crystallographic and chemical characteristics of the phases occurring in systems. Special attention is given to nonequilibrium states of uranium and its alloys, the kinetics and mechanism of transformations and the structure of metastable states of uranium alloys. There is a discussion of the general patterns of transformation of uranium alloys, which have an important role in developing the general theory of phase transformations.

400,899
PB84-216464 PC A03/MF A01
National Bureau of Standards (NML), Washington, DC. Metallurgy Div.
Mechanical Properties of a Leaded, Resulfurized, Rephosphorized Steel in Various Thermo/Mechanical Conditions.
Final rept.,
J. G. Early. Jan 84, 39p NBSIR-84-2839
Sponsored in part by Coast Guard, Washington, DC.

Keywords: *Steels, Mechanical properties, Cold working, Heat treatment, Steel 12214.

The results of the metallurgical evaluation of bar stock samples of AISI 12214 steel in two thermo/mechanical conditions, cold finished and hot rolled, illustrate the dominant role that the thermo/mechanical condition has on the resulting mechanical properties. The contributing effects of ferrite grain size and bar diameter on mechanical properties were small in comparison to the effects of cold work during the cold finishing operation. Cold finished bar stock samples subjected to a

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thermal brazing cycle (without the brazing alloy) develop mechanical properties that are very similar to those attained in hot rolled bars.

400,900
PB84-217173 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Heat Treatment and Electron Beam Surface Melting on the Friction and Wear Behavior of a Cu-12wt.%Al Alloy.

Final rept.,
P. J. Blau, 1984, 12p
Pub. in *Wear* 94, p1-12 1984.

Keywords: *Copper aluminum alloys, *Electron beams, *Heat treatment, *Eutectics, Surfaces, Wear, Microstructure, Hardness.

A Cu-12 wt% Al eutectoid composition binary alloy was wear and friction-tested in three heat-treated conditions designed to provide (1) a eutectoidal microstructure (E), (2) a martensitic microstructure (M) and (3) an electron beam-melted near surface microstructure (EB). Polished blocks of the alloy were worn dry against 52100 steel rings at 10 N load and 20 cm/s velocity in an argon gas environment. Both EB and M treatments had lower wear than the E heat treatment. All three showed transfer of material to the steel rings. Friction break-in characteristics varied with heat treatment. The martensitic microstructure, while lower in micro-indentation hardness had lower wear. Electron-beam melting of this alloy did not seem to improve performance any better than the quench to produce martensite.

400,901
PB84-217207 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Rapid Solidification Velocity on the Microstructure of Ag-Cu Alloys.

Final rept.,
W. J. Boettinger, D. S. Shechtman, R. J. Schaefer, and F. S. Biancianiello. Jan 84, 12p
Pub. in *Metallurgical Transactions (Section) A: Physical Metallurgy and Materials Science*, v15A p55-66 Jan 84.

Keywords: *Silver alloys, *Microstructure, Copper containing alloys, Solidification, Eutectics, Reprints, Rapid solidification.

Electron beam solidification passes have been performed on a series of Ag-Cu alloys between 1 wt.% Cu and the eutectic composition (28.1 wt.% Cu) at speeds between 1.5 and 400 cm/s. At low growth rates conventional dendritic or eutectic structures are obtained. The maximum growth rate of eutectic structure is 2.5 cm/s. At high growth rates microsegregation-free single phase structures are obtained for all compositions. The velocity required to produce this structure increases with composition for dilute alloys and agrees with the theory of absolute stability of a planar liquid-solid interface with equilibrium partitioning. For alloys between 15 and 28 wt.% Cu, the velocity required to produce the microsegregation-free extended solid solution decreases with composition and is related to nonequilibrium trapping of solute at the liquid solid interface. At intermediate growth rates for alloys with 9 wt.% Cu or greater, a structure consisting of alternating bands of cellular and cell-free material is obtained. The bands form approximately parallel to the local interface.

400,902
PB84-217421 PC A08/MF A01
National Bureau of Standards, Washington, DC.
NBS (National Bureau of Standards): Materials Measurements (Annual Report for the Period 1 April 1983-31 March 1984).
J. R. Manning. Jun 84, 155p NBSIR-84-2882
NASA Order-H-27954B
See also PB83-107854. Sponsored in part by National Aeronautics and Space Administration, Washington, DC.

Keywords: *Interfacial tension, *Solidification, Measurement, Convection, Thermophysical properties, Silicon, Tungsten, Space processing.

This work is being carried out in three independent tasks: Surface Tensions and Their Variations with Temperature and Impurities; Convection During Unidirectional Solidification; Measurement of High Temperature Thermophysical Properties. Tasks 1 and 2 are directed toward determining how the reduced gravity obtained in space flight can affect convection and solidifi-

cation processes. Emphasis in Task 3 is on development of levitation and containerless processing techniques which can be applied in space flight to provide thermodynamic measurements of reactive materials.

400,903
PB84-219930 Not available NTIS
National Bureau of Standards, Washington, DC.

Structural Alloys.
Final rept.,
H. I. McHenry. 1983, 42p
Pub. in *Materials at Low Temperatures*, Chapter 11, p371-412 1983.

Keywords: *Austenitic stainless steels, *Nickel steels, *Aluminum alloys, Cryogenics, Copper alloys, Nickel alloys, Castings, Mechanical properties, Titanium alloys, Welding, Reprints, Superalloys.

The mechanical and physical properties of selected alloys for cryogenic service are reviewed with emphasis on austenitic stainless steels, nickel steels, and aluminum alloys. Welding, the properties of weldments, and other fabrication considerations are discussed. Copper and copper alloys, nickel-base superalloys, and titanium alloys are briefly discussed.

400,904
PB84-220011 Not available NTIS
National Bureau of Standards, Washington, DC.
Dislocation Emission from Cracks in the Presence of Liquids.

Final rept.,
I. H. Lin, and R. Thomson. 1983, 3p
Sponsored in part by Army Research Office, Arlington, VA.
Pub. in *Scripta Metallurgica* 17, p1035-1037 1983.

Keywords: *Embrittlement, *Cracking(Fracturing), Liquid metals, Dislocations(Materials), Emission, Reprints.

Lynch (1) and others have proposed that liquid metal embrittlement may be associated with enhanced rather than decreased dislocation activity in the vicinity of the crack tip. This proposal has been based on evidence for shallow dimples which are observed on the embrittled crack surfaces in large numbers. The reported difference relative to the untreated metal is that the dimples are shallower and more concentrated ahead of the crack, with a resulting lower CoD, in the embrittled case. Lynch (1) has speculated that the reason for this result is that dislocations are more easily emitted in a solid metal in contact with a second liquid metal. This suggestion is in contradiction with a lowered intrinsic surface energy caused by the wetting liquid which would tend to make dislocation emission less favored, and perhaps lead to cleavage (2). In this note, the authors will present a mechanism by which a wetting liquid can modify the emission criterion at the tip, and discuss the requirements for embrittlement.

400,905
PB84-221316 Not available NTIS
National Bureau of Standards, Washington, DC.

Fracture Toughness of CF8 Stainless Steel Castings at 4 K.
Final rept.,
E. L. Brown, T. A. Whipple, and R. L. Tobler. Jun 83, 5p
Sponsored in part by Brookhaven National Lab., Upton, NY., and Department of Energy, Washington, DC.
Pub. in *Metallurgical Transactions A* 14A, p1179-1183 Jun 83.

Keywords: *Steel castings, *Stainless steels, Toughness, Cryogenics, Reprints, *Fracture toughness, Steel CF8, J integrals.

The first fracture toughness measurements for CF8 stainless steel castings in liquid helium at 4 K are reported. Single-phase (austenite) and duplex (austenite + delta-ferrite) castings were tested.

400,906
PB84-221357 Not available NTIS
National Bureau of Standards, Washington, DC.
Fracture Properties of a 25mn Austenitic Steel and Its Welds at 4 K.

Final rept.,
H. I. McHenry, J. W. Elmer, and T. Inoue. 1983, 12p
See also PB84-151778. Sponsored in part by Department of Energy, Washington, DC.
Pub. in *Proceedings of International Cryogenic Materials Conference* held at Kobe, Japan on May 11-14, 1982, paper in *Austenitic Steels at Low Temperatures*, p327-338 1983.

Keywords: *Austenitic steels, *Welded joints, Cryogenics, Fracture properties, Tensile properties, Crack propagation, Metal plates, Steel 5Cr 25Mn 1Ni, Steel 6.5Cr 25Mn 2.8Ni, Fracture toughness.

Tensile properties, fracture toughness, and fatigue crack growth rates of 25Mn-5Cr-1Ni steel plates and 25Mn-6.5Cr-2.8Ni welds were measured in liquid helium at 4 K. The yield strengths were 894 MPa for the base metal and 961 MPa for the weld metal. The fracture toughness values were measured by the J-integral method. The fatigue crack growth rates of both the base metal and the weld were similar to those of 316 stainless steel plate over the stress intensity range evaluated. The fracture surfaces of representative specimens were examined by scanning and transmission electron microscopy and magnetic measurements; they were ductile and contained no evidence of alpha martensite.

400,907
PB84-221936 Not available NTIS
National Bureau of Standards, Washington, DC.
Microstructure and Phase Solubility Extension in Rapidly Solidified NiAl-Cr Quasibinary Eutectic.
Final rept.,
D. Shechtman, W. J. Boettinger, T. Z. Kattamis, and F. S. Biancianiello. 1984, 8p
Pub. in *Acta Metallurgica* 32, n5 p749-756 1984.

Keywords: *Eutectics, Solidification, Microstructure, Free energy, Nickel alloys, Chromium containing alloys, Aluminum containing alloys, Reprints, Rapid solidification, Phase solubility.

The microstructure of melt-spun ribbon of the NiAl-Cr quasibinary eutectic composition has been characterized by optical and transmission electron microscopies. The eutectic composition is Ni-38.5wt%Cr-19.4wt%Al and is of interest because of the similarity of crystal structures (CsCl for beta-NiAl and BCC for alpha-Cr) and lattice parameters of the two phases in the eutectic. The rapidly quenched microstructure consists of 0.5 micrometer diameter columnar grains of the beta-NiAl phase supersaturated with chromium to the eutectic composition. Between these grains a fine rod-type eutectic structure of the beta-NiAl and alpha-Cr phases is observed with eutectic spacings as fine as 12 nm. The composition of the phases in the eutectic portion of the microstructure were found to be close to the equilibrium solubilities for these phases. A rationale for the appearance of a supersaturated beta-NiAl phase at the eutectic composition, rather than a supersaturated alpha-Cr phase, will be presented based on the T sub o curves for this alloy system.

400,908
PB84-223247 Not available NTIS
National Bureau of Standards, Washington, DC.
Austenitic-Steel Elastic Constants.
Final rept.,
H. M. Ledbetter. 1983, 21p
Sponsored in part by Department of Energy, Washington, DC. Office of Fusion Energy.
Paper in *Austenitic Steels at Low Temperatures*, p83-103 1983.

Keywords: *Austenitic steels, *Elastic properties, Alloying, Interstitials, Magnetic fields, Texture, Polycrystalline, Phase transformations, Bulk modulus, Poisson ratio, Shear modulus, Modulus of elasticity, Nickel containing alloys, Chromium containing alloys, Manganese containing alloys, Reprints, Temperature dependence.

The author reviewed recent studies, experimental and theoretical, at NBS on the subject of austenitic-steel elastic constants, especially at low temperatures. The experimental variables include temperature, substitutional alloying (Cr, Ni, Mn), interstitial alloying (C,N),

magnetic field, textures (castings, welds), and sample-to-sample variability. The principal theoretical problems include monocystal-polycrystal relationships, texture, and lattice stability.

400,909

PB84-223254 Not available NTIS
National Bureau of Standards, Washington, DC.

Mechanical Properties.

Final rept.,
D. T. Read. 1983, 31p
Pub. in *Materials at Low Temperatures*, Chapter 7, p237-267 1983.

Keywords: *Mechanical properties, Yield strength, Fatigue(Materials), Creep properties, Dislocations(Materials), Crystal structure, Austenitic stainless steels, Copper, Aluminum, Titanium, Cryogenics, Alloys.

The mechanical properties of a material describe the relationships between the stresses acting on the material and its resulting deformations. Stresses capable of producing permanent deformations, which remain after the stresses are removed, are considered in this chapter. Yield strength, ultimate strength, elongation to fracture, and reduction of area are important mechanical properties. The temperature range considered here is 4-300 K, that is, from room temperature down to liquid helium temperature. Only macroscopically homogeneous materials are considered. The behavior of metals is considered. The fundamental mechanisms controlling temperature-dependent mechanical behavior, phenomena encountered in low-temperature testing, and the mechanical properties of some representative engineering metals and alloys are described. Modification of test procedures for low temperatures and sources of data are also included.

400,910

PB84-223338 Not available NTIS
National Bureau of Standards, Washington, DC.

Fracture Mechanics.

Final rept.,
R. L. Tobler, and H. I. McHenry. 1983, 26p
Pub. in *Materials at Low Temperatures*, Chapter 8, p269-294 1983.

Keywords: *Cryogenics, Fracture strength, Crack propagation, Fatigue(Materials), Alloys, *Fracture mechanics.

A tutorial review of fracture mechanics as it applies to cryogenics is presented. The fracture toughness and fatigue crack growth parameters of structural alloys and other materials are described at temperatures ranging from 300 to 4 K. Attention focuses on measurement methods, data trends, correlations and qualitative prediction. Fracture mechanics techniques and applications are also discussed.

400,911

PB84-223346 Not available NTIS
National Bureau of Standards, Washington, DC.

Elastic-Plastic Analysis of Surface Flaws Using a Simplified Line-Spring Model.

Final rept.,
R. B. King. 1983, 15p
Sponsored in part by Department of Transportation, Washington, DC. Office of Pipeline Safety Regulation. Pub. in *Engineering Fracture Mechanics* 18, n1 p217-231 1983.

Keywords: *Cracks, *Mathematical models, *Surfaces, Plates(Structural members), Shells(Structural forms), Pipes(Tubes), Steels, Elastic properties, Plastic properties, Reprints, *Fracture mechanics, J integral.

The line-spring model has proven to be an effective tool for evaluating fracture parameters in surface-cracked plates and shells. However, application of the model requires detailed numerical computations, necessitating the availability of a specialized computer code. For approximate engineering calculations a version of the model which is more convenient to implement computationally, would be useful. In this paper a simplified line-spring model is presented along with detailed illustration of its application. The simplification is accomplished by replacing the crack front with a crack of constant depth and treating the ligament 'spring' as elastic perfectly plastic. Despite its simplicity, the model gives reasonably accurate predictions of fracture parameters, such as the J-integral or crack opening displacement (COD) at the root of surface cracks. This will be demonstrated by comparing analytical re-

sults for J and COD with previously published experimental data for surface-cracked steel plates.

400,912

PB84-223353 Not available NTIS
National Bureau of Standards, Washington, DC.

Martensitic Phase Transformations.

Final rept.,
R. P. Reed. 1983, 48p
Pub. in *Materials at Low Temperatures*, Chapter 9, p295-342 1983.

Keywords: *Phase transformations, *Cryogenics, Austenitic stainless steels, Nickel alloys, Iron alloys, Superconductors, Alkali metals, Solidified gases, Polymers, *Martensitic transformation.

This chapter concentrates on very low-temperature martensitic transformations, which are of great concern for cryogenic applications and research. The principal transformation characteristics are reviewed and then elaborated. The materials classes or alloy systems that exhibit martensitic transformations at very low temperatures are discussed in greater detail. In particular, the martensitic transformations and their effects in austenitic stainless steels, iron-nickel alloys, practical superconductors, alkali metals, solidified gases, and polymers are discussed.

400,913

PB84-223783 Not available NTIS
National Bureau of Standards, Washington, DC.

Dislocation-Shielding Analysis of a Blunt-Notched Brittle Crack Embedded in a Ductile Material.

Final rept.,
I. H. Lin. 1983, 4p
Pub. in *Proceedings of ICF Int. Symposium Fracture Mechanics*, Beijing, China, November 22-25, 1983, p951-956.

Keywords: *Fracture strength, Cracks, Dislocations(Materials), Models, Predictions, Fracture mechanics.

A fracture model of a blunt-notched brittle crack embedded in a plastically deformed ductile medium is developed. An elastic enclave separates the notched tip from the plastic zone that is generated by the dislocations created within this zone. Effects of the notch-root radius and material parameters on the fracture toughness are predicted. The predicted fracture toughness is consistent with experimental observations.

400,914

PB84-223957 Not available NTIS
National Bureau of Standards, Washington, DC.

Transition from an Emitting to a Cleaving Crack.

Final rept.,
I. H. Lin, and R. Thomson. 1983, 4p
Pub. in *Scripta Metallurgica* 17, p1031-1034 1983.

Keywords: *Embrittlement, Liquid metals, Cracking(Fracturing), Dislocations, Emission, Reprints, Fracture(Mechanics).

Lynch (1) and others have proposed that liquid metal embrittlement may be associated with enhanced rather than decreased dislocation activity in the vicinity of the crack tip. This proposal has been based on evidence for shallow dimples which are observed on the embrittled crack surfaces in large numbers. The reported difference relative to the untreated metal is that the dimples are shallower and more concentrated ahead of the crack, with a resulting lower CoD, in the embrittled case. Lynch (1) has speculated that the reason for this result is that dislocations are more easily emitted in a solid metal in contact with a second liquid metal. This suggestion is in contradiction with a lowered intrinsic surface energy caused by the wetting liquid which would tend to make dislocation emission less favored, and perhaps lead to cleavage (2). In this note, the authors will present a mechanism by which a wetting liquid can modify the emission criterion at the tip, and discuss the requirements for embrittlement.

400,915

PB84-224013 Not available NTIS
National Bureau of Standards, Washington, DC.

Actual Versus Predicted Stresses during Particle Erosion: Observations on Dislocation Cells as a Tool for the Study of Sub-Surface Stresses Accompanying Erosion and Wear Damage.

Final rept.,
D. Kuhlmann-Wilsdorf, L. K. Ives, and A. W. Ruff. Sep 83, 7p
Pub. in *Proceedings of Int. Conference on Erosion by Liquid and Solid Impact (6th)*, Cambridge, England, September 4, 1983, p42.1-42.7.

Keywords: *Dislocations(Materials), *Stresses, *Wear, *Copper, Erosion, Particles, Damage.

Studies of the dislocation structure underneath the surfaces of test samples can greatly aid in the understanding of the deformation processes accompanying damage due to erosion or wear. A little recognized aspect of this is the fact that a unique relationship exists between the average dislocation cell diameter and the flow stress which produced the deformation. Measurements of the cell diameter therefore reveal the sub-surface stresses during the damaging process, provided only that no subsequent recrystallization intervened. Application of this technique to earlier measurements of cell sizes in OFHC copper bombarded with irregular alumina particles of about 50 micrometer diameter and impact angles of 90 degrees and 20 degrees with velocities of 60 m/s and 20 m/s yielded a simple functional dependence of the sub-surface flow stress on those parameters and depth below the surface. This paper calculates an expected functional dependence which is then compared with the measurements; some significant differences are found. A number of further experiments are suggested to clear up this discrepancy.

400,916

PB84-224047 Not available NTIS
National Bureau of Standards, Washington, DC.

Mechanical Properties of Stainless Steel Castings at 4 K.

Final rept.,
T. A. Whipple, and H. I. McHenry. Dec 82, 4p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in *Proceedings of Int. Cryogenic Materials Conference*, Kobe, Japan, May 11-14, 1982, p104-107 Dec 82.

Keywords: *Nickel chromium molybdenum steels, *Stainless steels, *Steel castings, *Cryogenics, Fracture strength, Tensile properties, Ferrite, Nitrogen, Steel 19Cr 2Mo 9Ni.

The influences of delta-ferrite and interstitial nitrogen in the strength and toughness of stainless steel castings at 4K were evaluated using nine CF8M (nominally a 19Cr-9Ni-2Mo alloy) castings with controlled chemistries. The chromium and nickel contents were varied to obtain two series of alloys: one series of five alloys had 0.05 percent nitrogen and delta-ferrite contents ranging from 0 to 28.5 percent, and a series of five alloys had 9 + or - 1 percent ferrite and 0.02 to 0.20 percent nitrogen. The results indicate that an increase in either delta-ferrite or nitrogen content increases the yield strength at 4K. Fracture toughness decreases with increasing delta-ferrite up to a ferrite content of 17 percent and then remains constant. Fracture toughness decreases with increasing nitrogen content for nitrogen contents above 0.01 percent.

400,917

PB84-224054 Not available NTIS
National Bureau of Standards, Washington, DC.

Magnetic Field Effects on Tensile Behavior of Alloys 304 and 310 at 4 K.

Final rept.,
R. P. Reed, J. M. Arvidson, J. W. Ekin, and R. H. Schoon. Dec 82, 4p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in *Proceedings of Int. Cryogenic Materials Conference*, Kobe, Japan, May 11-14, 1982, p33-36 Dec 82.

Keywords: *Stainless steels, *Tensile properties, *Magnetic fields, Modulus of elasticity, Stresses, Strains, Yield strength, Cryogenics, Steel 304, Steel 310.

Field 11—MATERIALS

Group 11F—Metallurgy and Metallography

Experiments were conducted to assess the effects of a steady, transverse 7-T magnetic field on the austenite stress-strain characteristics of types 304 and 310 stainless steels at 4 K. Wire specimens of both a stable Fe-26Cr-20Ni (AISI 310) and metastable Fe-18Cr-9Ni (AISI 304) alloy were measured. No change in austenite flow strength of either alloy was observed from the application of a 7-T field. There was no detectable effect of a constant 7-T magnetic field on the yield strength of either alloy. Young's modulus at 4 K was found to decrease linearly with applied strain, but no effect of magnetic field was observed.

400,918
PB84-224161 Not available NTIS
National Bureau of Standards, Washington, DC.
Temperature Dependence of Flow Strength of Selected Austenitic Stainless Steels.
Final rept.,
R. P. Reed, R. L. Tobler, and J. W. Elmer. 1983, 12p
Pub. in *Austenitic Steels at Low Temperatures*, p105-116 1983.

Keywords: *Stainless steels, *Austenitic stainless steels, *Tensile strength, *Nickel chromium molybdenum steels, *Nickel chromium steels, Polycrystalline, Cryogenics, Martensite, Phase transformations, Reprints, Martensitic transformation, Temperature dependence.

It is important to characterize and to understand the temperature dependence of the tensile flow strength of austenitic steels for efficient design and material selection. Recent studies have suggested the possibility of three anomalies in the temperature dependence of the flow strength of Fe-Cr-Ni and Fe-Cr-Ni-Mn austenitic stainless steels. Reduction of flow strength at decreasing temperature may be associated with the onset of the austenite to martensite transformation (about 200 K), the magnetic transition at the Neel temperature (about 50 K) and low temperature dislocation dynamics (<20 K). The tensile flow strength was investigated in the temperature range 4 to 295 K for two annealed polycrystalline alloys: Fe-20Cr-16Ni-6Mn-0.2N steel (produced in the USSR and independently tested by two research laboratories) and Fe-18Cr-10Ni-0.1N steel (AISI 304LN). The former alloy is stable with respect to strain-induced martensitic transformations, the latter metastable.

400,919
PB84-224781 Not available NTIS
National Bureau of Standards, Washington, DC.
Fracture.
Final rept.,
R. Thomson. 1983, 64p
Pub. in *Physical Metallurgy (3rd Edition)*, Chapter 23, p1488-1551 1983.

Keywords: *Cracks, *Dislocations(Materials), Fractures(Materials), Embrittlement, Fracture strength, *Fracture mechanics.

The fundamentals of fracture are reviewed from the perspective of the metallurgist. The importance of the sharp crack and its interaction with dislocations is emphasized. The concept of shielding of the crack by dislocations is explored, and expressions for fracture toughness developed. The importance of the structure of the underlying crack is realized, and the role of the stable atomically sharp crack is explained. These general ideas are applied to a number of the classic problem areas of metallurgical fracture.

400,920
PB84-225267 Not available NTIS
National Bureau of Standards, Washington, DC.
Abrasive Wear Studies of Laser Surface-Melted Aluminum and Titanium Alloys with Carbide Additions.
Final rept.,
J. Ayers, L. K. Ives, F. Matanzo, and A. W. Ruff. 1983, 7p
Pub. in *Wear of Materials*, p265-271 1983.

Keywords: *Aluminum alloys, *Titanium alloys, *Wear resistance, *Abrasion resistance, *Carbides, Titanium carbide, Tungsten carbides, Vanadium carbides, Melting, Reprints, Titanium alloy 6Al 4V, Aluminum alloy 6061, Aluminum alloy 5052, Aluminum alloy 2024, Laser applications.

A laser melting technique has been used to incorporate carbide particles into the surface region of several aluminum and titanium alloys thereby obtaining a significant improvement in abrasive wear properties. A

multi-kilowatt CO₂ laser was used to melt a shallow pool in the surface of each specimen that was passed under the beam. At the same time, powder particles were injected into the melt pool by a stream of helium gas from a small nozzle positioned nearby. The melted region subsequently solidified, incorporating the hard particles within the alloy matrix. Particles of TiC, WC, and VC in the size range 40 micrometers to 150 micrometers were used in order to study the effect of particle type and size on wear rate.

400,921
PB84-225465 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Flat-On-Ring Sample Alignment on Sliding Friction Break-In Curves for Aluminum Bronze on 52100 Steel.
Final rept.,
P. J. Blau. 1984, 10p
Sponsored in part by Office of Naval Research, Arlington, VA.
Pub. in *Wear* 94, p201-210 1984.

Keywords: *Aluminum bronzes, *Steels, *Sliding friction, *Wear, Reprints.

The effects of test sample fixturing on the interpretation of frictional break-in behavior are described for dry sliding flat-on-ring tests of CDA 688 bronze on 52100 steel. It is demonstrated that for otherwise similar test conditions (i.e. 10 N load, 20 cm/s velocity, 1 micrometer polished block surfaces, flowing Ar gas surroundings), tilt of the fixed flat block can affect the break-in duration for friction and for wear due to the rate at which a balance of steady state sliding surface contact conditions is achieved.

400,922
PB84-225606 Not available NTIS
National Bureau of Standards, Washington, DC.
Copper-TFE Friction at Cryogenic Temperatures.
Final rept.,
R. S. Bell, C. K. Jones, and F. R. Fickett. Jan 84, 5p
Sponsored in part by International Copper Research Association, Inc., New York.
Pub. in *Cryogenics*, v24 n1 p31-35 Jan 84.

Keywords: *Copper, *Sliding friction, *Cryogenics, Fluorine organic compounds, Reprints, *Poly(ethylene/tetrafluoro), *Coefficient of friction, Temperature dependence.

Interfaces between metals and polytetrafluoroethylene (TFE) are common in cryogenic systems. In this paper the authors present results from measurements of the temperature dependence of the dynamic coefficient of friction between commercially pure copper and TFE. The effect of the copper surface finish was also determined. The effects of load and speed were evaluated over a small range, but nearly all data were taken at a surface speed of about 5.4 cm/s with a load of 1.63 N/sq cm. These parameters are typical of those encountered by the moving parts of cryogenic machinery.

400,923
PB84-226604 Not available NTIS
National Bureau of Standards, Washington, DC.
Ductile Fracture with Serrations in AISI 310S Stainless Steel at Liquid Helium Temperature.
Final rept.,
R. L. Tobler, and R. P. Reed. 1983, 14p
Sponsored in part by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in *Proceedings of Elastic Plastic Fracture: Second Symposium*, Philadelphia, PA, Oct 6-9 1983, American Society for Testing and Materials Special Technical Publication 803, pII-763-II-776.

Keywords: *Austenitic stainless steels, Cryogenics, Fracture properties, Fracture(Materials), Tests, J integrals, Fracture toughness, Steel 310-S.

Fracture toughness tests were performed on annealed austenitic stainless steel AISI 310S, immersed in liquid helium at 4 K, using 25 mm thick compact specimens. The J_{Ic} results (360 to 380 kJ/sq m) from single- and multiple-specimen test techniques are compared and shown to be in close agreement. Attention is called to the remarkable failure process of this steel at 4 K: crack extension occurs by ductile tearing, while the test records exhibit serrations owing to repeated bursts of unstable plastic flow and arrests. The nature of this behavior is discussed, and the performance of stable austenitic AISI 310S is compared to that of related steels including those which transform from austenite to martensite during testing at 4 K.

400,924

PB84-226810 Not available NTIS
National Bureau of Standards, Washington, DC.
Structural Alloys for Cryogenic Service.
Final rept.,
H. I. McHenry. Dec 82, 6p
Pub. in *Proceedings of International Cryogenic Material Conference*, Kobe, Japan, May 11-14, 1982, p313-318.

Keywords: *Austenitic stainless steels, *Nickel steels, *Aluminum alloys, *Cryogenics, Superconducting magnets, Liquefied natural gas, Rocket propulsion, Containers, Mechanical properties.

Many structural alloys are being successfully used in a wide variety of cryogenic systems. The author describes three important applications, identifies the alloys used and the design requirements that influence their selection, and discusses the properties of the single class of alloys most commonly used in each application. For large superconducting magnets, high strength in heavy sections is important; the austenitic stainless steels, particularly the nitrogen strengthened grades, are the preferred alloys. For land-based liquefied natural gas tanks, economy consistent with safe performance is essential; nickel steels are commonly used. For rocket propulsion systems, strength-to-weight ratio is the prime concern; aluminum alloys are usually selected. Problem areas that warrant further research are discussed.

400,925

PB84-226869 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Thermal Processing Variation on the Mechanical Properties and Microstructure of a Precipitation Hardening HSLA Steel.
Final rept.,
G. E. Hicho, S. Singhal, L. C. Smith, and R. J. Fields. Jun 84, 8p
Pub. in *Jnl. of Heat Treating* 3, n3 p205-212 Jun 84.

Keywords: *Steels, *Heat treatment, *Microstructure, Tensile properties, Impact strength, Hardness, Precipitation hardening, Fracture strength, Yield strength, Reprints, Steel A710.

Twenty-four variations in the heat treatment of ASTM A710 grade A, class 3 steel were performed to determine how sensitive this alloy is to deviations from the recommended heat treatment and to form a basis for understanding property variations in the heat affected zone of weldments. Tensile, impact, and hardness properties were measured for each heat treatment. Fractography and metallography were carried out to correlate microstructure with properties. It was found that small angle neutron scattering was extremely sensitive to small changes in the microstructure and also correlated extremely well with properties.

400,926

PB84-227073 Not available NTIS
National Bureau of Standards, Washington, DC.
Correlations of Fatigue Crack Growth Rate Parameters at Cryogenic Temperatures.
Final rept.,
Y. W. Cheng, and R. L. Tobler. 1983, 6p
Sponsored in part by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in *Proceedings of ICF Symposium Fracture Mechanics*, Beijing, China, November 22-25, 1983, p635-640.

Keywords: *Austenitic stainless steels, *Ferritic stainless steels, *Stainless steels, *Cryogenics, *Crack propagation, *Fatigue(Materials), Correlation.

Fatigue crack growth rate data of ferritic steels, AISI 300 series stainless steels, and austenitic steel welds at 295, 76, and 4 K were collected and analyzed in terms of the exponent in the Paris equation. The data considered pertain to constant amplitude fatigue loading and stress ratio equal to 0.1. It is observed that there is linear relation between log C and m, the parameters of Paris equation. The exponent, m, is insensitive to the variation of fracture toughness and yield strength of the material except in low fracture toughness materials. Temperature effects on m are observed for ferritic steels but not for austenitic steels.

400,927
PB84-227263 Not available NTIS
 National Bureau of Standards, Washington, DC.
Applied J-Integral Values in Tensile Panels.
 Final rept.,
 D. T. Read. Dec 82, 19p
 Sponsored in part by Naval Sea Systems Command,
 Washington, DC., and David W. Taylor Naval Ship Re-
 search and Development Center, Annapolis, MD.
 Pub. in Proceedings of Committee Safety Nuclear In-
 stallations (CSNI), Ductile Fracture Test Methods,
 Paris, France, Dec 1-3, 1982, p273-291.

Keywords: *Fracture properties, Structures, Nickel
 steels, *J integrals, Fracture(Mechanics), Fracture
 toughness.

The J contour integral has been applied widely in char-
 acterizing the fracture toughness of metals. In addi-
 tion, the applied J-integral can be used to character-
 ize the driving force for fracture in structures. This use of
 the J-integral requires knowledge of the dependences
 of the applied J integral on stress, strain, and crack
 size. Results from an experimental study of the applied
 J-integral as a function of strain in tensile panels are
 discussed in this paper.

400,928
PB84-227412 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Martensitic Transformations in Fe-Cr-Ni Stainless
 Steels.**
 Final rept.,
 R. P. Reed. 1983, 17p
 Sponsored in part by Department of Energy, Washing-
 ton, DC. Office of Fusion Energy.
 Pub. in Austenitic Steels at Low Temperatures, p41-67
 1983.

Keywords: *Nickel chromium steels, *Austenitic stain-
 less steels, *Phase transformations, *Stainless steels,
 Crystal structure, Stress strain diagrams, Cryogenics,
 Stability, Reprints, *Martensitic transformation, Tem-
 perature dependence.

Very low-temperature martensitic transformations are
 of great concern for cryogenic applications and re-
 search. The principal transformation characteristics
 are reviewed and then elaborated. The materials
 classes or alloy systems that exhibit martensitic trans-
 formations at very low temperatures are briefly dis-
 cussed, and references to reviews and compilations
 are given. The austenite stability of Fe-Cr-Ni alloys with
 regard to cooling, elastic stress, and deformation is
 discussed in detail, and the empirical stability expres-
 sions that have been developed are summarized and
 reviewed. Structural relationships between the face-
 centered cubic austenite (γ) and body-centered
 cubic (α) and hexagonal-close-packed (ϵ)
 martensite products are examined. Typical stress-
 strain curves of stable and metastable austenitic alloys
 are illustrated and analyzed as is the temperature de-
 pendence of the flow strength below room tempera-
 ture. Finally, the influence of martensite transformation
 upon alloy performance in cryogenic applications is
 surveyed.

400,929
PB84-227420 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Effects of Magnetic Field on Tensile Behavior at 4
 K of Alloys 304 and 310.**
 Final rept.,
 R. P. Reed, J. M. Arvidson, J. W. Ekin, and R. H.
 Schoon. 1983, 10p
 Pub. in Austenitic Steels at Low Temperatures, p187-
 198 1983.

Keywords: *Stainless steels, *Tensile properties,
 *Magnetic fields, Modulus of elasticity, Stresses,
 Strains, Yield strength, Cryogenics, Steel 304, Steel
 310.

Experiments were conducted to assess the effects of
 a steady, transverse 7-T magnetic field on the austen-
 ite stress-strain characteristics of types 304 and 310
 stainless steels at 4 K. Wire specimens of both a
 stable Fe-26Cr-20Ni (AISI 310) and metastable Fe-
 18Cr-9Ni (AISI 304) alloy were measured. No change
 in austenite flow strength of either alloy was observed
 from the application of a 7-T field. There was no de-
 tectable effect of a constant 7-T magnetic field on the
 yield strength of either alloy. Young's modulus at 4 K
 was found to decrease linearly with applied strain, but
 no effect of magnetic field was observed.

400,930
PB84-227438 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Properties of Austenitic Stainless Steel at Cryo-
 genic Temperatures.**
 Final rept.,
 H. I. McHenry. 1983, 27p
 Sponsored in part by Department of Energy, Washing-
 ton, DC. Office of Fusion Energy.
 Pub. in Austenitic Steels at Low Temperatures, p1-27
 1983.

Keywords: *Austenitic stainless steels, *Cryogenics,
 *Stainless steels, Fatigue(Materials), Fracture
 strength, Mechanical properties, Weldments, Welding,
 Nitrogen, Reprints.

The low temperature behavior of austenitic stainless
 steels is reviewed with emphasis on three general
 classes: (1) the AISI 300-series in the annealed condi-
 tion; (2) the nitrogen-strengthened grades; and (3)
 high-strength cold-rolled sheet of the AISI 300-series.
 Mechanical and physical properties of selected alloys
 in these classes are presented. Welding, the prop-
 erties of weldments, and other fabrication considerations
 are discussed. Recent results on the influence of fer-
 rite content, nitrogen, and sensitization on castings of
 composition similar to the AISI 300 series are also re-
 viewed.

400,931
PB84-235563
 (Order as PB84-235530, PC A07/MF A01)
 National Bureau of Standards, Washington, DC.
 Center for Materials Science.
**Characterization of Creep Damage in Metals Using
 Small Angle Neutron Scattering,**
 E. R. Fuller, Jr., R. J. Fields, T. J. Chuang, and S.
 Singhal. 1 Dec 83, 11p
 Included in Jnl. of Research of the National Bureau of
 Standards, v89 n1 p35-45 Jan-Feb 84.

Keywords: *Creep properties, *Neutron scattering,
 Materials tests, Metals, Failure.

Creep damage in polycrystalline metallic materials can
 be attributed to cavitation and cracking along the grain
 interfaces. Theories of creep cavitation that have been
 developed in recent years are reviewed. Further eval-
 uation and/or refinement of these theories has been
 retarded by a lack of an experimental counterpart.
 Small angle neutron scattering studies (SANS) provide
 one experimental tool which is complementary to
 others. SANS done at NBS and elsewhere have
 shown that this technique is suitable for studying nu-
 cleation and early stage of growth of creep cavities. This
 would provide the impetus to further progress in this
 area.

400,932
PB84-235589
 (Order as PB84-235530, PC A07/MF A01)
 National Bureau of Standards, Washington, DC.
 Center for Materials Science.
**Theory of Acoustic Emission from Phase Transfor-
 mations,**
 J. A. Simmons, and H. N. G. Wadley. 1 Dec 83, 10p
 Included in Jnl. of Research of the National Bureau of
 Standards, v89 n1 p55-64 Jan-Feb 84.

Keywords: *Phase transformations, Theories, *Acous-
 tic emissions.

A theoretical framework is developed within which it is
 possible to predict the dynamic elastic displacement
 field (acoustic emission) for a phase transformation in
 which there is a change of both crystal structure (elas-
 tic constants) and shape (density). An integral equa-
 tion is presented for the acoustic emission displace-
 ment field due to formation of inhomogeneous inclu-
 sions. This integral equation is solved by expressing
 the source in multipolar coefficients. Expressions for
 the source of elastic radiation are explicitly calculated
 for small isotropic spherical and ellipsoidal inclusions
 embedded in an isotropic matrix. These expressions
 are used for qualitative interpretation of recent experi-
 ments on martensitic transformations in steels and for
 identifying the information that may be deduced about
 transformation dynamics from quantitative measure-
 ments of acoustic emission.

400,933
PB84-235878 PC A12/MF A01
 National Bureau of Standards (NEL), Boulder, CO.
 Chemical Engineering Science Div.
**Thermal Conductivity of Aluminum, Copper, Iron,
 and Tungsten for Temperatures from 1 K to the
 Melting Point,**
 J. G. Hust, and A. B. Lankford. Jun 84, 259p NBSIR-
 84/3007

Keywords: *Aluminum, *Copper, *Iron, *Tungsten,
 Thermal conductivity, Electrical resistivity, Thermophy-
 sical properties, Mathematical prediction, Cryogenics.

Data on the thermal conductivity of commercially pure
 aluminum, copper, iron, and tungsten specimens have
 been collected, coded, critically analyzed, and corre-
 lated with analytical techniques based on theoretical
 and empirical equations. The resulting functions are
 presented and used to generate tables and graphs of
 thermal conductivity as a function of temperature and
 residual resistivity ratio (RRR). An annotated bibliog-
 raphy of references is included. Discussions are included
 on the variations in thermal conductivity caused by
 chemical impurities, physical defects, size effects, and
 magnetic fields. Smoothed values are presented for
 temperatures from 1 K to near the melting point and for
 a large range of RRR values.

400,934
PB84-237395 PC A10/MF A01
 National Bureau of Standards (NML), Boulder, CO.
 Fracture and Deformation Div.
**Effect of Crack-Tip Region Constraint on Fracture
 in the Ductile-to-Brittle Transition,**
 T. L. Anderson. May 84, 213p NBSIR-84/3001
 Sponsored in part by Minerals Management Service,
 Reston, VA.

Keywords: *Structural steels, Fracture properties, Me-
 chanical properties, Fracture strength, Cracks, Tough-
 ness, Mathematical models, J integrals.

The effect of geometry on fracture toughness of steel
 in the ductile-to-brittle transition region has been stud-
 ied. The critical crack-tip opening displacement
 (CTOD) and the critical J-integral have been measured
 as a function of temperature for ten fracture specimen
 configurations of ABS grade EH36 steel. A technique
 was developed to experimentally measure crack-tip
 constraint. Constraint decreased with crack blunting.
 This relaxation in constraint was modeled by a simple
 spring analog. The model was used to predict ductile-
 to-brittle transition curves for hypothetical structures.
 Some of the applications and limitations of the model
 are discussed.

400,935
PB84-239920 Not available NTIS
 National Bureau of Standards, Washington, DC.
**Factors Influencing the Low Temperature Depend-
 ence of Yielding in AISI 316 Stainless Steels.**
 Final rept.,
 R. L. Tobler, D. H. Beekman, and R. P. Reed. 1983,
 23p
 Sponsored in part by Department of Energy, Washing-
 ton, DC. Div. of Magnetic Fusion Energy.
 Pub. in Proceedings of International Cryogenic Materi-
 als Conference, Kobe, Japan, 11-14 May 1982, Paper
 in Austenitic Steels at Low Temperatures, p135-157
 1983.

Keywords: *Stainless steels, Cryogenics, Plastic de-
 formation, Yield strength.

Tensile tests at temperatures between 323 and 4K
 were performed on metastable austenitic AISI 316
 stainless steel (FE-17Cr-12Ni-2Mo). The yield and
 flow strengths at plastic strains up to 0.037 are ana-
 lyzed and compared to existing data, noting metallur-
 gical effects. The grain size effect on yield strength
 ($\sigma_{sub y}$) is weak at room temperature but sub-
 stantial at cryogenic temperatures. No martensite is
 detected after tensile loading at low temperatures to
 0.002 plastic strain. At higher strains (approximately
 0.03), body-centered cubic (α') martensite forms in
 the parent austenite phase at test temperatures below
 175K (the $M_{sub d}$ temperature). The initiation of
 α' transformation in this steel is associated with
 increased strain hardening below 175K, and not with a
 decrease of flow strength. Significant features of the
 temperature dependence of flow strength are: (1) a
 continuous rise of $\sigma_{sub y}$ with decreasing tempera-
 ture, in accord with thermally-activated plastic defor-

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mation, (2) an inflection in the thermal component of sigma sub y at about 150K, suggesting a change in deformation mechanism, and (3) absence of anomalies owing to martensitic transformations or to magnetic transition at the Neel temperature.

400,936
PB84-243898 Not available NTIS
National Bureau of Standards, Washington, DC.
Evaluation Method for Comparing Domestic and Foreign Materials Specifications.
Final rept.,
J. G. Early, and H. Hime. May 84, 8p
Sponsored in part by Coast Guard, Washington, DC.
Pub. in Jnl. of Testing and Evaluation 12, n3 p125-132 May 84.

Keywords: *Metals, *Chemical analysis, *Mechanical properties, *Specifications, *Guidelines, Tests, Comparisons, Reprints.

Consistent decisions on the degree of equivalence between metal specifications of different national origins cannot be made only on the basis of chemical composition and direct comparison of mechanical property numbers. There are numerous additional factors, which, if present, can influence the determination of equivalency because of their effect on property requirements. In order to remove the uncertainty in this decision-making process, these additional factors must be evaluated in each comparison. A generalized approach has been developed in which evaluation criteria have been identified and discussed in terms of their role in the determining of equivalence. These criteria are presented as part of a guideline for conducting material specification comparisons.

400,937
PB84-244003 Not available NTIS
National Bureau of Standards, Washington, DC.
PHAB - An Alloy Phase Diagram Bibliographic Database: A Part of the ASM/NBS Program for Alloy Phase Diagrams.
Final rept.,
J. R. Cuthill, and H. Baker. 1983, 4p
Pub. in Proc. Materials Research Soc. Symp., Boston, MA, October 31-November 4, 1982, 19, p429-432 1983.

Keywords: *Phase diagrams, *Alloys, *Information systems, Chemical equilibrium, Crystal structure, Thermodynamics, High pressure tests.

PHAB is intended to be a complete bibliographic file of the phase diagram data papers pertaining to the experimental determination, evaluation, and calculation of phase diagrams of binary, ternary and higher-order alloy systems. Metastable as well as stable equilibrium data, crystal structure, thermodynamic and high pressure data are included. The database will provide a service to the scientific community as well as serving the ASM/NBS Data Program for Alloy Phase Diagrams. The PHAB Database will serve as a source of data to the other activities and outputs of the Program, including alloy system evaluations, the Bulletin of Alloy Phase Diagrams and bound volumes of evaluated phase diagrams, as well as other databases.

400,938
PB84-244326 Not available NTIS
National Bureau of Standards, Washington, DC.
Mechanism for Metalloid Strengthening of Udimet-700.
Final rept.,
R. S. Polvani, A. W. Ruff, and P. R. Strutt. 1983, 4p
Pub. in Jnl. of Mater. Sci. Lett. 3, p287-290 1983.

Keywords: *High temperature tests, *Nickel containing alloys, *Heat resistant alloys, *Metalloids, Performance evaluation, Casting, Trace elements, Additives, Carbon, Boron, Silicon, Zirconium, Mechanical properties, *Udimet 700.

The deliberate use of metalloid (boron, carbon, silicon) and zirconium concentrations to improve the performance of nickel base superalloys has an interesting history. Initially small boron and zirconium additions were accidentally added as crucible contaminants during casting. Their importance to the prevention of high temperature creep fracture became clear only after improved casting techniques eliminated these 'contaminants'. However, there is no appreciation of the important and different roles these trace additions play during high temperature creep. For this reason, a representative nickel base superalloy, namely Udimet-700, was selected and the effects of trace metalloid additions were studied in detail.

400,939
PB84-244532 PC A05/MF A01
National Bureau of Standards (NML), Washington, DC.
Metallurgy Div.
Measuring the Corrosion Rate of Reinforcing Steel in Concrete,
E. Escalante, M. Cohen, and A. H. Kahn. Apr 84, 86p
NBSIR-84/2853
Sponsored in part by Federal Highway Administration, Washington, DC. Portions of this document are not fully legible.

Keywords: *Corrosion, *Reinforcing steels, *Concrete, *Nondestructive testing, Bridge decks, Construction materials.

The progress on a research program directed at developing a nondestructive method for measuring the corrosion of steel in concrete as related to bridge deck deterioration is reported. This report summarizes the past work and describes the new developments on this project. The five phases described are: (1) a literature review, (2) preliminary studies, (3) measurements in concrete, (4) field measurements, and (5) development of a microprocessor system.

400,940
PB84-244607 Not available NTIS
National Bureau of Standards, Washington, DC.
Temperature Behavior of Young's Moduli of Forty Engineering Alloys.
Final rept.,
H. M. Ledbetter. Dec 82, 4p
Pub. in Cryogenics 22, p653-656 Dec 82.

Keywords: *Alloys, *Temperature, *Modulus of elasticity, Iron alloys, Nickel alloys, Copper alloys, Aluminum alloys, Reprints.

Young's modulus and temperature data are collected graphically and tabulated for forty alloys that have technological applications. Alloy base metals include: aluminum, copper, iron, and nickel. Sources of data are: handbooks, original research at NBS, and the scientific-engineering literature. The temperature range 0 to 590 K is covered.

400,941
PB84-245893 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermodynamic Factors in the Extension of Solid Solubility in Al-Based Alloys.
Final rept.,
J. L. Murray. 1983, 11p
Pub. in Proceedings of Materials Research Society Symposium, Boston, MA., October 31-November 4, 1982, p249-259 1983.

Keywords: *Aluminum alloys, Thermodynamic properties, Thermal analysis, Solidification points, Solubility, Chemical properties, Phase diagrams, Reprints, Rapid solidification.

Stable and metastable equilibrium diagrams and T sub o curves are calculated for the Al-based binary systems Al-Ga, Al-Ge, Al-Fe, Al-Mg, and Al-Si. Extended solid solubilities and metastable phases have been produced by rapid solidification for each of these systems, and the calculations are compared to experimental observations.

400,942
PB84-245927 Not available NTIS
National Bureau of Standards, Washington, DC.
Mechanical Properties of Welds in Aluminum Alloy 5083 at 4K.
Final rept.,
R. A. Kelsey, L. N. Mueller, J. W. Elmer, and H. I. McHenry. Feb 82, 17p
Pub. in Proceedings of International Aluminum Welding Conference (1st), Cleveland, OH., April 7-8, 1981, p89-105 Feb 82.

Keywords: *Aluminum alloys, Mechanical properties, Cryogenics, Weldments, Aluminum alloy 5083.

A series of weldments were prepared by five cooperating companies in 51 mm thick 5083-0 aluminum plate using 5183 metal and gas metal arc welding (GMAW) processes. Tensile and notch-tensile properties measured at room temperature and at 4K are similar despite the fact that there were considerable variations in the welding procedures. Fracture toughness and fatigue crack growth rates of the weldments were measured at 4K and found to be similar to base metal properties.

Strengths of the welds are appreciably higher at 4K than at room temperature, and notch yield ratios are high, indicating that the welds are tough. Data for each of the mechanical properties do not vary significantly from weld to weld; and it is concluded that the mechanical properties of 5183 welds at 4K do not depend significantly on GMAW parameters and procedures.

400,943
PB84-246040 Not available NTIS
National Bureau of Standards, Washington, DC.
Automated Real-Time Analysis of Crack Growth Rates of Steels Tested in a Severe H2S Environment.
Final rept.,
C. Interrante, and S. R. Low, III. 1981, 9p
Sponsored in part by Metallurgical Society of AIME, Warrendale, PA., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Proceedings of International Conference on Effect of Hydrogen on Behavior of Materials (3rd), Moran, WY, August 26-31, 1980, p713-721 1981.

Keywords: *Crack propagation, *Steels, *Hydrogen, *Stress analysis, *Data acquisition, Design criteria, Performance evaluation, Hydrogen sulfide, Corrosion.

Electrical impedance measurements of crack size are used in a data-acquisition system that takes data, checks for drift using a standard specimen, computes the stress-intensity factor (K), and the crack-growth rate (da/dt). This system is designed to operate in real time, with either d.c. or a.c. current, for tests of up to five specimens that are conducted simultaneously. An improved environmental chamber for fully instrumented tests of double-cantilever beam (DCB) specimens has been designed to prevent the environment from attacking test-specimens lead wires, which are used to measure the crack length. Using this improved design and the data-acquisition system, DCB specimens were tested in the NACE standard solution for evaluation of metals for resistance to sulfide stress cracking at ambient temperatures.

400,944
PB85-100162 Not available NTIS
National Bureau of Standards, Washington, DC.
Corrosion Behavior of Some Stainless Steels in Underground Soil Environments.
Final rept.,
W. F. Gerhold, and B. T. Sanderson. Apr 81, 21p
Sponsored in part by American Iron and Steel Inst., Washington, DC.
Pub. in Proceedings of Conference on Corrosion 1981, Toronto, Canada, April 6-10, 1981, 21p.

Keywords: *Stainless steels, *Corrosion, Corrosion tests, Soils, Steel 201, Steel 202, Steel 301, Steel 304, Steel 316, Steel 409, Steel 410, Steel 430, Steel 434.

A soil burial program utilizing nine stainless steels was initiated in 1970. Included were annealed and sensitized materials and materials with welds and crevices. After exposure for up to 8 years in the soils, the annealed AISI Types 201, 202, 301, 304 and 316 were relatively immune to corrosion in 3 of the 6 soils while AISI Types 409, 410, 430 and 434 were perforated by corrosion in 5 of the 6 soils. In the more corrosive soils, the AISI 200 and 300 series were susceptible to pitting and tunneling corrosion.

400,945
PB85-100238 Not available NTIS
National Bureau of Standards, Washington, DC.
Mechanical Properties of CF8M Stainless Steel Castings at 4 K.
Final rept.,
T. A. Whipple, and H. I. McHenry. 1983, 6p
Sponsored in part by Department of Energy, Washington, DC. Office of Magnetic Fusion Energy.
Pub. in Proceedings of International Cryogenic Materials Conference, Kobe, Japan, May 11-14, 1982 p243-248 1983.

Keywords: *Stainless steels, Cryogenics, Mechanical properties, Castings, Tensile properties, Toughness, Steel CF8M, Steel 19Cr 9Ni 2Mo, Fracture toughness.

The influences of delta-ferrite and interstitial nitrogen in the strength and toughness of stainless steel castings at 4K were evaluated using nine CF8M (nominally a 19Cr-9Ni-2Mo alloy) castings with controlled chemistries. The chromium and nickel contents were varied to obtain two series of alloys: one series of five alloys had 0.05 percent nitrogen and delta-ferrite contents rang-

ing from 0 to 28.5 percent, and a series of five alloys had 9 plus or minus 1 percent ferrite and 0.02 to 0.20 percent nitrogen. The results indicate that an increase in either delta-ferrite or nitrogen content increases the yield strength at 4K. Fracture toughness decreases with increasing delta-ferrite up to a ferrite content of 17 percent and then remains constant. Fracture toughness decreases with increasing nitrogen content for nitrogen contents above 0.01 percent.

400,946

PB85-102184 Not available NTIS
National Bureau of Standards, Washington, DC.
Investigation of the Nature of Micro-Indentation Hardness Gradients Below Sliding Contacts in Five Copper Alloys Worn Against 52100 Steel.

Final rept.,
P. J. Blau. 1984, 12p
Pub. in Jnl. of Materials Science 19, p1957-1968 1984.

Keywords: *Microhardness tests, *Indentation hardness tests, *Electric contacts, *Copper alloys, Copper aluminum alloys, Sliding friction, Abrasion resistant steels, Microstructure, Bronzes, Deformation, Metallography, Wear, Mechanical properties, 52100 steel.

This paper presents the results of a study of the differences in the variation of micro-indentation hardness with depth below sliding contact surfaces of OFHC Cu, Cu-3.5wt%Al, Cu-7.0wt%Al, and two commercial bronzes: CDA 638 and 688. All five metal alloys were worn dry against 52100 steel in a flat block (Cu alloy) on rotating cylinder (steel) configuration. The load was 10 N and sliding velocity was 20 cm/s in flowing argon environment. Metallography was performed using tapered cross-sections of the sliding surfaces of the Cu alloys. The variation of micro-indentation hardness with depth was found to be dependent upon the type of microstructural features below which each hardness profile was obtained. Therefore, micro-indentation hardness gradients sometimes varied more from location to location on a given sample than between similar microstructural features on one alloy and another. There was no obvious correlation between relative wear volumes of the alloys and the magnitude of their near surface micro-indentation hardness gradients. There did however seem to be a correlation between relative volumes and the thicknesses of their highly deformed near-surface layers.

400,947

PB85-107324 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of Selenium and Tellurium in Stainless Steel, White Cast Iron, and Nickel Base Alloy Standard Reference Materials by Isotope Dilution Spark Source Mass Spectrometry.

Final rept.,
H. M. Kingston, P. J. Paulsen, and G. Lambert. 1984, 5p
Pub. in Applied Spectroscopy 38, n3 p385-389 1984.

Keywords: *Chemical analysis, *Stainless steel, *Selenium, *Tellurium, *Nickel containing alloys, Standards, Reprints, *Standard reference materials, *Isotope dilution mass spectrometry, *White cast iron.

Procedures using stable isotope dilution spark source mass spectrometry were developed for the simultaneous determination of selenium and tellurium in stainless steels, white cast irons, and nickel based alloys. The selenium and tellurium were reduced using hypophosphorous acid except in the nickel based alloy where electro-deposition onto gold was also used for tellurium. A gold carrier was used to scavenge the selenium and tellurium efficiently during reduction. The samples were homogenized with gold and introduced into the mass spectrometer as electrodes. The concentrations calculated from the general isotope dilution equation ranged from 0.14 micrograms/g for selenium to 353 micrograms/g for tellurium. The materials tested were ten different Standard Reference Materials available from the NBS.

400,948

PB85-108579 Not available NTIS
National Bureau of Standards, Washington, DC.
Structure of Rapidly Solidified Al-Fe-Cr Alloys.

Final rept.,
R. Yearim, and D. Shechtman. Nov 82, 8p
Pub. in Metallurgia Transactions A 13A, p1891-1898 Nov 82.

Keywords: *Aluminum alloys, Microstructure, Reprints, *Rapid solidification.

Four aluminum alloys, designed for use at elevated temperatures, were studied. The alloys were supersaturated with iron and chromium, and one of them contained small amounts of Ti, V, and Zr. The starting materials were alloy powders made by the RSR (Rapid Solidification Rate) centrifugal atomization process. Extrusion bars were made from the four powders. The as-extruded microstructure and the microstructure of the alloys after annealing at 482 C were investigated by optical and transmission electron microscopy and by X-ray diffraction. The microstructure consists of equiaxed grains of aluminum matrix and two types of precipitates, namely, Al₃(Fe,Cr) and a metastable phase, Al₆(Fe,Cr). The precipitates were different in their shape, size, distribution, and location within the grains.

400,949

PB85-108629 Not available NTIS
National Bureau of Standards, Washington, DC.
Phase Diagram Sample Preparation.

Final rept.,
R. D. Shull. Jun 83, 11p
Pub. in Bulletin Alloy Phase Diagram 4, n1 p5-15 Jun 83.

Keywords: *Phase diagrams, Reprints, Sample preparation.

The procedures by which samples are prepared for phase diagram studies are examined and critically evaluated. The three key elements that require attention (alloy purity, homogeneity, and equilibrium) are separately addressed, and several examples of bad procedure are presented with information on their past and future consequences. The origin of commonly confronted problems are described and special procedures are suggested for their circumvention. Additionally, new methods for the early detection of some sample problems are presented, and the usefulness of rapidly solidified materials (as specimens) in phase diagram studies is illustrated.

400,950

PB85-118412 Not available NTIS
National Bureau of Standards, Washington, DC.
Mechanism for Metalloid Strengthening of Udimet-700.

Final rept.,
R. S. Polvani, A. W. Ruff, and P. R. Strutt. 1984, 4p
Sponsored in part by National Research Council, Washington, DC. and National Science Foundation, Washington, DC.
Pub. in Jnl. of Materials Science Letters 3, n4 p287-290 1984.

Keywords: *Nickel alloys, Metalloids, Heat resistant alloys, Microstructure, Creep properties, Boron, Trace elements, Strength, Reprints, Nickel alloy Udimet-700.

Examination of the interrelation between microstructure and macro-creep behaviour revealed the basis for the well recognized effectiveness of trace additions, in nickel base superalloys. Solute atoms collect at the slightly mismatched second phase particles, in addition to segregating at the grain boundaries. Subsequently, this aggregation is available to pin mobile dislocations by forming atmospheres and clusters.

400,951

PB85-120723 Not available NTIS
National Bureau of Standards, Washington, DC.
Low-Temperature Magnetically Induced Elastic-Constant Anomalies in Three Manganese Stainless Steels.

Final rept.,
H. M. Ledbetter, and E. W. Collings. 1979, 19p
Sponsored in part by Advanced Research Projects Agency, Arlington, VA.
Pub. in Proc. 107th AIME Annu. Meet., Denver, Colorado, March 2 1978, p22-40 1979.

Keywords: *Elastic properties, *Austenitic stainless steels, Iron alloys, Low temperature tests, Transition temperature, Manganese containing alloys, Neel temperature, Magnetic properties, Physical properties, Steel 18Cr 12Mn 3Ni, Steel 21Cr 9Mn 6Ni, Steel 22Cr 5Mn 13Ni.

Elastic properties of three austenitic stainless steels -- Fe-18Cr-3Ni-12Mn, Fe-21Cr-6Ni-9Mn, and Fe-22Cr-13Ni-5Mn--were studied between room temperature and either liquid-nitrogen or liquid-helium temperature. A dynamic (pulse-echo, 10 MHz) method was used to determine longitudinal and transverse sound-wave velocities, which were converted to elastic constants --

Young's modulus, shear modulus, bulk modulus, and Poisson's ratio. All the elastic constants are anomalous at low temperatures. These anomalies correlate with a paramagnetic-antiferromagnetic (Neel) transition detected by magnetic-susceptibility measurements. The transition temperature depends strongly on Mn content. Higher Mn content causes a higher transition temperature and a larger elastic-constant anomaly.

400,952

PB85-128981 Not available NTIS
National Bureau of Standards, Washington, DC.

Zr-Rh System: A Case Study of Calculated and Experimental Phase Diagrams.

Final rept.,
R. M. Waterstrat. 1984, 9p
Sponsored in part by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of the Less-Common Metals 100, p347-355 1984.

Keywords: *Zirconium alloys, *Rhodium alloys, *Phase diagrams, Intermetallics, Reprints.

The current status of the Zr-Rh constitution diagram is reviewed. An outline of the procedures which may be used in calculating this phase diagram is presented beginning with Kaufman's predictive calculation in 1970. Kaufman's calculated phase diagram is compared with the currently accepted diagram determined from experimental data. The various types of experimental data which can be used to further improve the calculations are identified and some recent experimental results are also discussed. It is concluded that the most efficient strategy for obtaining a reliable phase diagram would involve both experiments and calculations since neither method achieves its maximum benefits when isolated from the other.

400,953

PB85-129427 Not available NTIS
National Bureau of Standards, Washington, DC.

Relationships between Phase Diagrams, the T_g and T_n Temperatures, Cooling Rates and Glass Forming Ability.

Final rept.,
T. B. Massalski, C. G. Woychik, and J. L. Murray. 1983, 7p
Pub. in Proceedings of Materials Research Symposium, Boston, MA, October 31-November 4, 1982, 19, p241-247 1983.

Keywords: Alloys, Phase diagrams, Glass transition temperature, Crystallization, Cooling, *Metallic glasses, Amorphous materials.

While the temperature concept has been of great use when comparing the glass forming ability of different alloys it would be desirable to broaden the GFA concept to include also the influence of the cooling rate and T_{sub n} parameters, and perhaps also certain features of the specific techniques that are used to produce amorphous alloys.

400,954

PB85-135499 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

High Accuracy Conductivity Measurements in Non-Ferrous Metals.

Final rept.,
G. M. Free. 1981, 8p
Pub. in Proceedings of Symposium on Eddy-Current Characterizing of Materials and Structures, Gaithersburg, MD, September 5-7, 1979, p121-128 1981.

Keywords: *Electrical resistivity, Electrical measurement, Metals, Electric measuring instruments, Eddy currents, Nonferrous metals.

An eddy current instrument has been built that measures electrical conductivity with a high degree of accuracy and precision. The instrument measures the electrical conductivity of non-ferrous metals at a constant skin depth. By keeping the product constant in all measurements, a linear relationship between conductivity and frequency can be established. Due to this linear relationship, only one conductivity standard is necessary to calibrate the instrument over the full range 1%-100% IACS.

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400,955

PB85-136216 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Magnetic Susceptibility and Strain-Induced Martensite Formation at 4 K in Type 304 Stainless Steel.
Final rept.,
R. B. Goldfarb, R. P. Reed, J. W. Ekin, and J. M. Arvidson. Jul 84, 18p
Pub. in *Advances in Cryogenic Engineering* 30, p475-482 Jul 84.

Keywords: *Stainless steels, *Martensite, *Strain, *Phase transformations, Cryogenics, Magnetic fields, Reprints, *Magnetic susceptibility, *Steel 304.

Changes in magnetic susceptibility, χ , as a function of strain-induced structural transformations in AISI type 304 stainless steel at 4 K have been observed using a mutual inductance technique with simultaneous measurement of stress and strain. There is a small increase in χ coincident with plastic strain and a large increase in χ with the load drops that occur during serrated yielding. These are attributed to the formation of bcc martensite. The increases in χ are irreversible upon unloading. The application of a moderate 3-MA/m (37-kOe) dc field had no effect on the martensite formation.

400,956

PB85-136224 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Effect of Mill Temper on the Mechanical and Magneto-resistive Properties of Oxygen-Free Copper in Liquid Helium.
Final rept.,
F. R. Fickett. Jul 84, 8p
Pub. in *Advances in Cryogenic Engineering* 30, p453-460 Jul 84.

Keywords: *Copper, Magneto-resistivity, Liquid oxygen, Mechanical properties, Cryogenics, Reprints.

Depending on the source of the ore and its subsequent processing, oxygen-free copper can show wide variations in low temperature mechanical and electrical properties. Further mechanical and thermal processing by the wire producer and final user will also affect the behavior of the copper as a stabilizer. Here we present data showing the effect of these processes on coppers from a variety of sources.

400,957

PB85-139970 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Temperature Dependence of the Tensile Yield Strength of Selected Austenitic Steels.
Final rept.,
R. P. Reed, and J. M. Arvidson. 1984, 8p
Pub. in *Advances in Cryogenic Engineering* 30, p263-270 1984.

Keywords: *Austenitic steels, Yield strength, Thermodynamic properties, Tensile strength, Reprints.

The trend toward the use of higher field superconducting magnets is creating the need for strong, tough structural materials to restrain the high magnetic forces. Austenitic and high-nitrogen-austenitic stainless steels are considered for such uses because of their high strength and good toughness, combined with high Young's modulus and low thermal conductivity. Study of the temperature dependence of tensile flow strength, including the 0.2 percent offset yield strength, leads to better understanding of deformation mechanisms in these face-centered cubic, polycrystalline alloys. The tensile properties of five austenitic Fe-Cr-Ni and Fe-Cr-Mn steels were measured. In these steels the Cr contents varied from 4.67 to 24.8 wt. percent; the nickel from 0.8 to 20.8 wt. percent; and the manganese from 1.7 to 21.79 wt. percent. Yet it is demonstrated that all steels primarily obtained their low temperature yield strength from carbon and nitrogen.

400,958

PB85-140002 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Ultrasonic Shear Wave Measurements of Known Residual Stress in Aluminum.
Final rept.,
G. V. Blessing, N. N. Hsu, and T. M. Proctor. Sep 84, 5p
Pub. in *Experimental Mechanics* 24, n3 p218-222 Sep 84.

Keywords: *Aluminum alloys, *Stress analysis, *Ultrasonic tests, Residual stress, Secondary waves, Reprints, Electromagnetic-acoustic transducers.

Ultrasonic shear wave time-of-flight measurements were made at a nominal frequency of 4 MHz on a shrink-fit disk sample of 2024 aluminum alloy. The stress state of the sample was produced by shrink-fitting a plug and ring to produce a calculated 65 MPa region of uniform compression in the plug, and a concomitant non-uniform tension and compression in the ring. Time-of-flight measurement scans across sample diameters were made using a piezoelectric shear transducer with a viscous couplant, and repeated using a contactless electromagnetic acoustic transducer. The ultrasonic results were then compared with elasticity theory, assuming the acousto-elastic relationship between sound velocity and material strain.

400,959

PB85-141364 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Calculated Elastic Constants of Composites Containing Anisotropic Fibers.
Final rept.,
S. K. Datta, H. M. Ledbetter, and R. D. Kriz. 1984, 10p
Pub. in *Int. Jnl. Solids Struct.* 20, n5 p429-438 1984.

Keywords: *Fiber composites, Elastic properties, Computation, Reprints, Carbon fiber reinforced plastics, Graphite reinforced composites.

By a wave-scattering method, the authors derive dispersion relationships for wave propagation perpendicularly to continuous fibers that are oriented unidirectionally. In the long-wavelength limit one obtains relationships that predict the composite's effective static elastic constants. The authors compare these relationships with others derived by energy methods to obtain upper and lower bounds of the effective static moduli. The authors demonstrate this comparison graphically by plotting for graphite-epoxy the predicted composite constants over the full range of fiber volume fractions. The authors consider the fibers to be anisotropic but transversely isotropic. Under special conditions, the energy-method upper and lower bounds compare identically with the results of this study. The static properties are, of course, special cases of the more general dispersion relationships. Graphs are given for nine elastic constants: axial and transverse Young's and shear moduli, bulk and plane-strain-bulk moduli, and three Poisson's ratios.

400,960

PB85-141976 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
J Integral Analysis of Surface Cracks in Pipeline Steel Plates.
Final rept.,
R. B. King, Y. W. Cheng, D. T. Read, and H. I. McHenry. 1983, 14p
Pub. in *American Society for Testing and Materials STP 803*, pl-444--I-457 1983.

Keywords: *Steels, *Cracks, Surface defects, Reprints, Fracture(Mechanics), J integrals.

A capability for direct experimental evaluation of the J-integral in surface-cracked members under elastic-plastic deformation is useful for providing understanding of the driving force for fracture. In addition, such a capability makes it possible to evaluate analytical and numerical predictions of J. From a recent proof of path independence of the J contour integral evaluated around surface flaws, experimental procedures have been developed for direct evaluation of J at the root of surface cracks.

400,961

PB85-142511 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Low Temperature Strengthening of Austenitic Stainless Steels with Nitrogen and Carbon.
Final rept.,
R. P. Reed, and N. J. Simon. 1984, 10p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in *Advances in Cryogenic Engineering* 30, p127-136 1984.

Keywords: *Austenitic stainless steels, Yield strength, Nitrogen, Carbon, Shear modulus, Reprints, Steel 304.

The role of carbon and nitrogen in strengthening Fe-Cr-Ni austenitic stainless steels is reviewed. Discussion focuses on: (1) the relative contributions of carbon and nitrogen; (2) a dependence of concentration on strength; and (3) the shear modulus and volume change contributions in interstitial strengthening of austenitic stainless steels.

400,962

PB85-142800 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Aging Process in Aluminum-Alloy 2024 Studied by Means of Eddy Currents.
Final rept.,
M. Rosen, L. Swartzendruber, E. Horowitz, S. Fick, and R. Mehrabian. 1982, 8p
Pub. in *Materials Science and Engineering* 53, n2 p191-198 1982.

Keywords: *Aluminum alloys, *Aging(Metallurgy), Precipitation hardening, Hardness, Electrical resistivity, Reprints, Aluminum alloy 2024.

The influence of precipitation kinetics during aging of 2024 aluminum alloy on electrical conductivity, as measured by eddy currents, and on hardness was investigated. Aging temperatures between 21 and 190C were used and measurements were made on both unstretched and plastically deformed (3 percent permanent strain) samples. The two techniques, electrical conductivity and hardness, respond in a complementary manner to the varying microstructures that form during different phases of the aging process.

400,963

PB85-142826 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Comparison of Four Microindentation Hardness Test Methods Using Copper, 52100-Steel, and an Amorphous Pd-Cu-Si Alloy.
Final rept.,
P. J. Blau. 1983, 18p
Pub. in *Metallography* 16, n1 p1-18 1983.

Keywords: *Indentation hardness tests, Comparison, Copper, Steels, Palladium alloys, Microstructure, Reprints, Amorphous materials, Microhardness.

Microhardness numbers obtained with Knoop and Vickers diamond indenters can be greatly affected by the nature of indenter/test piece interactions. The values obtained by traditional methods of microhardness calculations, using optical measurement of impression dimensions, can be misleading unless these interactions are taken into account. Using microhardness data for large-grained Cu, fine grained bearing steel (SAE 52100), and an amorphous ('glassy') metal alloy of Pd-Cu-Si, the effects of microstructure on microhardness numbers at various loads are explored. Four methods of measurement are used: (1) standard Knoop number (long impression diagonal), (2) standard Vickers number (average of two impression diagonals), (3) a modified Knoop number (long and short impression diagonals), and (4) direct impression area measurement by an electronic image analyzing system.

400,964
PB85-143428 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Heat Flow during Surface Melting: Effect of Temperature-Dependent Absorptivity.
 Final rept.,
 J. A. Sekhar, and R. Mehrabian. 1981, 3p
 Pub. in Metallurgical Transactions, B: Process Metallurgy 12, n2 p411-413 1981.

Keywords: *Solidification, *Melting, *Heat transmission, Absorptivity, Reprints, Rapid solidification, Laser applications, Materials processing.

This paper discusses the effects of temperature dependent absorptivity on the heat flow in a semi-infinite substrate rapidly melted and solidified by the switching of an intense stationary laser beam.

400,965
PB85-143527 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Heat Flow during Rapid Solidification of Undercooled Metal Droplets.
 Final rept.,
 C. G. Levi, and R. Mehrabian. 1982, 14p
 Pub. in Metallurgical Transactions, A: Physical Metallurgy and Materials Science 13, n2 p221-234 Feb 82.

Keywords: *Heat transmission, Aluminum, Mathematical models, Reprints, *Rapid solidification.

The solidification of undercooled spherical droplets with a discrete melting temperature is analyzed using both a Newtonian and a non-Newtonian (Enthalpy) model. Relationships are established between atomization parameters, the growth kinetics, the interface velocity and undercooling, and other important solidification variables. A new mathematical formulation and solution methodology is developed for non-Newtonian solidification of an undercooled droplet. An enthalpy model is used to model the solidification process in an undercooled droplet from a single nucleation event occurring at its surface. A superimposed bispherical (rotational bipolar) coordinate system is used. Numerical solutions for the solidification of pure aluminum droplets based on the enthalpy model are developed, and their results are compared to the trends predicted from the Newtonian model.

400,966
PB85-143543 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Microstructures of Rapidly Solidified Aluminum Alloy Submicron Powders.
 Final rept.,
 C. G. Levi, and R. Mehrabian. 1982, 11p
 Pub. in Metallurgical Transactions, A: Physical Metallurgy and Materials Science 13, n 1 p13-23 Jan 82.

Keywords: *Aluminum alloys, *Microstructure, Metal powder, Nucleation, Reprints, Rapid solidification.

The microstructures of electron transparent submicron aluminum alloy powders produced by an electrohydrodynamic process are described. The observations are coupled with thermodynamic, kinetic and heat flow concepts to deduce the thermal history and solidification mode of the powders. The range of microstructures observed include: homogeneous plane front solidified single crystals; cellular crystals; and powders containing blocky segregates, multiple grains and twins.

400,967
PB85-143600 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Heat Flow Model for Surface Melting and Solidification of an Alloy.
 Final rept.,
 J. A. Sekhar, S. Kou, and R. Mehrabian. 1983, 9p
 Pub. in Metallurgical Transactions A 14, n6 p1169-1177 1983.

Keywords: *Heat transmission, Heat flux, Melting, Solidification, Aluminum alloys, Alloys, Numerical analysis, Enthalpy, Reprints.

The heat flow model previously developed for a pure metal is extended and applied to rapid surface melting and solidification of an alloy substrate over a range of temperatures. The substrate is subjected to a pulse of stationary high intensity heat flux over a circular region on its bounding surface. The finite difference form of the heat transfer equation is written in terms of dimen-

sionless nodal temperature and enthalpy in an oblate spheroidal coordinate system. A numerical solution methodology is developed for an alloy which precipitates a eutectic phase at the end of solidification. Generalized solutions are presented for an Al-4.5 wt% Cu alloy subjected to a uniform heat flux distribution over the circular region. Dimensionless temperature distributions, size and location of the 'mushy' zone and average cooling rate during solidification are calculated as a function of the product of absorbed heat flux, q , the radius of the circular region a and time.

400,968
PB85-143659 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Crystallization Kinetics Study of Amorphous Pd-Cu-Si by Ultrasonic Measurements.
 Final rept.,
 M. Rosen, H. N. G. Wadley, and R. Mehrabian. 1981, 6p
 Pub. in Scripta Metallurgica 15, n11 p1231-1236 1981.

Keywords: *Crystallization, Reaction kinetics, Ultrasonic tests, Nucleation, Palladium alloys, Copper containing alloys, Silicon containing alloys, Reprints, *Metallic glasses, Amorphous materials.

The objective of the investigation was to study the crystallization kinetics in Pd sub 0.775Cu sub 0.06Si sub 0.165 ribbons by means of laser-generated and piezoelectrically detected, ultrasonic waves whereby the extensional wave velocities, and consequently the Young moduli, could be determined with a high degree of accuracy. Corroborative evidence was obtained by means of optical metallography.

400,969
PB85-144400 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Effect of Passivation and Passivation Defects on Electromigration Failure in Aluminum Metallization.
 Final rept.,
 H. A. Schafft, C. D. Younkins, T. C. Grant, C. Y. Kao, and A. N. Saxena. 1984, 6p
 Pub. in Proceedings of 1984 Reliability Physics Symposium, Las Vegas, NV., April 3-5, 1984 p250-255.

Keywords: *Aluminum coatings, Passivity, Failure, Metallizing, Cracks, Reprints.

Metal line structures with intentional defects in the passivation, to simulate cracks or pin holes, were used in electromigration studies. Results show that the stress changes in the metallization caused by these defects are not as important as the restraining action of the passivation in affecting a metallization's resistance to electromigration failure. Also, the observed effects of restorative forces acting on the metallization suggests that continuous monitoring for open-circuit failure may be necessary to obtain an accurate measure of the mean-time-to-failure.

400,970
PB85-145233 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Review of Our Present Understanding of Macrosegregation in Axi-Symmetric Ingots.
 Final rept.,
 S. D. Ridder, R. Mehrabian, and S. Kou. 1981, 24p
 Pub. in Proceedings of Symposium Modeling of Casting and Welding Processes, Rindge, NH., August 3-8, 1980, p261-284 1981.

Keywords: *Ingots, *Separation, Castings, Nickel containing alloys, Tin containing alloys, Experimental data, Theories, Mathematical models, Fluid flow, Isotherms, Reprints.

Our present understanding of the mechanisms responsible for certain types of macrosegregation occurring in ESR, VAR and continuous cast ingots are reviewed. Experimental observations on both a high temperature alloy Ni-27 wt.% Mo and low temperature Sn-Pb alloys are compared to theoretical predictions. The mathematical models developed extend previous work by coupling the convective heat and fluid flow in the fully liquid metal pool above the liquidus isotherm to the interdendritic fluid flow responsible for macrosegregation.

11G. Miscellaneous Materials

400,971
PB84-244722 Not available NTIS
 National Bureau of Standards, Washington, DC.
Substituting Non-Metallic Materials for Vulnerable Minerals.
 Final rept.,
 D. H. Reneker. 1984, 6p
 Pub. in Materials and Society 8, n2 p195-200 1984.

Keywords: *Materials, Substitutes, Performance evaluation, Cost analysis, Design criteria, Polymers, Ceramics, Reprints.

Work, in cooperation with industry, in the Center for Materials Science of the National Bureau of Standards on the processing, microstructure, performance and properties of materials is described. Resulting information about materials allows designers and manufacturers to make informed choices about the use of advanced ceramics and polymers to minimize dependence on vulnerable minerals as well as to optimize cost and performance.

11H. Oils, Lubricants, and Hydraulic Fluids

400,972
PB84-167741 PC A06/MF A01
 National Bureau of Standards, Washington, DC. National Measurement Lab.
Friction and Wear Characteristics of Molecular Compound Classes from Lubricating Base Oils. Part 1. Separation and Chemical Characterization.
 S. M. Hsu, P. Pei, and R. S. Gates. Feb 84, 115p
 NBSIR-84-2821
 Sponsored in part by Oak Ridge National Lab., TN.

Keywords: *Lubricating oils, *Wear tests, *Friction factor, Separation, Chromatography, Molecular structure, Spectrochemical analysis, Chemical properties, Physical properties, Chemical analysis, Wear inhibitors, High performance liquid chromatography.

If the antiwear additives in oils provide antiwear performance, i.e. wear and friction control, as long as the additives remain in the system, then the natural polar structures in the base oil control the friction and wear failure. Identification of these polar fraction structures could provide a basis for model compounds selection. Therefore, the approach that we have chosen is to separate three lubricating base oils to provide basic structural information on the constituents in base oil that control friction and wear. After careful characterization of these compound classes, model compounds of various molecular structures will be used to measure their effects on friction and wear under different load/speed combinations.

400,973
PB84-226448 Not available NTIS
 National Bureau of Standards, Washington, DC.
Evaluation of Automotive Crankcase Lubricants by Differential Scanning Calorimetry.
 Final rept.,
 S. M. Hsu, A. L. Cummings, and D. B. Clark. Oct 82, 13p
 Pub. in Base Oils for Automotive Lubricants, p127-139 Oct 82.

Keywords: *Lubricants, *Crankcases, *Oxidation, Automobiles, Stability, Performance evaluation, Reprints, *Differential scanning calorimetry.

A laboratory bench test has been developed to examine the oxidation stability of crankcase lubricants using a high pressure power-compensation differential scanning calorimeter (DSC). Oxidation induction time measured at 175 C and 3.62 MPa (525 psia) oxygen pressure was used to rank eight ASTM sequence IIID engine test reference oils. The DSC result correlated with the viscosity increase tendencies of the reference oils as determined by the engine tests. The new test method is rapid and requires only microliter sample size for testing with good precision. The method employs a mixture of soluble metal catalysts consisting of lead, iron, copper, manganese and tin (82%, 7%, 4%, 3.5%, 3.5%) together with a synthetic oxidized high boiling gasoline fraction. This combination was found necessary to simulate some of the engine conditions and chemistry.

Field 11—MATERIALS

Group 11H—Oils, Lubricants, and Hydraulic Fluids

400,974

PB84-227347

Not available NTIS
National Bureau of Standards, Washington, DC.
Thin-Film Oxygen Uptake Test for the Evaluation of Automotive Crankcase Lubricants.

Final rept.,

C. S. Ku, and S. M. Hsu. Feb 84, 9p

Pub. in Jnl. of American Society of Lubrication Engineers 40, n2 p75-83 Feb 84.

Keywords: *Lubricants, *Crankcases, *Oxygen, Automobiles, Oxidation, Stability, Catalysts, Reprints.

A thin-film, oxygen absorption test has been developed for the evaluation of automotive lubricants using a standard Rotary Bomb Oxidation Test apparatus (RBOT) with simple modifications. The test measures the induction time of the lubricant under test conditions which simulate high temperature oxidation processes in automotive engines. Effects of oxidized fuel components and metal catalyses as well as the effect of hydrolysis on oil oxidation were considered. Test results on the ASTM engine sequence IID reference oils suggested qualitative correlation with engine viscosity increase data. Additional commercial oils were also tested and the results fell within the reference oil ranges.

400,975

PB84-235902

PC A14/MF A01

National Bureau of Standards (NML), Washington, DC.
Center for Analytical Chemistry.

Measurements and Standards for Recycled Oil-4. Proceedings of a Conference Held at the National Bureau of Standards, Gaithersburg, Maryland on September 14-16, 1982.

Final rept.,

D. A. Becker. Jul 84, 320p NBS/SP-674

See also PB84-235910 through PB84-236181 and PB-299951. Also available from Supt. of Docs as SN003-003-02595-0. Library of Congress catalog card no. 84-601070.

Keywords: *Meetings, *Standards, *Lubricating oils, Hydraulic fluids, Refining, Specifications, Petroleum products, Oils, Stability, *Waste recycling, *Oil wastes, Liquid wastes, Waste utilization.

This publication is a formal report of the fourth and last Conference on Measurements and Standards for Recycled Oil, held at the National Bureau of Standards on September 14 to 16, 1982. There were five sessions on specific subject areas, with a total of 28 presentations. This conference was designed to bring together all of the work by NBS and NBS cooperators on the development of test procedures for re-refined lubricating oil. This proceedings contains the entire texts of the various presentations, including figures and tables.

400,976

PB84-235910

(Order as PB84-235902, PC A14/MF A01)

Association of Petroleum Re-Refiners, Washington, DC.

Recent Factors Affecting the Oil Recycling Industry.

J. A. McBain. Jul 84, 2p

Included in Measurements and Standards for Recycled Oil-4, p5-6 1984.

Keywords: *Lubricating oils, Forecasting, Technology, *Waste recycling, *Waste utilization, *Oil wastes, Liquid wastes.

The topic--Recent Factors Affecting the Oil Recycling Industry is extremely broad, for more has happened in the past few years that affect this industry than has happened in the previous two decades. Oil recycling is not new. It dates back to the early 1900s. The industry and the use of re-refined oil grew rapidly. By the 1960s the industry contained almost 150 companies re-refining almost 300 million gallons of used oil per year, almost 18 percent of our nation's lubricating needs. By the late 1970s the industry had dwindled to less than 20 companies producing less than 100 million gallons of re-refined oil per year, or less than 10 percent of our lubricant needs. There are many reasons for the decline of the industry. A few are significant. The picture of an industry in change is not unique. It is no more than the process of industrial growth. But in the case of the oil recycling industry, technological growth was stunted by several limiting government actions. If the past three years were positive, the next few years should prove to be even more dramatic. Technology will experience advancement, and re-refining equip-

ment will become more sophisticated. New companies will be entering the field and more of industry will be discovering the hidden asset in the reuse of oil. Whatever the changes, Association of Petroleum Re-Refiners (APR) will be involved, actively working on behalf of the industry. Working together, they further shape the legislative and regulatory environment in which the entire industry can prosper.

400,977

PB84-235928

(Order as PB84-235902, PC A14/MF A01)

California State Solid Waste Management Board, Sacramento.

California Used Oil Recycling Program.

G. W. Moskat. Jul 84, 5p

Included in Measurements and Standards for Recycled Oil-4, p7-11 1984.

Keywords: *Hazardous wastes, *Regulations, *Lubricating oils, California, *Waste recycling, *Oil wastes, Liquid wastes.

Used oil in California is classified as a hazardous waste material subject to the regulatory overview of many agencies. Because of its classification as such, used oil is regulated by the State Department of Health Services (DOHS), and subject to manifesting and vehicle registration requirements; the Air Resources Board (ARB), who regulates emission levels and hydrocarbon emissions from processing plants and fuel oil burners; the Regional Water Quality Control Boards who monitor oil disposal operations; the California Highway Patrol, who performs vehicle inspections of the hauling industry; and the State Solid Waste Management Board (SWMB), who regulates used oil recycling activities in the state. This report will focus upon the latter area of used oil recycling, and the program California has developed to effectively monitor the disposition of over 50.6 million gallons of used oil collected and recycled each year in the state. In addition, the author will discuss the efforts the state has made to promote the concept of oil recycling through public awareness and marketing activities.

400,978

PB84-235936

(Order as PB84-235902, PC E14/MF A01)

Department of Energy, Bartlesville, OK. Bartlesville Energy Technology Center.

Fate of Hazardous Wastes in Used Oil Recycling.

D. W. Brinkman, P. Fennelly, and N. Suprenant. Jul 84, 14p

Prepared in cooperation with GCA Corp., Bedford, MA.

Included in Measurements and Standards for Recycled Oil-4, p13-26 1984.

Keywords: *Hazardous materials, *Chemical analysis, Lubricating oils, Sampling, Oil wastes, *Waste recycling, *Path of pollutions, *Liquid waste disposal, Liquid wastes.

While it is known that used lubricating oils often contain one or more of the EPA priority pollutants, and it can be shown that this contamination frequently is introduced after the oil has been taken out of service, very little documentation exists on what happens to these hazardous species when the used oil is dumped, burned raw, or recycled. GCA Corporation has been working under contract to the U.S. Department of Energy, Office of Industrial Programs to (1) determine which hazardous contaminants tend to show up frequently in used oils, and (2) experimentally demonstrate the fate of these contaminants under number of scenarios. The scenarios under examination include dumping the used oil down a sewer, road oiling, open burning (no controls), reprocessing for fuel, and re-refining for use as lubricating oil basestock using several different methods. Because chemical analysis of samples is still in progress, the results shown in this paper are not complete and some data may be subject to further verification and possible modification.

400,979

PB84-235944

(Order as PB84-235902, PC A14/MF A01)

National Bureau of Standards (NML), Washington, DC.
Center for Analytical Chemistry.

Analysis of PCBs (Polychlorinated Biphenyls) in Oil: Technique and SRM (Standard Reference Material) Development.

R. M. Parris, F. R. Guenther, W. E. May, and S. N.

Chesler. Jul 84, 6p

Included in Measurements and Standards for Recycled Oil-4, p27-32 1984.

Keywords: *Lubricating oils, *Chemical analysis, Chlorine organic compounds, Sampling, Additives, Hazardous materials, *Oil wastes, *Polychlorinated biphenyls, *Liquid wastes, Aroclors, Electron capture detectors, Hall electrolytic conductivity detection, Waste recycling.

Polychlorinated biphenyls, PCBs, are toxic, persistent, global environmental contaminants. PCBs were formulated as complex mixtures of congeners and were manufactured until 1977 in the United States under the trade name of Aroclor. These mixtures have been extensively used in this country in high-voltage electrical components and may be introduced into the environment when these components are serviced, repaired or discarded. Since the PCB fluid physically resembles lubricating oils, there have been instances in which PCBs have been added to motor oils being collected for recycling purposes. An estimated 750 million pounds of PCBs are still in service in the United States. The use, transport and disposal of PCBs is regulated by the Environmental Protection Agency under the auspices of the Toxic Substances Control Act. Cairns and Siegmund recently reviewed the regulatory history and toxicity of PCBs and identified some of the problems of PCB analysis. Samples of used motor oil containing a wide range on concentrations and types of PCB contamination have been analyzed using this method; both electron capture (ECD) and Hall electrolytic conductivity detection (HECD) have been used. The ECD was found to be more sensitive than the HECD (by two orders of magnitude) and easier to maintain in a non-contaminated state. The HECD has a wider linearity range and is more selective because it responds only to halogenated compounds.

400,980

PB84-235951

(Order as PB84-235902, PC A14/MF A01)

National Bureau of Standards (NML), Washington, DC.
Recycled Oil Program.

Analysis for PCBs (Polychlorinated Biphenyls) in Oil: The NBS/ASTM (National Bureau of Standards/American Society of Testing and Materials) Round Robin.

D. A. Becker. Jul 84, 9p

Included in Measurements and Standards for Recycled Oil-4, p33-41 1984.

Keywords: *Lubricating oils, *Chemical analysis, Sampling, Concentration(Composition), Chlorine organic compounds, *Oil wastes, *Polychlorinated biphenyls, *Waste recycling, Aroclors, Liquid wastes.

Early in 1982, a cooperative effort on the analysis of polychlorinated biphenyls (PCBs) in lubricating oil was initiated by the National Bureau of Standards (NBS) Recycled Oil Program and the American Society of Testing and Materials (ASTM), Technical Division P. The primary purpose of this cooperative effort was to help provide the necessary information and data to identify an accurate, relatively simple method for the determination of PCBs in used and re-refined lubricating oils. If identified, such a method could be developed into an ASTM Standard Method. A secondary purpose was to assist oil recyclers to identify an appropriate analytical methodology which could be utilized to obtain reliable PCB analyses in these types of samples. This paper is a further update on the progress and results obtained in this study, and supplements information provided previously at ASTM meetings.

400,981
PB84-235969

(Order as PB84-235902, PC A14/MF A01)
California Dept. of Food and Agriculture, Sacramento.
Lube Oil Monitoring in the State of California,
J. N. Johnson. Jul 84, 3p
Included in Measurements and Standards for Recycled Oil-4, p43-45 1984.

Keywords: *Lubricating oils, *Regulations, California, Petroleum products, Labeling, Standards, Industrial plants, *Consumer products, Monitoring.

Lubricating oils are a unique commodity to the consumer. Few people, if any, can distinguish between grades or brands by touch, sight or smell. Unlike many other commodities, its sale and delivery into a vehicle is final in the sense that there is no practical way for the motorist to return or exchange the product if dissatisfied. The brand and labeling statements are principal factors in its presentation to the public. Therefore, the interests of the consumer are of primary importance in the assurance of stated quality. This is a vital factor in the monitoring and surveillance of lube oils. Of equal importance to consumer concerns, is the assurance that the lubricating oil industry competes in a marketplace where equity prevails and where unfair advantage is not gained through misleading and unfair business practices. The California Petroleum Products Program maintains a lubricating oil monitoring program to serve both the consumer and industry alike. State Petroleum Laboratories are located in Downey (Los Angeles) and Sacramento. Investigative staff work is conducted out of five regional offices that are strategically located throughout the State. Individual county weights and measures departments (56 counties) participate in joint enforcement of laws and regulations pertaining to petroleum in varying degrees.

400,982
PB84-235977

(Order as PB84-235902, PC A14/MF A01)
Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.
Revision of the MIL-L-2104C Specification,
T. C. Bowen. Jul 84, 3p
Included in Measurements and Standards for Recycled Oil-4, p47-49 1984.

Keywords: *Lubricants, *Standards, Specifications, Refining, Performance evaluation, Military vehicles, Chemical properties, *Oil wastes, *Waste recycling, *MIL-L-2104C oils, Liquid wastes.

This paper will present the Army's activities in upgrading Military lubricant specifications to allow the use of re-refined materials. Although primary emphasis will be placed on the proposed revision to specification MIL-L-2104C, it also provides an update relative to actions taken with other automotive lubricant specifications.

400,983
PB84-235985

(Order as PB84-235902, PC A14/MF A01)
National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
Correlation Aspects of a Virgin and a Re-Refined Engine Oil Containing the Same Additives,
P. L. Strigner. Jul 84, 10p
Included in Measurements and Standards for Recycled Oil-4, p51-60 1984.

Keywords: *Lubricating oils, *Additives, Standards, Comparison, Petroleum products, Field tests, Viscosity, Physical properties, Oxidation, Refining, *Oil wastes, Engine tests, Liquid wastes.

Over a three year period commencing early in 1979, Environment Canada and the National Research Council of Canada carried out comprehensive comparative testing of a re-refined-base and a virgin-base automotive engine oil, both containing the same additive package, i.e., the only difference between the two being the base oil. Both oils were formulated to meet API service classification SE and SAE viscosity classification 20W-40 requirements. The virgin-base engine oil, being a commercial formulation, was regarded as the reference oil while the re-refined-base engine oil, being an 'experimental' formulation, was assessed for its potential use as a viable engine oil based on its comparative performance to the virgin-base engine oil. The ultimate objective of the exercise, supplemented by future testing of other formulations, was to determine the suitability of re-refined-base engine oils for use in government vehicles.

400,984
PB84-235993

(Order as PB84-235902, PC A14/MF A01)
Southwest Research Inst., San Antonio, TX. Army Fuels and Lubricants Research Lab.
Development of Methodology for Engine Deposit Characterization,
K. B. Kohl, and E. A. Frame. Jul 84, 13p
Included in Measurements and Standards for Recycled Oil-4, p61-73 1984.

Keywords: *Lubricating oils, Regulations, Refining, National government, Fuels, *Oil wastes, *Waste recycling, Liquid wastes, Resource Conservation and Recovery Act, Fuel substitutes.

More than two billion gallons of lubricating oils are used each year in the United States. Approximately 50 percent of this total is consumed or otherwise lost during use. The remaining one billion gallons per year of the used lubricating oil are a significant and valuable resource. With proper re-refining treatment, used oil can be utilized as a fuel, or, more importantly, it can be reused as a lubricant or lubricant basestock. The U.S. government has enacted important legislation in recent years to encourage the utilization of this valuable natural resource.

400,985
PB84-236009

(Order as PB84-235902, PC A14/MF A01)
Franklin Research Center, Philadelphia, PA.
Development of a Bench Engine Screening Test for Motor Oils,
D. Heath. Jul 84, 9p
Included in Measurements and Standards for Recycled Oil-4, p75-83 1984.

Keywords: *Lubricating oils, Specification, Performance evaluation, *Oil wastes, *Waste recycling, *Engine tests, Liquid wastes.

This presentation is a status report of a cooperative project funded by the U.S. Army MERADCOM, NBS, and the Franklin Research Center. The initial phase of the project, the feasibility demonstration, will be completed within the next several weeks. The theme of this conference was so in line with our project that the author planned this presentation knowing that the initial test results might not be in-hand for today. The title, when the terms are explained, denotes the general concept which we are pursuing: specifically, to provide a screening tool for the Sequence V-D Test, and which may later be adapted to the other multicylinder and single cylinder oil specification engine tests.

400,986
PB84-236017

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Recycled Oil Program.
ASTM/NBS (American Society of Testing and Materials/National Bureau of Standards) Basestock Consistency Study,
D. A. Becker. Jul 84, 8p
Included in Measurements and Standards for Recycled Oil-4, p85-92 1984.

Keywords: *Lubricating oils, *Standards, Refining, Petroleum products, Sampling, Chemical analysis, Performance evaluation, Rheology, Physical properties, Chemical properties, Oxidation, Wear tests, *Oil wastes, *Waste recycling, Liquid wastes, Engine tests.

The ASTM/NBS Basestock Consistency Study was initiated in 1980 and completed in 1983. Its purpose was to help provide the technical data base required for the NBS Recycled Oil Program. In the study, six re-refined and four virgin lubricating oil basestocks were obtained monthly from different manufacturers. These oils, along with control samples, were characterized by 14 cooperating laboratories with over 50 different tests yielding over 65 different values per oil sample. The results and data analyses are compiled in a 500 page report, and are thought to be the most comprehensive ever obtained on lubricating oil basestocks.

400,987
PB84-236025

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Chemical Stability and Tribology Group.
Multiple Regression Analysis: A Look Inside the ASTM/NBS (American Society of Testing and Materials/National Bureau of Standards) BCS (Basestock Consistency Study) Data,
S. J. Weeks, and S. M. Hsu. Jul 84, 2p
Included in Measurements and Standards for Recycled Oil-4, p93-94 1984.

Keywords: *Lubricating oils, *Regression analysis, Rheology, Physical properties, Chemical properties, Hydrocarbons, Performance evaluation, Sampling, Wear tests, Oxidation, *Oil wastes, *Waste recycling, Liquid wastes, Engine tests.

The ASTM/NBS Basestock Consistency Study was designed to assess the consistency of re-refined lubricating basestocks. Historically, the quality of a lubricant is defined by the ASTM engine sequence tests. For virgin base oils, the crude source and refining process are required to remain constant for quality control of the finished product. Concerns arose over the variability of the base oil when used oils were used as the feedstock for re-refining. These concerns necessitated a new evaluation of the consistency criteria for re-refined oils. The goal of the BCS work was to assess the consistency of re-refined base oils in comparison to corresponding characteristics of virgin base oils. The BCS compiled data of samples submitted monthly from four virgin and six re-refined base oil products. These samples were analyzed over a 13 month period by 14 cooperative laboratories. Over 55 tests were performed by more than one laboratory. The tests were grouped into six categories: (1) rheology; (2) physical properties; (3) chemical properties; (4) hydrocarbon type analyses; (5) general performance tests, and (6) oxidation and wear bench tests. Statistical methods were used to evaluate the significance of the BCS data.

400,988
PB84-236033

(Order as PB84-235902, PC A14/MF A01)
Amoco Chemicals Corp., Naperville, IL.
Consistency of Virgin Basestocks,
H. S. Golinkin. Jul 84, 14p
Included in Measurements and Standards for Recycled Oil-4, p95-108 1984.

Keywords: *Lubricating oils, *Viscosity, *Chemical analysis, Refining, Lubricants, Trends, Graphs(Charts), *Oil wastes, *Waste recycling, Liquid wastes.

The two main areas of concern in discerning the equivalency of re-refined and virgin lubricants are the establishment of criteria for evaluating re-refined and virgin basestocks, and the determination of variances that can be tolerated. As a supplier of additives to the lubricant industry, Amoco Chemicals Corporation receives many basestock samples each year. This paper will attempt to show the limits of variability observed for six broad viscosity grades of virgin basestocks over a seven-year period. Certain trends over this period are indicated. Single basestock variability from three suppliers will also be examined.

400,989
PB84-236041

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Tribochemistry Group.
Evaluation of Test Methods for Physical Properties of Re-Refined Lubricating Base Oils,
S. J. Weeks, and S. M. Hsu. Jul 84, 15p
Included in Measurements and Standards for Recycled Oil-4, p109-123 1984.

Keywords: *Lubricating oils, *Physical properties, *Standards, Refining, Revisions, Gas chromatography, Petroleum products, Performance evaluation, Refractivity, Viscosity, Molecular weight, Boiling point, Density(Mass/volume).

ASTM standard test methods for determining physical characteristics of lubricating oil basestocks were selected, applied to re-refined base oils, and the results evaluated. The test methods evaluated were: color, viscosity, pour point, API gravity, density, flash point, boiling range distribution by gas chromatography, and

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Group 11H—Oils, Lubricants, and Hydraulic Fluids

refractive index. In addition, some properties derived from the above measurements were calculated. These included viscosity index, carbon distribution and structural group analysis by the n-d-M method, average molecular weight, and the viscosity-gravity constant. The evaluated test procedures were applied to most of the currently existing, commercially-available re-refined base oils. All of these standard test procedures except three were found to be acceptable when used with re-refined base oils. Modifications to the density, boiling range distribution and refractive index test methods were developed which made them acceptable for use with re-refined base oils. These modifications are described.

400,990
PB84-236058

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Chemical Stability and Tribology Group.
Evaluation of Chemical Property Test Methods for Re-Refined Lubricating Base Oils,
A. L. Cummings, P. Pei, and S. M. Hsu. Jul 84, 14p
Included in Measurements and Standards for Recycled Oil-4, p125-138 1984.

Keywords: *Lubricating oils, *Standards, *Chemical properties, Revisions, Saponification, Refining, Petroleum products, *Oil wastes, Liquid wastes, Total acid number, Total base number, Total nitrogen.

Several standard test methods measuring chemical properties of lubricants were evaluated for use on re-refined lubricating basestocks. The methods evaluated included total acid number (TAN), total base number (TBN), total nitrogen, basic nitrogen, saponification number, and water. Except for the TAN and basic nitrogen test methods, some modifications were necessary for the test methods when applied to re-refined base oils. The evaluation and the modifications for each test method are described.

400,991
PB84-236066

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Chemical Stability and Tribology Group.
Evaluation of Ashing Methods for the Determination of Total Metal Content of Lubricating Oil Basestocks,
J. J. Comford, and S. M. Hsu. Jul 84, 16p
Included in Measurements and Standards for Recycled Oil-4, p139-154 1984.

Keywords: *Lubricating oils, *Metals, *Chemical analysis, *Ash content, Magnesium, Lead(Metal), Petroleum products, Revisions, Trace elements, *Oil wastes, *Waste recycling, Liquid wastes.

Ash from a petroleum oil is the residue, free of carbonaceous material, remaining after burning and ignition in air at a specified high temperature. Ash content of a re-refined oil provides a method for the determination of total metals resulting from wear or additive metals remaining after re-refining. Three ashing methods were evaluated for metal retention to ensure that the ash value reflects an oil's total metal content, including such metals as magnesium and lead which are volatile under the ashing conditions. The sulfated ash method (ASTM D874) was found to have good metal retention properties, and was modified to improve its precision in the low ash range.

400,992
PB84-236074

(Order as PB84-235902, PC A14/MF A01)
Pennsylvania State Univ., University Park. Dept. of Chemical Engineering.
Development and Use of the Microoxidation Test with Crankcase Oils,
E. E. Klaus, P. Shah, and V. Krishnamachar. Jul 84, 13p
Included in Measurements and Standards for Recycled Oil-4, p155-167 1984.

Keywords: *Lubricating oils, *Crankcases, *Oxidation, Comparison, Refining, Petroleum products, Molecular weight.

The Penn State microoxidation test has been used to evaluate a wide variety of mineral oil and synthetic lubricants. Techniques have been developed to use this test to study basestocks and finished formulations under bulk system and concentrated contact conditions. The microoxidation test also has been modified and adapted for use with re-refined and virgin base

oils. This paper covers three specific projects. First, a modified microoxidation evaluation using steel and copper catalyst test cups has been used to provide a comparison of virgin and re-refined base oils. Second, conventional microoxidation tests have been used to evaluate fractions separated chromatographically from virgin and re-refined base oils. Some fractions were produced by gravity percolation through a silica gel column and others by an HPLC separation on a column with packing similar to that from the gravity system. Third, a set of microoxidation test conditions have been developed to give good correlation with formulated mineral oil lubricants in the 3C and 3D engine sequence test.

400,993

PB84-236082

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Metallurgy Div.

Evaluation of a Modified Timken Test for the Characterization of Motor Oils,
L. K. Ives, P. A. Boyer, and A. W. Ruff. Jul 84, 14p
Included in Measurements and Standards for Recycled Oil-4, p169-182 1984.

Keywords: *Lubricating oils, *Wear tests, Revisions, Refining, Loads(Forces), Performance evaluation, Laboratory equipment, *Timken test, *Oil wastes, *Waste recycling, Engine tests, Liquid wastes.

A modified version of the Timken method, ASTM D2782, for the determination of the load carrying capacity of lubricating fluids is described and evaluated. The modified method differs from the standard method primarily in that a very small volume of oil (0.2 ml) is used. The evaluation procedure consisted of applying the modified Timken method to a series of IID engine sequence test reference oils having known performance characteristics. Good correlation was obtained between the modified Timken test results and documented IID engine sequence test can plus lifter wear values. A similar correspondence was also found for VD engine sequence test reference oils. Good correlation with service data was obtained when the modified Timken method was applied to Royal Canadian Mounted Police Field Trial Oils. Results are also presented on the application of the method to commercial SF motor oils and to the determination of additive response of re-refined base oils.

400,994

PB84-236090

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Chemical Stability and Tribology Group.

Development of a Step Loading Seizure Test for Engine Oil Additive Response,
R. S. Gates, and S. M. Hsu. Jul 84, 12p
Included in Measurements and Standards for Recycled Oil-4, p183-194 1984.

Keywords: *Lubricating oils, *Additives, *Wear inhibitors, Loads(Forces), Performance evaluation, Wear tests, Oxidation, Stability, Engine tests.

Additive response measures the effect of base oils on the performance of an additive or combination of additives. This study is concerned with measuring the effect of basestock composition on antiwear performance of oils with an SE/CC additive package. A step loading seizure test procedure using a four-ball wear tester was developed to measure the antiwear additive response of eighteen base oils. The procedures examined were: a step loading seizure test, and a thin film step loading seizure test with six microliters sample volume. The latter procedure combines oxidation and wear in a single test. Both test procedures have been shown to relate to engine wear experience. The conventional (10 ml) step loading seizure test procedure was found capable of measuring additive response only a very low additive concentrations. The micro-sample step loading seizure test procedure was able to measure differences in additive response among the base oils at the normal treat rate of 8.0 percent (wt.) additive package.

400,995

PB84-236108

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Tribochemistry Group.

Differential Scanning Calorimetry Test Method for Oxidation Stability of Engine Oils,
S. M. Hsu, A. L. Cummings, and D. B. Clark. Jul 84, 14p
Included in Measurements and Standards for Recycled Oil-4, p195-208 1984.

Keywords: *Lubricating oils, *Crankcases, *Oxidation, Chemical stabilization, Performance evaluation, Degradation, Chemical reactions, Thermochemistry, Chemical reactions, *Differential scanning calorimetry, *Oil wastes, *Waste recycling, Chemical reaction mechanisms, Liquid wastes.

A laboratory bench test has been developed which measures oxidation stability of automotive crankcase lubricants under simulated engine conditions. The test employs a high-pressure, differential scanning calorimeter (DSC) to measure oxidation induction times in thin-film oil samples at 175C in 3.6 MPa oxygen. Engine chemistry is simulated by mixing the oil sample with oil-soluble metal naphthanates and oxidized nitrated gasoline. The DSC test ranks the relative oxidation stability of seven ASTM engine sequence IID reference oils in the same order as the engine test does. The bench test requires less than an hour's time to perform, uses only 1 mg of sample, with an average 6 percent repeatability. Details of method development are discussed elsewhere. A copy of the paper is included as an appendix to this abstract.

400,996

PB84-236116

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC. Chemical Kinetics Div.

Comparative Response of Re-Refined and Virgin Lube Oils to Additives by DSC (Differential Scanning Calorimetry),
J. A. Walker, W. Tsang, and L. Szegvary. Jul 84, 13p
Included in Measurements and Standards for Recycled Oil-4, p209-221 1984.

Keywords: *Lubricating oils, *Additives, *Antioxidants, Refining, Comparison, Petroleum products, Stability, Thermochemistry, *Differential scanning calorimetry, *Oil wastes, High pressure differential scanning calorimetry, Liquid wastes.

Earlier studies have demonstrated the capability of high pressure differential scanning calorimetry (HPDSC) for determining the propensity towards auto-oxidation of lubricating oils. This report is an extension of previous work and is focused on the following issues: (a) The consistency of basestocks produced over the course of a year, with special reference to the similarities and differences between re-refined and virgin basestocks. (b) The effect of the various components in the additive mixture on the intensity and time of response. (c) The response of various fractions of the basestocks to a particular additive. (d) The response of basestocks to different additive packages.

400,997

PB84-236124

(Order as PB84-235902, PC A14/MF A01)
Auburn Univ., AL. Dept. of Chemical Engineering.
Kinetic Studies for Waste Oil Demetallization,
A. R. Tarrer, R. Sachhathep, D. L. Vives, and L. J. Hirth. Jul 84, 17p
Included in Measurements and Standards for Recycled Oil-4, p223-239 1984.

Keywords: *Reaction kinetics, *Lubricating oils, Refining, Catalysts, Hydrogenation, Mathematical models, *Oil wastes, *Waste utilization, Liquid wastes, Ammonium phosphates, Numerical solution.

Research in waste oil re-refining was begun at Auburn University in January 1982. Major emphasis was placed on the development of kinetic parameters for demetallization using dibasic ammonium phosphate (DAP). In addition, studies were conducted in the area of hydrogenation accompanied by demetallization of waste oil using three types of guard catalysts. Thermal demetallization was also briefly investigated. The data obtained in the laboratory was used in the design fabrication and operation of a small re-refining unit recently started up in the Auburn area. Currently, the final prod-

uct is a high quality fuel oil obtained at a capacity of 200,000 gallons/year. Future plans entail the addition of hydrotreating unit for the production of a high quality lube oil basestock. The experimental findings at Auburn will be of aid in the characterization of waste oils in terms of kinetic behavior and the prediction of operative parameters for their processing.

400,998
PB84-236132

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC.
Tribology Group.
Re-Refined Lubricating Base Oil Characterization Using Liquid Chromatographic Techniques,
P. Pei, and S. M. Hsu. Jul 84, 15p
Included in Measurements and Standards for Recycled Oil-4, p241-255 1984.

Keywords: *Lubricating oils, *Chemical analysis, Refining, Separation, Chromatographic analysis, Petroleum products, Impurities, Hydrocarbons, Infrared spectroscopy, Mass spectroscopy, Performance evaluation, *Oil wastes, *Waste recycling, Liquid wastes, Differential scanning calorimetry.

A separation scheme to characterize lubricating base oils in terms of molecular compound classes has been developed with the purpose of isolating and analyzing impurities in a re-refined base oil. The lubricating base oil is first separated into three major fractions--saturates, aromatics, and polars--using clay-gel liquid chromatography. The polars fraction is separated further into chemical compound classes having different polarities and functional structures. Analytical methods such as infrared and mass spectroscopy were used to elucidate the fundamental structures of the major fractions and compound classes in the polars subfractions. The saturate fraction consists mainly of paraffinic and cyclic paraffinic compounds. The aromatic fraction is composed of mono-, di-, and tri-aromatic compounds. Both poly-nuclear aromatic compounds and hydrocarbons with heteroatoms such as sulfur, halogen, and oxygen are present in the polar fraction.

400,999
PB84-236140

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC.
Chemical Stability and Tribology Group.
Evaluation of ASTM (American Society of Testing and Materials) D2007 Method for the Determination of Lubricating Oil Composition,
C. S. Ku, P. Pei, and S. M. Hsu. Jul 84, 13p
Included in Measurements and Standards for Recycled Oil-4, p257-269 1984.

Keywords: *Lubricating oils, *Chemical analysis, Hydrocarbons, Petroleum products, Refining, Viscosity, Separated, Solvent extraction, Infrared spectroscopy, Chromatographic analysis, *ASTM D2007 method, *Oil wastes, Liquid wastes, Procedures.

ASTM D2007, 'Characteristic Groups in Rubber Extender and Processing Oils by the Clay-Gel Adsorption Chromatographic Method,' and its variations are evaluated for lubricating base oils, both virgin and re-refined. The results are compared with the n-d-M method (refractive index, density, and molecular weight) and low resolution mass spectroscopy. ASTM D2007 is found to be acceptable for use with lubricating base oils, offering a rapid analytical procedure for classifying both virgin and re-refined base oils of various viscosity grades. Hydrocarbon types such as polar compounds, aromatics, and saturates are separated and characterized.

401,000
PB84-236157

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC.
Chemical Stability and Tribology Group.
Test Methods for Total Chlorine in Lubricating Base Oils,
P. Pei, R. Fleming, and S. M. Hsu. Jul 84, 15p
Included in Measurements and Standards for Recycled Oil-4, p271-285 1984.

Keywords: *Lubricating oils, *Chlorine, *Trace elements, *Chemical analysis, Refining, Petroleum products, Quality control, *Oil wastes, Liquid wastes.

Chlorine in trace quantities usually can be found in re-refined lubricating base oils. While the effects of chlorine on performance is not clear at this time, a method to measure chlorine accurately as a means of quality

control is needed. Five analytical methods for the determination of chlorine in lubricating base oils were studied. They are: ASTM D-808, an oxygen bomb method; ASTM D-1317, a sodium alcoholate method; the Microcoulometric Titration method (MCT); X-ray Fluorescence (XRF); and Neutron Activation Analysis (NAA). The first three methods (ASTM D808, D1317, and MCT) are not specific for chlorine but are generally used for chlorine measurement assuming that halogens other than chlorine are absent. The last two methods (XRF and NAA) are chlorine specific.

401,001
PB84-236165

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC.
Tribology Group.
Thin-Film Oxygen Uptake Test for the Evaluation of Automotive Lubricants,
C. S. Ku, and S. M. Hsu. Jul 84, 10p
Included in Measurements and Standards for Recycled Oil-4, p287-296 1984.

Keywords: *Lubricating oils, *Automobiles, *Crankcases, Lubricants, High temperature tests, Revisions, Laboratory equipment, Viscosity, Oxidation, Catalysts, *Thin film oxygen absorption test, Rotary bomb oxidation test apparatus, Engine tests.

A thin-film, oxygen absorption test has been developed for the evaluation of automotive lubricants using a standard Rotary Bomb Oxidation Test apparatus (RBOT) with simple modifications. The test measures the induction time of the lubricant under test conditions which simulate high temperature oxidation process in automotive engines. Effects of oxidized fuel components and metal catalyses as well as the effect of hydrolysis on oil oxidation were considered. Test results on the ASTM engine sequence IIID reference oils suggested qualitative correlation with engine viscosity increase data. Additional commercial oils were also tested and the results fell within the reference oil ranges. The paper has been published elsewhere and a copy of the paper is included as an appendix to this abstract.

401,002
PB84-236173

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC.
Chemical Stability and Tribology Group.
Thin-Film Oxidation Test: Relationship between Composition and Additive Response for Re-Refined Oils,
C. S. Ku, and S. M. Hsu. Jul 84, 12p
Included in Measurements and Standards for Recycled Oil-4, p297-308 1984.

Keywords: *Lubricating oils, *Additives, *Chemical analysis, Refining, Oxidation, Stability, Chemical stabilization, Hydrocarbons, Performance evaluation, Specifications, Standards, *Oil wastes, *Thin film oxygen absorption test, Engine tests.

Sixteen re-refined lubricating base oils from various manufacturing processes were examined for oxidation stability using a NBS thin film oxygen uptake test. The oils were tested with a commercial SE/CC detergent-inhibitor additive package. Correlations among oxidation stability and chemical composition parameters such as saturates, aromatics, polars, sulfur, chlorine, and total nitrogen content were investigated. The key components that appear to affect oxidation stability of re-refined base oils were found to be sulfur, total polar constituents and percent of saturated hydrocarbons.

401,003
PB84-236181

(Order as PB84-235902, PC A14/MF A01)
National Bureau of Standards (NML), Washington, DC.
Recycled Oil Program.
NBS (National Bureau of Standards) Provisional Tests for Re-Refined Engine Oil,
D. A. Becker, and S. Hsu. Jul 84, 9p
Included in Measurements and Standards for Recycled Oil-4, p309-317 1984.

Keywords: *Lubricating oils, *Standards, *Specifications, Refining, Additives, Crankcases, Performance evaluation, *Oil wastes, *Waste recycling, Engine tests, Liquid wastes, Waste utilization.

In Section 383(c) of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6363(c)), the Congress of the United States stated the following: 'As soon as practicable after the date of enactment of this Act, the

National Bureau of Standards shall develop test procedures for the determination of substantial equivalency of re-refined or otherwise processed used oil or blend of oil, consisting of such re-refined or otherwise processed used oil and new oil or additives, with new oil for a particular end use.' The National Bureau of Standards (NBS) completed test procedures for recycled oil used as burner fuel in 1978. This present paper, together with other papers delivered at this conference and in other publications, summarizes NBS efforts to provide a coherent methodology for establishing the substantial 'equivalency between re-refined and virgin engine crankcase oils. Further, this paper describes a set of proposed provisional test procedures which can be used to establish the consistency of re-refined engine crankcase oil.

401,004

PB84-242916 Not available NTIS
National Bureau of Standards, Washington, DC.
Interactions of Additives and Lubricating Base Oils.
Final rept.,
S. M. Hsu, and R. S. Lin. 1983, 9p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in SAE (Society of Automotive Engineers) Technology Paper 831683, p51-59 1983.

Keywords: *Lubricating oils, *Additives, *Crankcases, Dispersants, Detergents, Oxidation, Stability, Antioxidants, Temperature, Reprints.

Automotive lubricating oils consist of base oils and a variety of chemical additives. In this study, interactions among an antioxidant (ZDDP), a dispersant (succinimide), and a detergent (calcium sulfonate) are studied in terms of oxidation stability. Oxidation tests were conducted at 60C and 160C using the free radical titration test and the thin film oxygen uptake test respectively. Complex chemical interactions in terms of oxidation stability were found among the additives, as well as the additives with the polar species in the base oil. Optimum oxidation concentrations for some of the additives were observed. The effects of temperatures on the interaction were also described.

401,005

PB85-100360 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Aromatic Impurities on the Positive Streamer Growth in Marcol 70.
Final rept.,
R. E. Hebner, E. F. Kelley, G. J. FitzPatrick, and E. O. Forster. Jun 84, 4p
Pub. in Proceedings of 1984 IEEE International Symposium on Electrical Insulation, Montreal, Canada, June 11-13, 1984, p284-287.

Keywords: *Insulation, *Impurities, *Electrical faults, Dielectric properties, Insulating oil, *Aniline/dimethyl, *Marcol 70 fluids.

The growth of positive streamers has been photographed in Marcol 70 in the presence and the absence of dimethylaniline (DMA). Marcol 70 is a fluid which is chemically similar to transformer oil but with the aromatic components removed. This combination has been studied previously by other authors, and was chosen for this work, because it should provide useful information on the contribution of aromatic components to the electrical properties of transformer oil. As in earlier studies, it was noted that the positive streamers initially propagate at or near sonic speed. After the streamer has propagated some distance across the inter-electrode gap, a supersonic secondary streamer develops that leads to breakdown. The initiation of this second event is significantly delayed by DMA. As in earlier studies in n-hexane, the reason for this behavior is assumed to be structural changes in the streamers because of the low ionization potential of DMA. These structural changes, in turn, lead to a modification of the electric field distribution between the positive streamer tips and the plane cathode. Information derived from the photographs suggests that the field distribution changes from a very nonuniform to a more uniform one, which would lead to the observed higher breakdown voltages. The data presented are not in complete agreement with those reported in the literature. This disagreement is believed to be attributable to experimental differences.

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401,006

PB85-104867 Not available NTIS
National Bureau of Standards, Washington, DC.
Response of Carbon Black Filled Butyl Rubber to Cyclic Loading.
Final rept.,
G. B. McKenna, and L. J. Zapas. 1981, 16p
Pub. in Rubber Chemistry and Technology 54, n4
p718-733 Sep-Oct 81.

Keywords: *Carbon black, *Butyl rubber, *Creep properties, Stress relaxation, Viscoelasticity, Failure, Loads(Forces), Reprints, BKZ theory.

Derham and Thomas recently reported on the creep behavior of a carbon black filled natural rubber under load-unload cycling. They found that, contrary to what would be expected for a linear viscoelastic material, the rate at which the material creeps is greater under cyclic loading than under static loading conditions. In order to further study this phenomenon of stress softening, the authors conducted stress relaxation and creep experiments under static and cyclic loading conditions. In order to analyze the data they used the BKZ single integral nonlinear constitutive equation of Bernstein, Kearsley and Zapas. The results show that the softening effect in cyclic stress relaxation experiments is not very large but that under cyclic creep conditions (at similar levels of deformation) the softening is quite emphatic.

11I. Plastics

401,007

PB83-204818 PC A03/MF A01
National Bureau of Standards, Boulder, CO.
Tensile, Compressive, and Shear Properties of A 64-kg/m³ Polyurethane Foam at Low Temperatures,
J. M. Arvidson, L. L. Sparks, and Chen Guobang.
Feb 83, 34p NBSIR-83-1684
Sponsored in part by Gas Research Inst., Chicago, IL.

Keywords: *Polyurethane resins, *Cellular plastics, Compressive properties, Tensile properties, Shear properties, Cryogenics, Modulus of elasticity, Low temperature.

Polyurethane foam, having a density of 64-kg/cu m, was tested at 295, 111, 76, and 4 K. The material properties reported are Young's modulus, proportional limit, yield strength (at 0.2% offset), tensile, shear, and compressive strengths, and elongation (elastic and plastic). To perform these tests, a unique apparatus was developed. This apparatus permits tension, compression, and shear testing of materials at any temperature ranging from 295 to 1.8 K. Strain is measured with a concentric, overlapping-cylinder capacitance extensometer that is highly sensitive and linear in output.

401,008

PB84-135458 PC A06/MF A01
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
Transient Horizontal Flame Spread Tests on Cellular Plastics - Experimental Results: Volume 1,
S. Tan. Oct 83, 108p HOME FIRE PROJECT TR-53,
NBS-GCR-83-445

Keywords: *Cellular plastics, *Flammability testing, Plastics, Foam, Polystyrene, Polyurethane resins, Combustion products, Heat measurement, Ignition, *Flame spread test method.

Experimental results from measurements of the characteristics of transient horizontal flame spread over cellular plastics under the influence of external radiation are presented. The measurements made include the radial spread of fire, mass pyrolysis rate, radiative and convective power released by fire and the production and consumption of gas species by fire. The efficiency of burning of various plastics is also presented. The plastics used are primarily cellular foams obtained from the PRC materials bank. Volume 1 contains the description and discussion of the experimental procedures and computations. Volumes 2 and 3 contain experimental data and summary of the empirical physical and chemical data reduced from the experimental data, respectively.

401,009

PB84-142272 PC A14/MF A01
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
Transient Horizontal Flame Spread Tests on Cellular Plastics - Experimental Results: Volume 2 and Volume 3,
S. Tan. Oct 83, 312p HOME FIRE PROJECT TR-53,
NBS-GCR-83-446
See also PB84-135458.

Keywords: *Cellular plastics, *Flammability testing, Plastics, Ignition, Tables(Data), Graphs(Charts), Pyrolysis, Polystyrene, Foam, Polyurethane resins, *Flame spread tests.

Experimental results from measurements of the characteristics of transient horizontal flame spread over cellular plastics under the influence of external radiation are presented. The experiments involve flame spread from point ignition to radii of about 0.3 m. A single wax match is used for ignition. The measurements made include the radial spread of fire, mass pyrolysis rate, radiative and convective power released by fire and the production and consumption of gas species by fire. The efficiency of burning of various plastics is also presented. The plastics used are primarily cellular foams obtained from the PRC materials bank. The maximum external radiative flux used is 0.85 w/sq cm. Volume 1 contains the description and discussion of the experimental procedures and computations. Volumes 2 and 3 contain experimental data and summary of the empirical physical and chemical data reduced from the experimental data, respectively.

401,010

PB84-155704 PC A06/MF A01
National Bureau of Standards, Washington, DC.
Polymer Science and Standards Division Annual Report 1983,
L. E. Smith, M. G. Broadhurst, G. T. Davis, F. W. Wang, and B. M. Fanconi. Jan 84, 114p NBSIR-84-2813
See also PB83-200105.

Keywords: *Polymers, *Standards, Dental materials, Medical supplies, Durability, Plastics, Dielectric properties, Additives, Transport properties, Elastomers, Stability, Performance evaluation, Molecular structure, Standards, Mechanical properties, Composite materials, Molecular conformation.

Although synthetic polymers have been used as materials for technology during only three quarters of a century, they have left little of our economy, technology, industry, science, and culture untouched. We have moved rapidly into an age in which an evergrowing number of humanity's needs are served by polymers. The volume currently produced exceeds that of steel and forms the basis of industries which add over \$106 billion of value by manufacturer (a measure of the relative economic importance of manufacturing among industries) and provides 3.3 million jobs. Recent summaries show that polymers and polymer composites research already accounts for about 47 percent of the total industrial R&D expenditure for metals, polymers, and inorganic materials. Among these materials, polymers also constitute about 40 percent of the value added by manufacturer, 45 percent of the jobs, 49 percent of the number of scientific publications, and 42 percent of the American Society for Testing and Materials (ASTM) standards.

401,011

PB84-175538 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Mechanical Behavior of Ultra High Molecular Weight Polyethylene.
Annual rept. no. 4, 1 Oct 82-30 Sep 83,
J. M. Crissman. Jan 84, 44p NBSIR-84-2808(FDA)
Sponsored in part by Food and Drug Administration,
Silver Spring, MD. Bureau of Medical Devices.

Keywords: *Polyethylene, *Mechanical properties, Molecular weight, Creep tests, Stress analysis, Gamma irradiation, Crack propagation, Plastic deformation.

This report describes work done during FY 1983 under task 80-01, NBS-FDA/BMD (Bureau of Medical Devices) Interagency Agreement. The report covers the fourth year of a four year project concerned with the study of the morphology and mechanical properties of ultra high molecular weight polyethylene (UHMWPE). The work done during FY 1983 dealt principally with

the following aspects of the mechanical behavior of UHMWPE, (1) the temperature dependence of the creep and recovery behavior of uniaxial extension and compression at small deformations, (2) longer term (> 1 day) creep and recovery behavior of uniaxial extension and compression at small deformations, (3) the effect of gamma-irradiation on the creep and recovery behavior, and (4) the effect of gamma-irradiation on the environmental stress-crack resistance of UHMWPE.

401,012

PB84-192954 PC A02/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Thermal Conductivity of Glass Fiber/Epoxy Composite Support Bands for Cryogenic Dewars, Phase 2.
Final rept. Jan-Sep 83,
J. G. Hust. Mar 84, 24p NBSIR-84-3003
Contract NASA-S-12425-C

Keywords: *Fiberglass reinforced plastics, *Epoxy resins, *Composite materials, *Thermal conductivity, Dewar flasks, Cryogenics, Samples, Low temperature tests, Mechanical properties, *Support bands.

The thermal conductivities of three specimens of glass fiber/epoxy composites were measured and reported for the temperature range 4 to 300 K. These specimens were fabricated from two cryogenic dewar support bands. An average conductivity curve for the three specimens is presented. The data for the three specimens are within + or - 5% of this average curve. The average curve is compared to a similar curve obtained five years ago in Phase I of this continuing study of composite materials.

401,013

PB84-217280 Not available NTIS
National Bureau of Standards, Washington, DC.
Hydrolytic Degradation of Polyester Polyurethane Foams.
Final rept.,
D. W. Brown, R. E. Lowry, and L. E. Smith. Mar 84,
2p
Pub. in Polymer Preprints, v22 n1 p223-224 Mar 81.

Keywords: *Degradation, *Polyurethane resins, *Foam, *Hydrolysis, Fuel tanks, Reaction kinetics, Reprints.

Urethane foams, some new and some from fuel tanks of military aircraft, were hydrolytically degraded until soluble. The acid contents were determined and extrapolated backward in time to get the value before aging. The foams from the fuel tanks were found to have much higher acid contents than the new materials. Since acid is a product of hydrolytic scission of esters, this reaction probably occurs during use, limiting the life of the foam. The condition of foam in existing tanks can be judged quickly by immersing a small piece of foam in dimethyl formamide.

401,014

PB84-218999 Not available NTIS
National Bureau of Standards, Washington, DC.
Migration of Low Molecular Weight Components from Polymers: 1. Methodology and Diffusion of Straight-Chain Octadecane in Polyolefins.
Final rept.,
S. S. Chang. Feb 84, 8p
Pub. in Polymer 25, p209-217 Feb 84.

Keywords: *Polymers, *Molecular weight, *Transport properties, *Diffusion coefficients, *Olefin resins, *Alkanes, Plastics, Antioxidants, Radioactive isotopes, Reprints, *Tracer techniques, Monomers.

The migration kinetics of monomers, oligomers and antioxidants from several polymers into various solvents at different temperatures has been studied by radioactive tracer techniques. This paper describes in detail the methodology used for observing the migration and for reducing the data. Examples of the migration that follows strictly the Fickian diffusion behavior with a constant diffusion coefficient are shown. These examples were obtained by first saturating the polyolefin test plaques with a labelled oligomer and then extracting the labelled species from the polymer with identical, but unlabelled, oligomer as the solvent. The polyolefin test plaques were made from linear and branched polyethylene, as well as from isotactic polypropylene.

401,015
PB84-219005 Not available NTIS
 National Bureau of Standards, Washington, DC.
Fat-Simulating and Accelerating Solvents for Polyolefins and MWD (Molecular Weight Distribution) of Solvent Extracts of Polyethylenes.
 Final rept.,
 S. S. Chang, W. J. Pummer, and J. R. Maurey. Oct 83, 6p
 Pub. in *Polymer* 24, p1267-1272 Oct 83.

Keywords: *Solvent extraction, *Reaction kinetics, *Diffusion coefficients, *Olefin resins, Food packaging, Molecular weight, Vegetable oils, Antioxidants, Reprints, *Tracer techniques.

Migration kinetics of straight-chain oligomers and antioxidants from several polyolefins at different temperatures into various solvents have been studied by radioactive tracer techniques. Anhydrous ethanol appears to be a well suited food-oil or liquid-fat simulant for extracting different types of migrants from polyolefins. Pure and mixed triglycerides are also good oil or fat simulants, but the triglycerides offer no simpler analytical procedures than the use of oil or fat themselves. n-Octanol may also be considered as a reasonable oil or fat simulant; however, its action depends somewhat on the choice of migrants. The molecular weight distributions (MWDs) of the n-heptane and ethanol extracts of polyolefins have been analysed. n-Heptane can not only accelerate the migration of the individual migrant but also remove oligomer species that are slightly soluble or present at low levels in the oil or simulant extracts.

401,016
PB84-221373 Not available NTIS
 National Bureau of Standards, Washington, DC.
Resistivity of Ultra-Drawn Polyvinylidene Fluoride.
 Final rept.,
 A. J. Bur. 1982, 6p
 Pub. in *Proceedings of Electrical Insulation Dielectric Phenomena* held at Amherst, Massachusetts on October 17-21, 1982, p156-161 1982.

Keywords: *Electric resistance, X ray analysis, Crystal structure, Drawing, *Vinylidene fluoride polymers.

Resistivity measurements have been carried out on polyvinylidene fluoride (PVDF) samples which were mechanically oriented beyond their natural 4:1 draw ratio up to 7:1. Drawing, which was done at 140 C, was done in two steps: first, a length of unoriented material was drawn until it necked to its natural draw ratio of 4:1; second, the 4:1 sample was reclamped in the testing machine and drawn to the desired draw ratio. For resistivity measurements, the samples were fitted with a guarded electrode in order to avoid the effects of surface and leakage currents. Upon application of a step voltage, current was observed as a function of time using an electrometer. The 10 minute current was used to calculate the sample resistance. The samples were also characterized by x-ray observations from which the proportionate amount of alpha and beta crystalline phases was calculated. The effects of poling on resistivity were also studied. The data showed that resistivity increased with increasing draw ratio, with increased beta phase and with poling.

401,017
PB84-221746 Not available NTIS
 National Bureau of Standards, Washington, DC.
Thermal Oxidation of Poly(Methyl Methacrylate).
 Final rept.,
 T. Hirata, T. Kashiwagi, and J. E. Brown. 1984, 2p
 Pub. in *Proceedings of the American Chemical Society National Meeting (187th)*, St. Louis, MO., April 8-13, 1984, p176-177.

Keywords: *Oxidation, *Furniture, *Fire tests, *Pyrolysis, Residential buildings, Molecular weight, Fire resistance plastics, Reaction kinetics, Activation energy, Thermogravimetry, Plastics, *Polymethyl methacrylate, Gel chromatography.

A continual increase in the use of synthetic polymeric materials for interior furnishings significantly modifies fire initiation and growth in buildings. In order to predict an important aspect of these processes, the thermal oxidative stability of poly(methyl methacrylate), PMMA, was investigated by isothermal heating and thermogravimetry (TG) as a first step. The molecular weight and the molecular weight distribution were measured by gel permeation chromatography for the isothermally degraded PMMA samples. The decrease in PMMA

molecular weight as a function of weight loss was much more rapid in air than in nitrogen. The change in degree of polymerization with heating time indicates that PMMA initially decomposes by a first order random chain scission process in air.

401,018
PB84-236389 PC A06/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Fire Research.
Modeling of Smoldering Combustion Propagation,
 T. J. Ohlemiller. Jun 84, 112p NBSIR-84/2895

Keywords: *Combustion, *Flammability testing, *Plastics, Safety, Polyurethane resins, Foam, Chemical reactions, Mathematical models, Reaction kinetics, Cellulosic resins, *Smoldering, Numerical solution.

Smoldering combustion, which can pose a serious life safety hazard, is encountered most frequently in various cellulosic materials and in open-cell polyurethane foams. It is probable that the principal heat source driving this process is heterogeneous oxidation but gas phase reactions may also contribute at higher temperatures. The chemistry involved is best-defined for the case of pure cellulose but even here the details are limited and actual mechanisms poorly understood; simplified kinetic descriptions, typically derived from isothermal or thermodynamic experiments, currently provide the only tractable inputs for smoldering combustion models. The general problem of smolder wave propagation through a permeable bed of fuel particles is posed; coupled to the chemistry, one must also consider the physical processes of heat and mass transfer on both the particle scale and on the smolder wave scale. The general equations can be somewhat simplified, after non-dimensionalization, for cases where certain dimensionless parameters are very large or very small compared to unity. Existing smolder propagation models are all greatly simplified compared to this general model, neglecting gradients on the particle scale and considering only one-dimensional gradients on the wave scale. These models are reviewed; their contributions and deficiencies are noted.

401,019
PB85-100949 PC A08/MF A01
 National Bureau of Standards, Boulder, CO.
Thermal and Mechanical Properties of Polyurethane Foams and a Survey of Insulating Concretes at Cryogenic Temperatures.
 Final rept. Jan 79-Feb 84,
 L. L. Sparks, and J. M. Arvidson. Apr 84, 154p
 NBSIR-84/3011, GRI-84/0086
 Contract GRI-5081-352-0425

Keywords: *Polyurethane resins, *Foam, *Mechanical properties, *Insulation, *Cryogenics, *Thermodynamic properties, Portland cement, Low temperature tests, Liquefied natural gas, Storage.

Thermal and mechanical properties of expanded plastics, foams, are reported. The system studied was rigid, closed cell, CCI3F blown, polyether based polyurethane. The primary temperature range of study was 100 to 300 K; however, several properties were determined to 4 K. The nominal densities of the foams tested were 32, 64, and 96 kg/cu m. Properties reported are thermal conductivity, thermal expansion, strength and moduli in tension and in compression, proportional limit, yield strength, ultimate strength, and shear strength. Physical properties were determined both parallel and perpendicular to the orthogonal axes of the bulk supplies. The gas content of the specimens was determined using a gas chromatograph-mass spectrometer and with a gas displacement pycnometer. Empirical procedures for estimating the temperature dependent thermophysical properties were developed. These procedures are based on the experimental data and utilize the characterization parameters for molar gas concentration, gas pressure, and cell morphology. Regulations affecting vapor dispersion in the area around liquefied natural gas facilities make it attractive to construct dikes and impounding areas out of materials having low thermal conductivities. Several insulating concretes have the general properties required for such applications. Screening tests were done to determine the thermal conductivity, modulus of rupture, and the compressive strength of several polyester based materials with glass bead or perlite aggregate and of portland cement based materials with vermiculite or polystyrene aggregate. A bibliography resulting from an extensive literature survey of lightweight concretes is presented. Seven of the references which were particularly applicable are presented in annotated form.

401,020
PB85-104636 Not available NTIS
 National Bureau of Standards, Washington, DC.
Technique for Determining the Polarization Distribution in Thin Polymer Electrets Using Periodic Heating.
 Final rept.,
 S. B. Lang, and D. K. Das-Gupta. 1981, 4p
 Pub. in *Ferroelectrics* 39, Nos. 1-4 p1249-1252 1981.

Keywords: *Electrets, *Polymeric films, *Polarization(Charge separation), Pyroelectricity, Least squares method, Ferroelectric materials, Plastics, Reprints, *Vinylidene fluoride polymers.

The variation in the polarization distribution through the thickness of a polymer electret is determined by heating each electrode of the sample with a laser beam which is modulated at various frequencies between 0.1 and 100 kHz. The periodic heating induces temperature waves which are attenuated exponentially as a function of both depth in the sample and frequency of modulation. The resulting 'thermal probe' heats regions having different polarizations and produces an AC pyroelectric current. A linear least-squares analysis of the experimental current-frequency data gives the polarization distribution.

401,021
PB85-107340 Not available NTIS
 National Bureau of Standards, Washington, DC.
Blister Test for Adhesion of Polymer Films to SiO₂.
 Final rept.,
 J. A. Hinkley. 1983, 12p
 Pub. in *Jnl. of Adhesion* 16, p115-126 1983.

Keywords: *Polymeric films, *Silicon dioxide, *Adhesion, Polystyrene, Polymethyl methacrylate, Substrates, Blistering, Reprints.

Films of polystyrene or polymethyl methacrylate were cast on oxidized silicon substrates, then detached by the application of gas or water pressure from the back side of the film through a hole in the substrate. Critical detachment pressures showed good repeatability and could be used to calculate the work of adhesion. For polystyrene on a hydrophilic silica in the presence of water, the apparent work of adhesion is 78 mJ/sq m. Other polymer/substrate combinations gave meaningful variations in detachment pressure.

401,022
PB85-110179 Not available NTIS
 National Bureau of Standards, Washington, DC.
Role of Thermal Analysis in the Lifetime Prediction of Polymers.
 Final rept.,
 J. H. Flynn. 1981, 4p
 Pub. in *Proceedings of European Symposium Thermal Analysis (2nd)*, University of Aberdeen, United Kingdom, September 1-4, 1981, p223-226.

Keywords: *Polymers, *Thermal analysis, *Aging tests(Materials), *Life(Durability), Stability, Plastics, Polymethyl methacrylate, Degradation, Thermogravimetry.

The role of thermal analytical techniques in the development of accelerated aging methods for the prediction of service lifetime limits of polymeric materials is critically examined. The use of Arrhenius parameters for extrapolation over a wide temperature range in which the polymer may pass through phase changes, ceiling temperatures, and other changes in the mechanism of degradation warrants considerable skepticism. Techniques for obtaining high precision and testing for changes in mechanism are illustrated for several polymers.

401,023
PB85-140440 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Mechanical Properties of Some Fiber Reinforced Polymer Composites After Implantation as Fracture Fixation Plates.
 Final rept.,
 G. B. McKenna, G. W. Bradley, H. K. Dunn, and W. O. Statton. 1980, 4p
 Pub. in *Biomaterials* 1, n4 p189-192 1980.

Keywords: *Composite materials, *Reinforced plastics, *Mechanical properties, Medical supplies, Fiberglass reinforced plastics, Polysulfone, Reprints, *Biomaterials.

Field 11—MATERIALS

Group 11I—Plastics

Graphite/polysulfone and glass/epoxy composite materials were implanted on canine femora for 16 weeks and 12 months. The 16 week study used osteotomized femora, the 12 month study used intact femora. The plates were harvested and tested in four point bending. Strength and stiffnesses were compared with controls. It was found that neither the glass/epoxy nor the graphite/polysulfone showed loss of strength or stiffness after 16 weeks. In the 12 month study, however, both systems showed a loss of strength and the graphite/polysulfone showed a considerable loss in stiffness.

401,024

PB85-160133 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD. Polymer Science and Standards Div.

Prediction of the Long Term Stability of Polyester-Based Recording Media.

Progress rept. Aug 83-Dec 84,
D. W. Brown, R. E. Lowry, and L. E. Smith. Dec 84,
50p NBSIR-84/2988

See also PB83-172668. Sponsored by National Archives and Records Service, Washington, DC.

Keywords: *Aging tests(Materials), *Polymeric films, *Magnetic tapes, *Adhesives, *Binders(Materials), Humidity, Storage, Archives, Infrared spectroscopy, Polyethylene terephthalate, Hydrolysis, Stability.

Aging studies with poly(ethylene terephthalate) film base indicate the lifetime is equal to about 1000 years if the material is stored at 20-25C and 50% relative humidity. Concentration changes of acid and alcohol groups that occur as a result of aging have been measured by infrared analysis. Rate constants calculated by this method agree reasonably well with those calculated from acid contents determined by titration. Cross-linked polyester polyurethanes were prepared as models of the binder of magnetic tape. Aging studies with these materials indicate that they hydrolyze more slowly than ordinary polyester polyurethanes. Samples aged at 85C at 100, 50, and 25% relative humidity eventually deteriorated greatly in a physical sense. Magnetic tapes were aged and measurements made of the sol content of the binder and its adhesion to the polyester base. The latter quantity appears to be a more valuable indicator of tape condition than sol content. Values of binder adhesion of six brands of magnetic tape initially varied between 800 and 35 N/m (or g/cm). Binder adhesion in aged tapes was less the higher the temperature and humidity of aging. A tape transport had difficulty processing tape with values of binder adhesion as low as 10 N/m. There was no problem at 35 N/m. It is anticipated that the lifetime of magnetic tapes can be predicted by measurements of binder adhesion.

11J. Rubbers

401,025

PB84-143643 PC A03/MF A01
National Bureau of Standards, Boulder, CO.

Tensile, Compressive, and Shear Properties of a 96 kg cubic meter Polyurethane Foam at Low Temperatures,

J. M. Arvidson, R. S. Bell, L. L. Sparks, and C. Guobang. Dec 83, 31p NBSIR-83-1696

Sponsored in part by Gas Research Inst., Chicago, IL.

Keywords: *Polyurethane resins, *Shear properties, *Compressive properties, *Tensile properties, Foam, Elongation, Young's modulus, Procedure.

Polyurethane foam, having a density of 96 kg/cu m, was tested at 295, 111, 76, and 4 K. The material properties reported are Young's modulus, proportional limit, yield strength (at 0.2% offset), tensile, shear, and compressive strengths, and elongation (elastic and plastic). The test apparatus permits tension, compression, and shear testing of materials at any temperature ranging from 295 to 1.8 K.

401,026

PB84-225598 Not available NTIS
National Bureau of Standards, Washington, DC.

Equilibrium Acid Concentrations in Hydrolyzed Polyesters and Polyester-Polyurethane Elastomers.

Final rept.,
D. W. Brown, R. E. Lowry, and L. E. Smith. 1983,
14p
Pub. in Jnl. of Applied Polymer Science 28, p3779-3792 1983.

Keywords: *Elastomers, *Polyurethane resins, *Polyester resins, Hydrolysis, Degradation, Chemical equilibrium, Humidity, Reprints, Poly(butylene adipate) diols, Poly(caprolactone diol).

Three polyester diols were aged at relative humidities (RH) of 25, 50, and 93%. Poly(butylene adipate) diols and a poly(caprolactone diol) reached equilibrium acid concentrations.

401,027

PB85-104750 Not available NTIS
National Bureau of Standards, Washington, DC.

Experiments on the Small Strain Behavior of Crosslinked Natural Rubber. 1. Torsion.

Final rept.,
G. B. McKenna, and L. J. Zapas. 1983, 7p
Pub. in Polymer 24, n11 p1495-1501 Nov 83.

Keywords: *Natural rubber, *Crosslinking, *Strain tests, Elastomers, Elasticity, Torsion tests, Reprints.

Experiments in torsion where the torque and normal force were monitored continuously with time were carried out on samples of natural rubber crosslinked with, 1, 3 and 5 phr dicumyl peroxide. It was found that while the shear modulus increased as expected with amount of crosslinking agent, the individual derivatives of the strain energy function did not. Delta W/delta I2 increased only slightly with amount of peroxide, while delta W/delta I1 increased dramatically. Also the authors found that at small strains delta W/delta I2 did not become negative for any of the samples tested contrary to results which have been reported in the literature. This is in spite of the fact that our experiments were carried to smaller strains than had been reported previously.

401,028

PB85-140937 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Internal Volumetric Setting Expansion of Casting Investments.

Final rept.,
F. A. Marsaw, W. G. de Rijk, R. Hesby, R. W. Hinman, and G. Pelleu. Sep 84, 6p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of Prosthetic Dentistry 52, n3 p361-366 Sep 84.

Keywords: *Investment casting, *Dental materials, Expansion, Setting, Volumetric analysis, Elastomers, Plastics casting, Reprints.

Previous studies of setting expansion employed external measurements on a core of investment material; no determinations have been attempted in the center of the mold where the wax pattern is located. The purpose of this study was to develop a technique for evaluating setting expansion in the pattern area of an investment mold. The setting expansion of three commercially available phosphate-bonded investments was determined by measuring the change in volume of a cavity located in the center of the investment. A water-filled reservoir with a volume of 1.2 ml was connected to a 0.1 ml pipette (0.3 mm in diameter) and embedded in the center of the casting investment. Changes in the volume of the reservoir resulted in changes in the water level in the pipette. The internal temperature of the investment was monitored by a thermocouple. This experiment was performed with both nonyielding metal and yielding rubber casting rings. The results for the metal and rubber casting rings were indistinguishable. These findings indicate a need to re-evaluate the methods by which setting expansion is measured as well as the mechanism by which this expansion takes place.

11L. Wood and Paper Products

401,029

PB84-216449 PC A03/MF A01
National Bureau of Standards, Washington, DC.

NBS (National Bureau of Standards) Voluntary Product Standard: Construction and Industrial Plywood.

1984, 46p NBS/PS-1/83
Also available from Supt. of Docs as SN003-003-02570-4.

Keywords: *Standards, *Plywood, Requirements, Wood products, Veneers, Adhesive bonding, Durability, Construction, Exposure, Moisture, Defects, Maintenance, Performance evaluation.

The purpose of this Voluntary Product Standard is to establish nationally recognized requirements for the principal types and grades of construction and industrial plywood and to provide a basis for common understanding among producers, distributors, and users of the product.

12.

MATHEMATICAL SCIENCES

12A. Mathematics and Statistics

401,030

PB84-224773 Not available NTIS
National Bureau of Standards, Washington, DC.

Fourth Order Accurate Fast Direct Method for the Helmholtz Equation.

Final rept.,
R. F. Boisvert. 1984, 10p
Pub. in Proceedings of Elliptic Problem Solvers II, Monterey, CA., January 10-12, 1983, p35-44 1984.

Keywords: Finite difference theory, Fourier transformation, Divichlet problem, *Helmholtz equation, Neumann problem, Poisson equation.

A fourth order accurate fast direct method for the Helmholtz equation with Dirichlet, Neumann, or periodic boundary conditions on rectangular domains in two or three dimensions is described. High accuracy is attained through the use of compact finite differences techniques, and the resulting algebraic equations are solved using Fourier transforms. The results of several computational examples are also presented.

401,031

PB84-224831 Not available NTIS
National Bureau of Standards, Washington, DC.

Realizing a Flexible, Iterative Style of Statistical Analysis with a Microcomputer.

Final rept.,
W. Liggett. 1983, 5p
Pub. in Proceedings of Annual Technical Symposium of the Washington, DC Chapter of the Association for Computing Machinery (22nd), Gaithersburg, Maryland, June 23, 1983, pL2.1-L2.6.

Keywords: *Statistical analysis, *Microcomputers, BASIC programming language, Iterative methods, Computer software.

To analyze a data set as completely as possible, a statistician needs computing methods that are flexible, facilitate iterative development, and provide full documentation. A statistician can meet these requirements with a microcomputer by developing for each analysis a BASIC program that does all the computing including the graphics. This approach is flexible because the necessary data management, numerical, and graphical operations can be easily programmed. It facilitates iterative development because the BASIC program records the current state of the analysis and can be updated. It provides full documentation in the form of the final version of the program. This approach is ap-

appropriate only for analysts who are knowledgeable enough in statistics and numerical analysis to choose and code good algorithms. For such an analyst, this approach may be competitive with the analyst's other options. It is competitive with the use of a statistical package when the package is inflexible. It is competitive with the use of FORTRAN for interfacing software when the interfacing requires additional programming skill.

401,032

PB84-244946 Not available NTIS
 National Bureau of Standards, Washington, DC.
Fitting Straight Lines When Both Variables Are Subject to Error.

Final rept.,
 J. Mandel. Jan 84, 14p
 Pub. in Jnl. of Quality Technology 16, n1 p1-14 Jan 84.

Keywords: *Linear regression, *Regression analysis, Least squares method, Errors, Reprints.

Least squares linear regression is one of the most widely used statistical techniques. Almost all textbooks or statistical methods provide the necessary formulas for the fitting process, based on the assumption that there is no error in the independent variable. How these formulas should be modified when both variables are subject to error, is dealt with in detail, using, as an example, an interlaboratory study.

401,033

PB84-245950 Not available NTIS
 National Bureau of Standards, Washington, DC.
Lopsided Sets and Orthant-Intersection by Convex Sets.

Final rept.,
 J. F. Lawrence. 1983, 19p
 Pub. in Pacific Jnl. of Mathematics 104, n1 p155-173 1983.

Keywords: *Set theory, *Convex sets, Inequalities, Reprints, Matroids.

Given a subset L of the $(2 \sup d)$ closed orthants in d-dimensional Euclidean space, is there a convex set K which intersects those closed orthants in L, while missing those not in L. A strong combinatorial condition on L, which is necessary for the existence of such a convex set, is exhibited. This condition is studied and its close connections with the theory of oriented matroids are examined. The sets L satisfying this condition - the 'lopsided' sets - have rich combinatorial structure which can be exploited in the study of convex sets and systems of linear inequalities.

401,034

PB85-100147 Not available NTIS
 National Bureau of Standards, Washington, DC.
Theory and Practice of Hierarchical Control.

Final rept.,
 J. S. Albus, A. J. Barbera, and R. N. Nagel. 1981, 22p
 Sponsored in part by American Federation of Information Processing Societies, Arlington, VA.
 Pub. in Proceedings of IEEE Computer Soc. Int. Conf. (23rd), Productivity - An Urgent Priority Held at Washington, DC. on September 15-17, 1981, p18-39.

Keywords: *Control theory, *Robots, *Automatic control, Microcomputers, *Hierarchical control.

A theory of hierarchical control is presented incorporating three parallel interconnected hierarchies. The first is a behavior-generating hierarchy which decomposes tasks into subtasks in the context of sensory information. The second is a sensory-processing hierarchy which extracts the information needed for goal seeking behavior. The third is a world-model hierarchy which generates expectations and predictions for the sensory-processing modules at each level. A robot control and vision systems is described that implements the triple hierarchy model in a microcomputer network. A possible application of the theory to an automatic factory control system is outlined.

401,035

PB85-107308 Not available NTIS
 National Bureau of Standards, Washington, DC.
Discussion on Paper by Brewer and Sarndal. Reply to Comments by Brewer.

Final rept.,
 K. R. Eberhardt. 1983, 5p
 Pub. in Session VIII in Incomplete Data in Sample Surveys 3, p369-371, p399-400 1983.

Keywords: *Sampling theory, Probability theory, Data reduction.

This paper is an invited discussion of the paper, Six Approaches to Enumerative Survey Sampling, by K.R.W. Brewer and C.E. Sarndal. The impact of labels on finite population sampling theory is discussed, leading to the conclusion that the formal role given to the labels is a critical component of any theory. In discussing the use of randomization in sample design, a maximum property of simple random sampling is given.

401,036

PB85-107399 Not available NTIS
 National Bureau of Standards, Washington, DC.
Laws of Error III: Later (Non-Gaussian) Distributions.

Final rept.,
 C. Eisenhart. 1983, 5p
 See also PB85-107407.
 Pub. in Encyclopedia of Statistical Sciences 4, p562-566 1983.

Keywords: *Statistical distributions, Reprints, *Laws of error.

J.D. Gergonne (1821), J. W. L. Glaisher (1873), E. J. Stone (1873), F. Y. Edgeworth (1883), S. Newcomb (1883), R. M. Stewart (1920), and H. Jeffreys (1932, 1939) propose methods of weighting based on mixtures of Gaussian laws of error (or, normal distributions) to reduce influence of discordant observations. N. Mantel (1956) shows Stone-Edgeworth solution to be fallacious. S. D. Poisson's invention (1824) of so-called 'Cauchy distribution' negates presumed universality of 'arithmetic mean rule' and the 'hypothesis of elementary errors' as bases for Gauss's law of error. Poisson's amendment (1829) to the Gaussian distribution to admit penultimate asymmetry of distributions of sums of independent random errors as their number increases without limit, and F. W. Bessel's amendments (1838) to admit flatter or sharper modes, as predecessors to the Gram-Charlier type A (c. 1860-1905) and Edgeworth (1896-1905) series expansions of probability distributions. Similarity of G. H. L. Hagen's derivation (1837) of the Gaussian law of error from the binomial distribution and K. Pearson's derivation (1895) of his system of frequency curves from the hypergeometric distribution.

401,037

PB85-107407 Not available NTIS
 National Bureau of Standards, Washington, DC.
Laws of Error II: The Gaussian Distribution.

Final rept.,
 C. Eisenhart. 1983, 16p
 See also PB85-107415.
 Pub. in Encyclopedia of Statistical Sciences 4, p547-562 1983.

Keywords: *Statistical analysis, Normal density functions, Least squares method, Central limit theorem, Reprints, *Laws of error.

C. F. Gauss's derivation (1809) of his law of error based on axiomatic acceptance of the 'arithmetic mean rule' is outlined; J. Bertrand's (1888, 1889), P. Pizzetti's (1892), B. Meidell's (1908) and H. Poincare's (1912) criticisms of Gauss's derivation noted; and the support for Gauss's law provided by P. S. Laplace's (1810, 1811, 1812) proofs of the asymptotic normality as n approaches infinity of sums and linear functions of n independent random variables indicated. R. Adrain's (1809), Sir John Herschel's (1850), and W. F. Donkin's (1857) proofs of Gauss's law starting from quite different assumptions about the mathematics of errors are outlined as well as the proofs of G. H. L. Hagen (1837), F. W. Bessel (1838), M. W. Crofton (1870), and others, based on Thomas Young's (1819) 'hypothesis of elementary errors.' The efforts of Bessel (1818, 1838), C. S. Peirce (1873), Sir George Airy (1879), and others to provide empirical support for Gauss's law as the real-life law of error are mentioned and declared illusory.

401,038

PB85-107415 Not available NTIS
 National Bureau of Standards, Washington, DC.
Laws of Error I: Development of the Concept.

Final rept.,
 C. Eisenhart. 1983, 18p
 See also PB85-107407.
 Pub. in Encyclopedia of Statistical Sciences 4, p530-547 1983.

Keywords: *Statistical analysis, Statistical distributions, Probability distribution functions, Reprints, *Laws of error.

The development of laws of error is traced in the text, and portrayed in a chart, from the inception of the concept in an April 1755 letter of Thomas Simpson through the contributions of J.H. Lambert (1760, 1765), P.S. Laplace (1774, 1781), J.L. Lagrange (1776) and Daniel Bernoulli (1778) to the publication (1809) of the law of C.F. Gauss, which became universally regarded in the 19th century as 'the law of error'.

401,039

PB85-108751 Not available NTIS
 National Bureau of Standards, Washington, DC.
Control of Wave Processes with Distributed Controls Supported on a Subregion.

Final rept.,
 J. Lagnese. 1983, 18p
 Pub. in Siam (Society for Industrial and Applied Mathematics) Jnl. on Control and Optimization 21, n1 p68-85 Jan 83.

Keywords: *Wave equations, Reprints, One dimensional.

It is proved that solutions of one dimensional wave equations satisfying general boundary conditions at the ends of a bounded interval I can be exactly controlled to any finite energy state by means of distributed controls which vanish outside of any fixed non-empty subinterval I. An example is given which shows that no such general analogous result can hold in higher dimensions. In this case, for a spherical region, those states are characterized which can be exactly controlled to zero by means of controls supported in an annulus within the region. It is found that very strong controllability obtains when the controls are distributed near the boundary, but that only rather weak controllability is possible with controls supported in an interior annulus. Applications of these results to boundary control problems in annular regions are also discussed.

401,040

PB85-115699 Not available NTIS
 National Bureau of Standards, Washington, DC.
High Order Generalized Method of Averaging.

Final rept.,
 D. E. Gilsinn. 1982, 22p
 SIAM (Society of Industrial and Applied Mathematics) Jnl. on Applied Mathematics, v42 n1 p113-134 1982.

Keywords: *Average, Van der Pol differential equation, Perturbation theory, Computation, Oscillation, Algorithms, Reprints, Asymptotic approximation.

A high order generalized perturbation technique is developed that extends the Krylov - Bogoliubov - Mitropolsky method of averaging to vector systems written in normal form with multiple angular components. An algorithm is presented that iteratively gives the terms in the asymptotic approximation. A nonresonance condition is assumed that guarantees the smoothness of the terms. The main result establishes that the absolute error between the unaveraged normal system and its N-th power of the perturbation parameter. The high order algorithm is applied to a coupled van-der-Pol oscillator system. Some numerical results are given to show that the main result reflects actual computational experience.

Field 12—MATHEMATICAL SCIENCES

Group 12A—Mathematics and Statistics

401,041
PB85-115723 Not available NTIS
National Bureau of Standards, Washington, DC.
Mixed Finite Element Methods - Reduced and Selective Integration Techniques: A Unification of Concepts.
Final rept.,
D. S. Malkus, and T. J. R. Hughes. 1978, 19p
Pub. in Computer Methods in Applied Mechanics and Engineering, v15 n1 p63-81 Jul 78.

Keywords: *Finite element analysis, Incompressible flow, Degrees of freedom, Euler-Lagrange equation, Plates(Structural members), Beams(Supports), Computation, Constraints, Reprints, *Integration, Lagrange multipliers.

The equivalence of certain classes of mixed finite element methods with displacement methods which employ reduced and selective integration techniques is established. This enables the accuracy of the mixed formulation to be obtained without incurring the additional computational expense engendered by the auxiliary field of the mixed method. Applications and numerical examples are presented for problems with constraints which can be difficult to enforce in finite element approximations and have often dictated the use of mixed principles. These include thin beams and plates, and linear and nonlinear incompressible and nearly-incompressible continuum problems in solid and fluid mechanics.

401,042
PB85-123594 Not available NTIS
National Bureau of Standards, Washington, DC.
Constructive Characterization of Trees with at Least K Disjoint Maximum Matchings.
Final rept.,
P. J. Slater. 1978, 13p
Pub. in Jnl. of Combinatorial Theory Ser. B 25, n3 p326-338 1978.

Keywords: *Trees(Mathematics), Graph theory, Reprints.

Let $H = F(v) + G(w)$ denote the graph obtained from F and G by identifying vertices v of F and w of G ; H will be said to be obtained by surgery on F and G . A matching of a graph is a collection of edges, no two of which are incident with the same vertex. This paper presents a constructive characterization of the $(S \text{ sub } k), k = \text{or} > 2$, of trees which have at least k disjoint maximum matchings. For each $k = \text{or} > 2$ there are three types of surgery such that T is in $(S \text{ sub } k)$ if and only if T can be obtained from a star $(K \text{ sub } 1, n)(n = \text{or} > k)$ by a finite sequence of the specified surgical operations. A constructive characterization is also given for trees with two disjoint maximum independent vertex sets.

401,043
PB85-123602 Not available NTIS
National Bureau of Standards, Washington, DC.
Note on Cospectral Graphs.
Final rept.,
C. R. Johnson, and M. Newman. 1980, 8p
Pub. in Jnl. Combinatorial Theory Ser. B 28, n1 p96-103 1980.

Keywords: *Graph theory, Matrices(Mathematics), Polynomials, Eigenvalues, Congruences, Isomorphisms, Permutations, Reprints.

It is noted that many cospectral pairs of graphs are accidents due to the interpretation of 0,1 as real numbers. A $1, x$ adjacency matrix, together with a method for dealing with it, is suggested. Many cospectral pairs are simply distinguished, and those which are not have adjacency matrices similar via matrices very much like permutations.

401,044
PB85-128908 Not available NTIS
National Bureau of Standards, Washington, DC.
Alternative to the Pluecker Relations.
Final rept.,
H. A. Robinson. 1977, 4p
Pub. in American Mathematical Society 66, n2 p237-240 1977.

Keywords: Algebraic varieties, Vector spaces, Polynomials, Tensors, Reprints, *Plucker relations, Grassmann space.

It is shown how to obtain a set of homogeneous, degree m polynomials in $(\text{sub } m, \text{sup } n)$ indeterminates

over a field F so that the associated algebraic variety is the set of decomposable elements in the m -th Grassmann space over an n -dimensional vector space over F . The same techniques are used to produce an analogous result for the tensor product of m finite dimensional vector spaces.

401,045
PB85-130797 (Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
Statement of a Total Confidence Interval Based on the Concept of Randomization of Systematic Errors: Large and Small Sample Sizes.
W. Woeger. 1984, 2p
Included in Precision Measurement and Fundamental Constants II, p383-384 1984.

Keywords: *Measurement, *Confidence limits, Random error, Randomization, Sampling, *Uncertainty, Systematic errors.

Interpreting the systematic error in a measurement series as the realization of a random variable, confidence intervals of the mean for the special cases of large and small sample sizes are constructed by statistical methods, assuming normal distributions. These confidence intervals combine the effects of 'random' and 'systematic' errors and are extensions of the commonly used formulae.

401,046
PB85-140416 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Positive Definite Matrices and Catalan Numbers.
Final rept.,
F. T. Leighton, and M. Newman. 1980, 5p
Pub. in Proceedings of the American Mathematical Society 79, n2 p177-181 1980.

Keywords: *Matrices(Mathematics), Determinants, Reprints, Catalan numbers.

It is shown that the number of $n \times n$ integral triple diagonal matrices which are unimodular, positive definite and whose sub and super diagonal elements are all one, is the Catalan number $((\text{superscript } 2n)(\text{subscript } n))/(n+1)$. More generally, it is shown that if A is a fixed integral symmetric matrix and d is a fixed positive integer, then there are only finitely many integral diagonal matrices D such that $A+D$ is positive definite and $\det(A+D) = d$.

401,047
PB85-140481 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Criteria for Choosing a Linearized Least Squares Technique for the Exponential Model Exp ((A sub 1) and (A sub 2) x).
Final rept.,
G. G. Munro. 1981, 9p
Pub. in Jnl. of Computer Physics 44, n1 p189-197 Nov 81.

Keywords: *Least squares method, Exponential functions, Estimates, Reprints, Covariance matrices, Parameter estimation.

A user-oriented discussion of the determination of the parameters $((A \text{ sub } 1)$ and $(A \text{ sub } 2) x)$ in the exponential model $\exp((A \text{ sub } 1)$ and $(A \text{ sub } 2) x)$ is presented in the context of four commonly employed linear least squares techniques. The best method to use is found to be dependent on several criteria, of which the most important are: (1) the objective of fit; (2) the range of data; and (3) the type of error contained in the data. Selecting the best method according to these criteria, the benefit of extending either the range of data or the density of data is determined for the purpose of obtaining the best values of $((A \text{ sub } 1)$ and $(A \text{ sub } 2) x)$. Further, in the important 'modified' least squares method, the effect of the modified weight factor on the evaluation of the covariance matrix is estimated.

401,048
PB85-142818 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Normal Form and Representation Theory.
Final rept.,
R. Cushman, A. Deprit, and R. Mosak. 1983, 16p
See also PB82-263443.
Pub. in Jnl. of Mathematics and Physics 24, n8 p2102-2117 1983.

Keywords: *Lie algebras, *Hamiltonian functions, *Three body problem, Matrices(Mathematics), Pertur-

bation theory, Vector spaces, Nonlinear systems, Polynomials, Oscillations, Conformal mapping, Dynamics, Reprints, *Representation(Mathematics), Two degrees of freedom.

Representation theory of Lie algebras is called upon to develop a procedure for normalizing a dynamical system with two degrees of freedom in the neighborhood of an equilibrium when the Hamiltonian $H(x,y,X,Y)$ in the coordinates (x,y) and their conjugate momenta (X,Y) is of the type $H = ((X \text{ squared}) + (Y \text{ squared}))/2 + V(x,y,X,Y)$, the potential energy V being a sum of homogeneous polynomials in the phase variables of degree strictly greater than two. The fact that the resulting potential V' is a polynomial in the new coordinates (x',y') and the angular momentum $G' = x'Y' - y'X'$ implies that the normalization is a rotation in the configuration space from a fixed frame to an ideal frame. The technique is intended for normalizing an Hamiltonian in equilibrium at the origin when the Lie derivative associated with the quadratic part is not semi-simple e.g. the planar Restricted Problem of Three Bodies at the equilateral equilibrium L_4 when the basic frequencies are equal (Routh's singular case).

401,049
PB85-144954 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Stable Marching Scheme for an Ill-Posed Initial Value Problem.
Final rept.,
A. S. Carasso. Jun 83, 25p
Grant DAAG29-78-G-0091
Pub. in International Series of Numer. Math. 63, p11-35 Jun 83.

Keywords: *Parabolic differential equations, *Partial differential equations, Numerical integration, Computation, Reprints, *Initial value problems, Ill posed problems, Evolution equations.

The author develops and analyzes a marching procedure for the numerical computation of backwards parabolic equations with variable coefficients and noisy initial data. The scheme is stable (but inconsistent) and leads to error bounds of logarithmic convexity type for t bounded away from the line $t = T$, where the solution is only of class $(L \text{ sup } 2)$. The scheme is a two step procedure where the solution is appropriately filtered in the frequency domain, at every alternate step. The procedure assumes a constraint on the class of solutions which is stronger than the usual $(L \text{ sup } 2)$ bound at $t = T$. This stronger constraint is equivalent to the usual constraint in the constant coefficient case.

401,050
PB85-147882 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Hybrid Finite Element Method for Scalar Wave Refraction Into Three Dimensional Bodies.
Final rept.,
P. H. E. Meijer, and G. A. H. Cowart. 1 Oct 84, 11p
Pub. in Jnl. of Applied Physics 56, n7 p1909-1920, 1 Oct 84.

Keywords: *Finite element analysis, *Refraction, Wave functions, Scattering, Reprints, Helmholtz equation, Three dimensional, Cubature.

The hybrid finite element method is a combination of the finite element method in a closed domain and an analytic solution outside this domain. The analytic solution is used in the region of homogeneous dielectric constant, while the finite element method is applied to the region of heterogeneous dielectric constant. Using matching conditions, that are of the nature of a non-local boundary condition, and which were described in a previous article, equations are obtained for the scalar amplitudes of the wave function refracted into an heterogeneous object of general geometry. The problem is described by a functional, containing integrals over the volume and surface of a spherical domain which completely encloses the scattering object. This domain is divided into a set of finite elements by connecting a network of points, called nodes, distributed on and in the spherical domain. The integrals are then approximated and the variation of the functionals results in a system of linear equations in the unknown wave functions at the nodal points of the domain. The new aspect of the method is the use of cubature formulas to reduce the surface integrals to sums. The formulation is tested by comparing results with the analytic solution of the scattering by a homogeneous sphere. The relative errors, as a function of incident wave-

length, are given for various points in the scattering sphere.

401,051
PB85-163384 PC A02/MF A01
 Harris (Carl M.) and Associates, Charlottesville, VA.
Computer Generation of Latin Hypercube Sampling Plans.
 Final rept.,
 C. M. Harris. Nov 84, 18p NBS/GCR-84/476
 Sponsored by Federal Emergency Management Agency, Washington, DC.

Keywords: Mathematical models, Simulation, Sampling, Algorithms, *Latin hypercube sampling, Sensitivity analysis, HYPCUBE computer program, FORTRAN 77 programming language, Cyber-855 computers.

A previous study examined the primary statistical methods for understanding possible randomness in large-scale model prediction. The major focus of that work was a discussion of the role of Latin hypercube sampling for the measurement of uncertainty in model output. This work documents the development of detailed software for selecting a hypercube sampling plan. This computer code generates Latin hypercubes of any user-applied dimension. The time necessary to run the program goes up with size, but this growth is slow and should not pose any unusual problem for the user.

12B. Operations Research

401,052
PB84-166701 PC A05/MF A01
 National Bureau of Standards, Washington, DC. National Engineering Lab.
Survey of Sensitivity Analysis Methodology,
 R. G. Hendrickson. Feb 84, 89p NBSIR-84-2814

Keywords: Mathematical models, Computation, Statistical analysis, Sampling, Errors, Mathematical programming, Surveys, Reviews, *Sensitivity analysis.

This survey on the methodology of sensitivity analysis presents a general statement of the several broad categories of this discipline for the purpose of pulling together the various approaches and theory, to show the extent and sophistication of new techniques, special applications, and the relation of sensitivity analysis to model evaluation.

401,053
PB85-102275 Not available NTIS
 National Bureau of Standards, Washington, DC.
Linearization in 0-1 Variables: A Correction.
 Final rept.,
 A. J. Goldman. Oct 83, 2p
 Pub. in Operations Research 31, n5 p946-947 Sep-Oct 83.

Keywords: *Nonlinear programming, Computation, Correction, Reprints, Integer programming, Linearization, Zero one programming.

A published method for linearizing nonlinear 0-1 programs is shown to be incomplete, but a simple modification restores its validity and retains most of its computational advantage.

401,054
PB85-116317 PC A03/MF A01
 Harris (Carl M.) and Associates, Charlottesville, VA.
Issues in Sensitivity and Statistical Analysis of Large-Scale, Computer-Based Models.
 Final rept.,
 C. M. Harris. Aug 84, 41p NBS/GCR-84/466
 Sponsored in part by Federal Emergency Management Agency, Washington, DC.

Keywords: *Mathematical models, *Computerized simulation, Statistical analysis, Probability theory, Sensitivity analysis, Uncertainty, Response surface analysis, Energy models.

This report addresses both the theoretical and practical considerations associated with the use of sensitivity analysis in model evaluation. Special attention is paid to uses of sensitivity analysis to determine the rates of output change with respect to changes in the inputs, importance ranking of the inputs from a sensitivity viewpoint, and assessment of output variability attributable to the inputs. One of the natural conse-

quences of such statistical quantification of the variability of the model's outputs is the development of tools useful for the decision maker in employing the target model in the analysis of measures for dealing with an uncertain environment. Two analysis techniques, model sampling and response surface analysis, are described in the report. Illustrations are provided to demonstrate how one would apply each of the techniques as an integral part of a model evaluation.

401,055
PB85-142974 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
IFORS (International Federation of Operational Research Societies) in Retrospect, IFORS Twenty-Fifth Anniversary Banquet Speech.
 Final rept.,
 J. H. Engel. 1984, 11p
 Sponsored by International Federation of Operational Research Societies and Technical Univ. of Denmark, Lyngby.
 Pub. in Operational Research '84, p55-65 1984.

Keywords: *Operations research, *Scientific societies, *Societies, Reviews, Reprints, *International Federation of Operational Research Societies.

The author reviews, in a non-technical way, what has happened to IFORS during its first twenty-five years, and shows that IFORS has succeeded in encouraging the creation of a world-wide community of scientists engaged in operational research.



13. MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

13A. Air Conditioning, Heating, Lighting, and Ventilating

401,056
PATENT-4 423 768 Not available NTIS
 Department of the Army, Washington, DC.
Piezoelectric Polymer Heat Exchanger.
 Patent,
 S. Edelman, and L. D. Ballard. Filed 20 Apr 83,
 patented 3 Jan 84, 6p AD-D011 301/9, PAT-APPL-6-370 027
 Supersedes PAT-APPL-6-370 027, AD-D005 384.
 This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231, \$1.00.

Keywords: *Patents, *Heat exchangers, *Piezoelectric materials, *Polymers, Electrodes, Heat transfer, Sheets, Efficiency, Fluid flow, Channel flow, PAT-CL-165-84.

Disclosed is an apparatus for providing for increased heat transfer efficiency of a heat exchanger by separating contiguous fluid conductive channels by means of a flexible sheet fabricated from a piezoelectric polymer. An electrode pattern of predetermined configuration is applied to one or both sides of the piezoelectric sheet and an electrical signal applied thereto in order to set the sheet into a flexural resonance condition whereupon a standing wave pattern is established to not only break up the boundary layer of fluid which adheres to each side of the sheet, but also minimizing the thickness of the laminar sub-layer.

401,057
PB84-135607 PC A06/MF A01
 National Bureau of Standards, Washington, DC.
Air Quality Criteria for Storage of Paper-Based Archival Records,
 R. G. Mathey, T. K. Faison, S. Silberstein, J. E. Woods, and W. B. Johnson. Nov 83, 112p NBSIR-83-2795
 Sponsored in part by General Services Administration, Washington, DC., and National Archives and Records Service, Washington, DC.

Keywords: *Archives, *Air pollution, *Papers, *Environmental engineering, Sulfur dioxide, Nitrogen oxides, Ozone, Temperature, Humidity, Storage, *Air quality, *Air pollution effects(Materials).

Criteria for temperature, relative humidity, and gaseous and particulate contaminant concentrations are proposed for spaces used for storage and preservation of paper-based archival records. The criteria are based on available information from the literature, and recommendations of the January 19-20, 1983, National Bureau of Standards Workshop on Environmental Conditions for Archival Storage. Methods are discussed for meeting these criteria. Air quality criteria are proposed for different categories for archival storage. Factors to consider in the design of archival storage facilities are addressed and recommendations made to aid in the design of environmental conditioning systems for these facilities. A review of literature describes the damage that may be caused by high temperature, high and low relative humidity, and air pollutants to paper-based records. Results of measurements of temperature, relative humidity, air exchange rate, and gaseous contaminant concentrations (sulfur dioxide, nitrogen oxides, and ozone) in the National Archives Building in Washington, D.C., are presented. These measurements are compared with those made in other buildings having controlled environments.

401,058
PB84-135615 PC A02/MF A01
 National Bureau of Standards, Washington, DC.
Measurement of the Concentration of Sulfur Dioxide, Nitrogen Oxides, and Ozone in the National Archives Building.
 Final rept.,
 E. E. Hughes, and R. Myers. Oct 83, 25p NBSIR-83-2767
 Sponsored in part by General Services Administration, Washington, DC.

Keywords: *Archives, *Air pollution, Concentration(Composition), Sulfur dioxide, Nitrogen oxides, Ozone, Ventilating systems, *Indoor air pollution, *Air pollution effects(Materials).

Continuous measurements of nitrogen oxides, sulfur dioxide and ozone were made consecutively at locations in the stack areas of the National Archives building in Washington, DC. Similar measurements were made at single locations in the Madison Building of the Library of Congress and the East Wing of the National Gallery of Art. The results indicate that the ventilating system of the National Archives has no effect on the concentration of nitrogen oxides or sulfur dioxide drawn into the building. The results for ozone were inconclusive. The newer ventilating systems of the Madison Building and the East Wing are effective in removing sulfur dioxide but not the oxides of nitrogen.

401,059
PB84-154004 PC A05/MF A01
 National Bureau of Standards, Washington, DC. National Engineering Lab.
Calibration of Temperature Measurement Systems Installed in Buildings.
 Building science series (Final),
 C. W. Hurley, and J. F. Schooley. Jan 84, 87p NBS-BSS-153
 Also available from Supt. of Docs. as SN003-003-02546-1. Library of Congress catalog card no. 83-600622.

Keywords: *Calibrating, *Temperature measuring instruments, *Buildings, Thermometers, Resistance thermometers, Thermocouples, Thermistors, Pressure, Thermopiles, Integrated circuits, Temperature control, Accuracy, Standards.

Energy Management Control Systems (EMCS) cannot function properly or efficiently without accurate temperature measurements since temperature is one of

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13A—Air Conditioning, Heating, Lighting, and Ventilating

the fundamental measurements of any EMCS. This report was written for the purpose of describing various methods of on-site calibration of temperature sensing devices used in EMCS and to review the characteristics of these devices that are directly related to calibration. The significance of recording the results of each calibration is emphasized and the possible effects of systematic errors in temperature monitoring systems is discussed.

401,060
PB84-157973 PC A02/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Automated Office: An Environment for Productive Work, or an Information Factory: Executive Summary,
A. I. Rubin. Dec 83, 22p NBSIR-83-2784-2
Sponsored in part by General Services Administration, Washington, DC.

Keywords: *Office buildings, *Environments, Design, Human factors engineering, Acoustics, Illuminating, Comfort, Job analysis, Quality of life, Automation.

This study is a report of research findings and recommendations covering topics which influence automated office design. The subjects covered are: office design, office information systems, organizational factors, ergonomics, technology and communications. Advances in technology, coupled with the explosive growth of office-based work have resulted in the automation of many offices. To date, technology has provided the major impetus for automation, with mixed results. Systems frequently do not meet the need of the end-user because of the lack of appropriate planning. Design issues are particularly neglected during planning, resulting in problems with the visual, thermal, and acoustic environment in many offices.

401,061
PB84-182146 PC A05/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Laboratory Evaluation of the Steady-State and Part Load Performance of Absorption Type Heating and Cooling Equipment,
R. Radermacher, M. McLinden, S. Klein, and D. Didion. Mar 84, 93p NBSIR-84-2816
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Heat pumps, *Water chillers, Flow rate, Temperature gradients, Cooling load, Mathematical models, Valves, Seasonal variations, Computer applications.

In this investigation, an absorption water chiller and an absorption heat pump were extensively tested under steady-state and cyclic operating conditions. Since the tests were performed on two different units, one for a cooling only and one for a heating only application, the report is set up in two parts discussing the results of the testing of each unit separately.

401,062
PB84-217447 PC A07/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Test Methods and Standards Development for Active Solar Heating and Cooling Systems.
Final rept.,
H. R. Trechsel, and B. L. Collins. Apr 84, 145p NBSIR-84-2845
Contract DE-AI01-76PRO6010

Keywords: *Solar heating, Tests, Standards, Heat storage, Materials, Residential buildings, Solar collectors, *Solar water heating, Solar absorbers.

Since test methods and standards for active solar heating and cooling systems did not exist in 1976, the Department of Energy sponsored research at the National Bureau of Standards (NBS) and other laboratories to aid in the development of research-based standards. This research was intended to facilitate a sound data base for the development of national consensus standards and test methods. In the present report, research by NBS and other laboratories is described for solar domestic hot water systems, solar collectors, thermal storage devices and collector materials. For collectors, the report describes research and test methods for determining the performance of cover plates, absorber materials, collector insulation, gaskets and sealants, rubber hose, containment materials, and heat transfer fluids.

401,063
PB84-221282 Not available NTIS
National Bureau of Standards, Washington, DC.
Prospects for Small Cryocoolers.
Final rept.,
R. Radebaugh. 1982, 5p
Pub. in Proceedings of International Cryogenic Conference (9th) held at Kobe, Japan on May 11-14, 1982, p761-765 1982.

Keywords: *Refrigerators, Reliability, Cryogenics, Research, Helium, *Cryogenic refrigerators, *Cryocoolers.

Small cryocoolers are commonly used in the areas of infrared detection, satellite communication, and cryopumps. Some emerging application areas deal with SQUID and Josephson junction devices, which require temperatures of about 8 K or below. The need for high reliability in these small cryocoolers has dictated the use of regenerative-cycle machines, but such machines are presently limited to temperatures above about 8 K. This paper discusses some of the research being done to improve reliability, decrease noise, and reduce the low-temperature limit of small cryocoolers.

401,064
PB84-221621 Not available NTIS
National Bureau of Standards, Washington, DC.
Simplified Methods for Determining Seasonal Heat Loss from Uninsulated Slab-on-Grade Floors.
Final rept.,
T. Kusuda, and J. W. Bean. 1984, 22p
Pub. in American Society of Heating, Refrigeration and Air-Conditioning Engineers Transactions 90, pt. 1 p611-632 1984.

Keywords: *Floors, *Slab on ground construction, *Heat loss, Green's function, Fourier transformation, Comparison, Finite element analysis.

Three different types of slab-on-grade heat loss calculation procedures are discussed and compared with each other. The procedures discussed are the Green's function type solution, Delsantes Fourier Transform type solution and the Mitalas procedure derived from the finite element analysis. Although the Green's function and Delsante type solutions agree very well with each other, the Mitalas solution showed a larger time lag effect resulting in lower winter heat loss and much higher summer floor heat loss than those determined by the other two methods.

401,065
PB84-221985 Not available NTIS
National Bureau of Standards, Washington, DC.
Effective Use of Daylighting.
Final rept.,
S. J. Treado, and G. L. Gillette. Jun 83, 9p
Pub. in Proceedings of the Energy Technol. Conf. (10th), Washington, DC., 28 Feb-2 Mar 83, p647-655 Jun 83.

Keywords: *Daylighting, Buildings, Architecture, Windows, Cooling load, Heating load, Effectiveness, Energy analysis.

The type, size and configuration of fenestration apertures have a strong impact on building lighting, heating and cooling loads. Daylight utilization has been shown to have good potential for reducing lighting energy requirements; however, the effect of daylighting schemes on building space heating and cooling energy requirements must also be considered. Since the luminous efficacy of solar radiation is typically two or three times that of electric light sources, the substitution of the proper levels of daylight for electric lighting can reduce lighting and cooling loads substantially, while providing the additional psychological and aesthetic benefits traditionally associated with fenestration in buildings. This paper describes some of the results obtained from measurements and computer simulations regarding the optimum utilization of daylight in buildings. The findings are summarized in the form of design guidelines for effective fenestration utilization.

401,066
PB84-224302 PC A05/MF A01
National Bureau of Standards, Washington, DC.
Strategies for Energy Conservation for a School Building,
J. Y. Kao. Mar 84, 78p NBSIR-84-2831
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Buildings, Heating, Air conditioning, United States, Regions, Comparison, Evaluation, Computerized simulation, *Energy conservation, *School buildings, BLAST computer program, Energy consumption.

A comparative analysis is made of the thermal performance of selected HVAC systems and control strategies commonly employed in education buildings. The comparisons are made for six geographical locations representing wide climatic variations within the continental United States. Hour-by-hour simulations with the BLAST computer program are used to obtain the yearly heating, cooling, and fan energy consumption of an elementary school. The HVAC systems simulated are constant volume reheat, variable air volume, dual-duct, and unit ventilator systems. The control strategies tested are dry-bulb temperature economy cycle, enthalpy economy cycle, supply air temperature resetting, and the combinations of these strategies. The results of these simulations are presented and discussed. Substantial energy consumption differences are shown to exist.

401,067
PB84-224344 PC A11/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Performance Criteria for Solar Heating and Cooling Systems in Commercial Buildings.
Final rept.,
Apr 84, 232p NBS/TN-1187
Contract DE-AI01-76PRO6010
Also available from Supt. of Docs as SN003-003-02579-8.

Keywords: *Solar heating, Commercial building, Design, Development, Technology, Performance, Criteria, Solar water heating, Solar space heating, Solar air conditioning.

This document establishes baseline criteria for the design, development, technical evaluation and procurement of solar heating and cooling systems for commercial buildings. These performance criteria were developed in accordance with Public Law 93-409 the 'Solar Heating and Cooling Demonstration Act of 1975.' The document is intended as a resource for use in establishing minimum acceptance levels of performance for solar heating and cooling systems. Criteria which deal with public health and safety are in compliance with general building codes and standards. The criteria on thermal and mechanical performance, durability/reliability and operation/servicing present performance requirements considered to be representative of acceptable levels for conventional space conditioning equipment. By the use of performance language in the document, it is believed that sufficient latitude has been provided to allow innovation and flexibility that is essential for the stimulation of a viable solar industry.

401,068
PB84-225226 Not available NTIS
National Bureau of Standards, Washington, DC.
Approach to Optimization of Low-Power Stirling Cryocoolers.
Final rept.,
D. B. Sullivan, R. Radebaugh, D. E. Daney, and J. E. Zimmerman. 1983, 24p
Sponsored in part by Office of Naval Research, Arlington, VA.
Pub. in Proceedings of Biennial Conference Refrigeration Cryogenic Sensors Electronic Systems (2nd), Greenbelt, MD., Dec 7-8, 1982, p107-130 1983.

Keywords: *Refrigerators, Stirling cycle, Optimization, Design, Cryogenics, *Cryocoolers, Cryogenic refrigerators.

The authors describe a method for optimizing the design (shape of the displacer) of low-power Stirling cryocoolers relative to the power required to operate the systems. A variational calculation which includes static conduction, shuttle, and radiation losses, as well as regenerator inefficiency, has been completed for

coolers operating in the 300 K to 10 K range. While the calculations apply to tapered displacer machines, comparison of the results with stepped-displacer cryocoolers indicates reasonable agreement.

401,069

PB84-226075 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Building Technology.

Performance and Selection Criteria for Mechanical Energy Saving Retrofit Options for Single-Family Residences,

E. Kweller, and S. Silberstein. Jun 84, 77p NBSIR-84-2870

Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Residential buildings, *Heating systems, Houses, Water heaters, Heat pumps, Space heating, Insulation, Weathering, Performance evaluation, Standards, Cost analysis, Furnaces, Oil burners, Gas furnaces, *Energy conservation, Renewable energy sources, Waste heat utilization.

Under the Weatherization Assistance Program the U. S. Department of Energy (DoE) provides funds for energy-conserving building improvements in homes of low-income persons. In proposing to modify the program to also provide funds for energy-conserving mechanical options, DoE requested that the National Bureau of Standards investigate energy-conserving mechanical options that may be suitable for inclusion in the Weatherization Assistance Program. This report estimates energy savings, and provides performance and selection criteria, standards, and installed costs for mechanical equipment options for single-family homes; all from prior studies reported in the literature. Performance and selection criteria are presented as advantages, disadvantages and limitations for each option. Four broad categories of energy-saving mechanical options were investigated: space heating, water heating retrofit options, heat pump water heaters, and recovery of central air conditioner waste heat by desuperheaters. Gas- and oil-fueled forced-air furnaces and hydronic (hot water) space-heating equipment were treated in this report.

401,070

PB84-227461 Not available NTIS
National Bureau of Standards, Washington, DC.

Cryocooler for Applications Requiring Low Magnetic and Mechanical Interference.

Final rept.,
J. E. Zimmerman, D. E. Daney, and D. B. Sullivan.

Dec 82, 11p
Pub. in Proceedings of Biennial Conf. Refrigeration Cryogenic Sensors (2nd) Electronic Systems, NASA Goddard Space Flight Center, Greenbelt, MD. Dec 7-8, 1982, NASA Conference Publication 2287, p95-105.

Keywords: *Refrigerators, Stirling cycle, Design, Cryogenics, *Cryocoolers, Cryogenic refrigerators.

A very low-power low-interference Stirling cryocooler is being developed based on principles and techniques developed over the last four years and described in several previous publications. It differs in several important details from those built previously. It uses a tapered displacer based upon an analytical optimization procedure. The displacer is driven by an auxiliary piston and cylinder (rather than by mechanical linkage) using some of the working fluid itself to provide the driving force. This provides smooth, vibration-free motion, and, more importantly, allows complete mechanical and spatial separation of the cryostat from the pressure-wave generator. Either of two different pressure-wave generators can be used. One uses a non-contaminating unlubricated ceramic piston and cylinder. The other uses a compressed-air-operated rubber diaphragm and motor-driven valves to cycle the pressure between appropriate limits.

401,071

PB84-241496 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Building Equipment Div.

Test Results and a Recommended Test Procedure for Heat Traps,

J. E. Harris. Mar 84, 30p NBSIR-84/2851

Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Water heaters, Gas appliances, Tests, Heat loss, Traps, Performance evaluation, *Energy conservation, *Heat traps, Procedures.

A series of standby loss tests was conducted on a 40 gallon gas water heater to determine the standby losses and the variability of those losses. Tests were run with both inlet and outlet plugged and insulated to determine the jacket losses, then tests were conducted with bare and insulated, vertical copper pipe, with and without heat traps. It was determined that the variability of the heat losses was large enough to conclude that the possible heat loss reduction by the use of heat traps could not be accurately detected and therefore the effectiveness of heat traps could not be accurately tested on gas water heaters. A recommended test procedure for heat traps was developed using a water heater simulator and then a number of tests were conducted with four different heat traps, in a variety of pipe sizes and material, bare and insulated, in vertical and horizontal orientations. It was recommended that the water heater simulator be used for any heat trap testing. It was also recommended that the heat trap credits currently given in the DOE water heater test procedure be dropped since any benefit of heat traps will be shown by the test results.

401,072

PB84-243997 Not available NTIS
National Bureau of Standards, Washington, DC.

Procedures for Determining Annual Efficiency for Furnaces and Vented Household Heaters with Modulating-Type Controls.

Final rept.,
E. Kweller. Jun 83, 18p

Pub. in ASHRAE Transactions 89, Pt. 1-B, p301-318 Jun 83.

Keywords: *Furnaces, *Heating equipment, *Modulators, *Combustors, Households, Performance evaluation, Design criteria, Ignition time, *Energy conservation, Consumer products, Procedures.

As annual operating efficiency of vented heating equipment is affected by burner fuel and combustion air modulation, it is important to differentiate between the various types of controls in determining annual energy requirements. Test procedures for evaluating annual efficiency have already been developed and implemented by the Department of Energy (DOE) for furnaces with single-stage thermostat control. A modified test procedure is necessary to account for operation with fuel modulation. A revised procedure that accommodates two types of fuel-modulating controls has recently been developed. Tests are conducted at reduced and maximum firing rates, and part-load efficiencies for the two firing rates are calculated and weighted to obtain a weighted annual efficiency. A analysis of weather data is used to obtain outdoor average temperatures for calculating infiltration losses and for the weighting fractions used. These test methods and calculation procedures are based on and are an extension of the current DOE test procedures for the single-stage type of thermostat control of central warm air furnaces.

401,073

PB84-246032 Not available NTIS
National Bureau of Standards, Washington, DC.

Daylighting Computation Procedure for Use in DOE-2 and Other Dynamic Building Energy Analysis Programs.

Final rept.,
G. Gillette, and T. Kusuda. Jan 83, 11p

Sponsored in part by National Fenestration Council, Topeka, KS.

Pub. in Jnl. of the Illuminating Engineering Society 12, n2 p78-85 Jan 83.

Keywords: *Daylighting, Computerized simulation, Buildings, Reprints, *Energy conservation, Energy analysis, Passive solar heating systems.

A computer model is discussed for estimating the annual energy performance of a daylighted building. The model is designed for inclusion into larger building energy simulation programs such as DOE-2, BLAST, and NBSLD, where it will provide means of evaluating the impact of daylighting as it relates to the total building's energy requirements. Algorithms have been developed for giving hourly sky conditions, hourly interior daylight, and hourly adjusted electric lighting load. Extensive comparisons with field measurements show a correlation in most cases of within 30% of real conditions.

401,074

PB85-102788 Not available NTIS
National Bureau of Standards, Washington, DC.

Thermographic Inspection of Exterior Wall Insulation Retrofits.

Final rept.,
R. A. Grot, and Y. M. L. Chang. 1983, 16p
Sponsored in part by American Society for Testing and Materials, Philadelphia, PA., Department of Energy, Washington, DC. and Oak Ridge National Lab., TN.

Pub. in Proceedings of Thermal Insulation, Materials, and Systems for Energy Conservation in the 1980's, Clearwater, FL., December 8-11, 1981, p321-336 1983.

Keywords: *Heat loss, *Houses, Airtightness, Thermal insulation, Quality control, Analysis of variance, Houses, Thermal measurements, Low income groups, Defects, Reprints, Retrofitting, Weatherization.

A national demonstration of the effectiveness of an optimal weatherization program for low-income families was conducted by the Community Services Administration and the National Bureau of Standards. Of the original 200 some homes as participants, over 100 single-family dwellings in 12 cities in the continental United States were retrofitted and inspected with thermography equipment. The weatherization techniques included air infiltration reducing measures such as caulking & weatherstripping, additional attic insulation, storm windows, exterior wall insulation, basement/crawl space insulation, & modification or replacement of the heating systems. In order to assess the quality of the workmanship of the energy reducing measures applied to the building envelope, and in particular the quality of the installation of cavity wall insulation, thermographic surveys were performed after the completion of the weatherization work.

401,075

PB85-109627 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.
Building Equipment Div.

Fortran 77 Computer Program for Test Procedure Calculations of Vented Heaters,

R. A. Wise, and F. C. Parsons. Sep 84, 53p NBSIR-84/2918

Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Space heaters, *Computer programs, Tests, Fortran, Vented heaters.

The Fortran 77 computer program described in the report is to be used to calculate results from tests run on vented heaters. The Department of Energy recently published a revised test procedure for such heaters but which contains a simplified method for testing with a number of testing options that allow more detailed tests to be run. The new procedure also provides for the testing of units with manual controls of two types, modulating controls of two types, and the testing of units incorporating thermal stack dampers as well as electro-mechanical dampers. Once input selections have been made, the program performs the calculations required and prints out the results.

401,076

PB85-120129 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.

Criteria for Mechanical Systems in Multifamily Buildings for Residential Weatherization Options,

L. S. Galowin. Sep 84, 79p NBSIR-84/2939

Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Residential buildings, *Heating equipment, *Construction materials, *Cooling systems, Criteria, Maintenance, Replacing, Performance, Regulations, *Weatherization, Retrofitting, Energy conservation.

The National Bureau of Standards (NBS) prepared the original criteria and list of eligible retrofit options adopted for energy conservation by the Department of Energy Conservation in Existing Buildings Act of 1976. NBS was requested to review, update, and expand the criteria and list of retrofits for 1984 amendments to the regulation. This report presents the criteria and reference standards for retrofit options of mechanical equipment and systems in multifamily buildings. Mechanical systems equipment, controls, energy management systems, burners, and boiler/furnace tune-

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13A—Air Conditioning, Heating, Lighting, and Ventilating

ups/repairs were included. The options for retrofit technologies for equipment replacement components include items such as burners, burner controls, combustion chamber refractories, modifications with dampers, turbulators, and waste heat recovery devices. The criteria developed did not include economic factors and statutory constraints under the rulemaking procedures.

401,077

PB85-120657 Not available NTIS
National Bureau of Standards, Washington, DC.
Experimental Evaluation of Engine-Driven Heat Pump Systems.

Final rept.,
B. R. Maxwell, and D. A. Didion. 1978, 18p
Pub. in Proc. ASME Winter Annu. Meet., Energy Conservation in Building Heat and Air Conditioning Systems, San Francisco, California, December 10-15 1978, p59-76.

Keywords: *Heat pumps, *Engines, *Drives, Stirling cycle engines, Diesel engines, Experimental data, Performance, Capacity, Heating, Cooling, Compressors, Temperature, Reprints, Energy conservation, Coefficient of performance.

A laboratory investigation was conducted of an engine-driven air-to-air, variable speed, 3-ton Rankine heat pump. A water-cooled Stirling engine was used in one series of tests and a water-cooled Diesel engine of comparable size was used in another series. The steady-state part-load performance of both engine-driven systems was determined as a function of outdoor temperature and compressor speed. Engine coolant energy and recoverable exhaust energy were determined and included in the heating mode calculations. Heating and cooling capacities, system coefficients of performance, and seasonal performance factors were determined for both systems. Additional tests were concerned with defrost-mode energy requirements and the influence of coolant temperature on system performance.

401,078

PB85-123610 Not available NTIS
National Bureau of Standards, Washington, DC.
Milliwatt Stirling Cryocooler for Temperatures below 4 K.

Final rept.,
J. E. Zimmerman, and D. B. Sullivan. 1979, 2p
Pub. in Cryogenics 19, n3 p170-171 1979.

Keywords: *Refrigerators, Liquid helium, Cryogenics, Reprints, *Cryocoolers, *Cryogenic refrigerators.

This paper describes a single-stage Stirling machine producing several mW of refrigeration at temperatures in the range of 3 to 4 K and dissipating 50 to 100 mW at temperatures of 8 to 14 K. The cold parts of the system are made of spun-glass epoxy rod and tubing, and the working fluid is helium at subatmospheric average pressure. Part of the working fluid is liquified during operation.

401,079

PB85-128817 Not available NTIS
National Bureau of Standards, Washington, DC.
Adaptive Controller for Heating and Cooling Systems: Modeling, Implementation and Testing.

Final rept.,
C. Park, and A. J. David. 1982, 8p
Pub. in Proceedings of Winter Annual Meeting of the American Society of Mechanical Engineers (103rd), Phoenix, AZ, November 14-19, 1982, 8p.

Keywords: *Controllers, Adaptive systems, Automatic control, Algorithms, Space HVAC systems, Energy consumption, Microprocessors.

The use of adaptive control algorithms was studied for microprocessor driven direct digital control of elementary building heating and cooling subsystems. An algorithm was designed for digital regulation of a linear, time-invariant first-order system with a system dead time. A recursive least squares algorithm was used to estimate, on-line, the parameters of the system. The parameter estimates were then used to calculate the feedback gains of a Proportional plus Integral (PI) controller.

401,080

PB85-134054 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Universal Economic Optimization Paths for Solar Hot Water Systems in Commercial Buildings.

Final rept.,
G. T. Sav. 1979, 13p
Pub. in Energy 4, n3 p415-427 Jun 79.

Keywords: *Size determination, Optimization, Climatology, Commercial buildings, Economic analysis, Incentives, Marketing, Solar energy, *Solar water heating, Solar collectors.

This paper presents a simplified methodology for determining the economically optimal size solar hot water system to install in a commercial building. The methodology can be used to develop universal economic optimization paths for relatively broad climatological areas. The optimization paths show the optimal collector area as a linear function of annual hot water load, for a given set of economic parameters. Moreover, the paths show that for any climatological area, the optimal fraction of load supplied by solar is independent of the level of hot water load. The optimization paths appear to be an extremely valuable tool for developing regional sizing guidance to the building community, for conducting sensitivity analyses, and for developing regionally efficient monetary incentives for increasing the market penetration of solar energy.

401,081

PB85-141430 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Performances of Different Passive Solar Systems at the NBS (National Bureau of Standards) Test Facility.

Final rept.,
B. M. Mahajan, S. T. Liu, and K. A. Reed. 1984, 6p
Sponsored by Department of Energy, Washington, DC. Office of Solar Heat Technologies.
Pub. in American Society of Mechanical Engineers Technical Paper 84-WA/Sol-3, 6p 1984.

Keywords: *Solar heating, Performance evaluation, Temperature, Wind velocity, Wind direction, Test facilities, Instruments, Reprints, *Passive solar heating systems, Trombe walls, Air infiltration, Energy consumption.

This paper compares the measured winter-time performances of three full-sized adjoining rooms each with a different south-facing passive solar feature. These rooms are a direct gain cell, a control cell, and a Trombe wall cell in the NBS passive solar test facility. The performances of these three cells were monitored for a period of three weeks during January-February, 1984 under the following experimental conditions: lower-bound temperature fixed and upper-bound temperature free floating in all cells; and vents of the Trombe wall blocked. During the experiment data from about 426 sensors are collected. The data include: auxiliary energy supplied, continuous air infiltration, temperatures, and wind speed and direction. This paper briefly describes the test facility, instrumentation, data acquisition system and procedures, and presents representative results from the performance monitoring experiment.

401,082

PB85-142305 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Fundamentals of Alternate Cooling Systems.

Final rept.,
R. Radebaugh. 1983, 47p
Pub. in Cryocoolers, Chapter 11, p129-175 1983.

Keywords: *Refrigerators, *Thermodynamics, Electrons, Phonons, Magnetic dipoles, Mixtures, Photons, Electrochemical cells, Cryogenics, Reprints, *Cryogenic refrigerators, *Cryocoolers, Electric dipoles.

This paper is written as Chapter 11 for the book Cryocoolers, by G. Walker. In this chapter, the thermodynamic fundamentals applicable to any refrigeration system are discussed. Emphasis is placed on systems other than the gas-liquid systems normally used in mechanical refrigerators in hopes of stimulating new ideas in refrigeration. Because refrigeration power is proportional to the available entropy of the system, entropy comparisons are used to evaluate the potential of new systems. The systems discussed here include such things as electrons, phonons, magnetic dipoles, electric dipoles, mixtures, electrochemical cells, photons, as well as some gas-liquid-solid systems. A de-

scription of how each of these systems can be used for refrigeration, along with the useful temperature range, is presented.

401,083

PB85-142362 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Nonideal Regenerator Performance: The Effect of Void Volume Fluid Heat Capacity.

Final rept.,
D. E. Daney, and R. Radebaugh. Sep 84, 3p
Sponsored by Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.
Pub. in Cryogenics 24, n9 p499-501 Sep 84.

Keywords: *Regenerators, Heat exchangers, Specific heat, Thermal efficiency, Refrigerating, Reprints.

The performance of thermal regenerators is analyzed for a range of parameters of particular interest for low temperature refrigeration. Using a time-dependent, one-dimensional, incompressible flow, numerical model we show that the void volume fluid heat capacity can strongly influence regenerator behavior. Inclusion of the void volume term gives significant improvements in the predicted effectiveness when the void volume and matrix heat capacities are of the same order. For some regimes of low thermal loads increasing the matrix heat capacity may actually reduce the effectiveness.

401,084

PB85-143311 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Criteria for Recommending Lighting Levels.

Final rept.,
G. T. Yonemura. 1981, 17p
See also PB81-185126. Sponsored by Department of Energy, Washington, DC. Office of Building and Community Systems.
Pub. in Light Research and Technology 13, n3 p113-129 1981.

Keywords: *Illuminating, Luminous intensity, Human factors engineering, Visual perception, Visibility, Criteria, Reprints.

The role of lighting on behavior ranges from allowing simple detection of objects to creating moods and impressions. Lighting standards and recommendations for general applications should be based on the visibility (seeing) requirements where differences between individuals are minimal. The evaluative visual response where significant differences in interpretations and evaluations between individuals and/or groups of individuals do occur cannot be universally applied, but should be treated as design options to be applied when they are important aspects of the intended function of the space. But the lighting criteria or standard must evaluate the seeing process under stimulus conditions approximating those encountered in the real space. It is recommended that conspicuity, defined as: 'how well the detail stands out from the background', or ease of seeing be the metric for visibility.

401,085

PB85-144905 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Impact of Building Codes and Regulations on Indoor Air Quality.

Final rept.,
P. E. McNall. 1984, 5p
Sponsored by American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA. Pub. in Proceedings of Engineering Foundation Conference on Management of Atmospheres in Tightly Enclosed Spaces, Santa Barbara, CA., October 17-21, 1983, p57-61 Jun 84.

Keywords: *Building codes, *Air pollution, Standards, Design criteria, Ventilation, Regulations, Assessments, *Indoor air pollution, *Air quality.

In the United States there is a comprehensive complex and often inconsistent system of regulations which relates to building design, construction and occupancy. These regulations, in the various states, are examined to assess the technical bases for their ventilation provisions and to determine if they permit innovation in indoor and air quality technology.

401,086

PB85-145316 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Impact of a Retrofitted Heat Recovery Unit on an Existing Residential Heat Pump and Water Heater.
Final rept.,
K. M. Tu, and S. Fischler. 1980, 25p
Sponsored by Oak Ridge National Lab., TN.
Pub. in Proceedings of Conference Waste Heat Recovery for Energy Conservation - Residential and Light Commercial Heat Pumps, Air Conditioning, and Refrigeration Systems, West Lafayette, IN., September 15-17, 1980, p 55-79.

Keywords: *Heat pumps, *Heat recovery, *Hot water heating, Residential buildings, Performance tests, Temperature, Compressors, *Retrofitting, Energy conservation.

Two heat recovery units were retrofitted, one at a time, with one heat pump and one storage-type water heater to produce two integrated heat pump - heat recovery unit - water heater systems. Each system was operated with appropriate measuring devices to determine the effect(s) of using the 'retrofit' heat recovery unit on the performance of the heat pump and water heater. The system was operated with the outdoor unit of the heat pump in an environmental chamber with 'outdoor temperatures' of 75, 85, 95, and 20F. The indoor unit of the heat pump was in an environmental chamber whose 'indoor temperature' was set at 80F when the outdoor temperature was 75, 85, 95F, and 70F when the outdoor temperature was set at 20F. The indoor relative humidity was maintained at approximately 50%. The heat recovery unit and water heater were in an environmental chamber set at the 'basement temperature' of 65F with 50% relative humidity.

401,087

PB85-145407 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Climate Data Abbreviation for the Computerised Calculation of Heating and Cooling Requirements in Buildings.
Final rept.,
D. H. Nall, and E. A. Arens. 1979, 15p
See also PB-289 927.
Pub. in Energy and Buildings 2, n2 p135-149 Apr 79.

Keywords: *Heating load, *Cooling load, *Climate, Weather, Thermal analysis, Buildings, Data, Computation, Reprints, *Energy consumption.

This paper documents the development of a climate data abbreviation technique for building thermal analysis. The paper first discusses the need for and requirements of abbreviated data. The technique is then described together with the statistical analyses used to develop it. A series of tests of the representativeness of the abbreviated climate data are documented. Finally, the limitations and potentials of the abbreviation technique are discussed.

401,088

PB85-151561 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Ventilation Concepts for Office Buildings.
Final rept.,
P. E. McNall, and A. K. Persily. 1984, 10p
Sponsored by American Conference of Governmental Industrial Hygienists, Inc., Cincinnati, OH.
Pub. in Annual American Conference of Governmental Industrial Hygienists 10, p49-58 1984.

Keywords: *Office buildings, *Ventilation, Heating equipment, Air conditioning equipment, Reprints, Air quality.

This paper describes several heating, ventilating, and air-conditioning (HVAC) systems which are commonly used in new and existing office buildings. These systems are analyzed from the viewpoint of how well they provide ventilation to the interior spaces for air quality purposes. Several problems are identified, which need further research to ensure adequate ventilation for air quality.

401,089

PB85-153443 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Research Priorities for Improving the Effectiveness of Active Solar Hot Water and Space Conditioning Systems.
Final rept.,
R. D. Dikkers, W. J. Kennish, C. B. Winn, and W. Huston. Dec 84, 76p NBSIR-84/2980
Contract DE-AI01-76PR06010
Prepared in cooperation with TPI, Inc., Beltsville, MD. and Solar Environmental Engineering Co., Inc., Fort Collins, CO.

Keywords: *Solar heating, *Solar water heating, *Research management, Maintenance, Research projects, Project planning, Performance evaluation, Reliability, Tests, Control equipment.

As part of the FY 1983 Department of Energy Systems Effectiveness Research Program, the National Bureau of Standards (NBS) was assigned responsibility for developing research priorities for improving the effectiveness (i.e., thermal performance, cost, reliability and maintainability) of active solar hot water and space conditioning systems. To carry out this task, NBS, in cooperation with various industry representatives, organized and conducted two meetings in August 1983. The first meeting covered all major aspects of active solar hot water and space conditioning systems. The second meeting dealt only with solar control subsystems. Based on information obtained from these meetings, recommended research priorities for improving the effectiveness of active solar energy systems are presented.

401,090

PB85-153849 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Potential Energy Savings in Residential Oil-Fired Heating Systems in the U.S.
Final rept.,
G. E. Kelly, D. A. Didion, D. Quigley, and B. Collins. Dec 84, 62p NBS/BSS-163
Also available from Supt. of Docs as SN003-003-02623-9. Sponsored by Department of Energy, Washington, DC. Library of Congress catalog card no. 84-601145.

Keywords: *Oil burners, *Heating equipment, Residential buildings, Thermal efficiency, Performance, Maintenance, Fuel consumption, Nozzles, Field tests, Data, Computerized simulation.

Recent studies of the performance of residential oil-fired heating systems in the New England area from 1974-1977 demonstrated that significant energy savings are achievable through better maintenance and simple system modifications. These studies showed that annual tune-up of the furnace or boiler would improve the seasonal efficiency of most units, while considerable energy savings are possible by reducing the firing rate of the burner. Reduction in nozzle size with burner modification or with the installation of a new flame retention burner was found to reduce oil consumption substantially. In addition, more innovative equipment modifications such as the use of stack dampers, sealed combustion systems, and heat recovery devices also resulted in fuel savings, although to a lesser extent. Both experimental field data and results from computer simulations of furnace performance are presented.

401,091

PB85-163376 PC A03/MF A01
Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
Thickness Effect in Low-Density Insulation,
P. J. Burns. Aug 84, 48p NBSIR-84/2906
Sponsored by Department of Energy, Washington, DC.

Keywords: *Thermal insulation, Thickness, Glass fibers, Heat transfer.

A discussion is presented of theory of heat transfer in low-density, glass-fiber insulation via conduction, convection, and radiation. It is concluded that the primary modes of heat transfer in this material are air conduction and radiation. An analysis of NBS data of measured apparent thermal conductivity for different thicknesses results in a parameter estimate of the optical extinction coefficient. This parameter determines the amount of change in apparent thermal conductivity as

a function of sample thickness. This phenomena is referred to as the 'thickness effect'.

401,092

PB85-163392 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Short Duration Winter-Time Performances of Different Passive Solar Systems,
B. M. Mahajan. Sep 84, 59p NBSIR-84/2930
Sponsored by Department of Energy, Washington, DC.

Keywords: Performance, Buildings, Data, *Passive solar heating systems, Trombe walls.

The report describes the test building, instrumentation, data acquisition system and procedures, and test conditions for the two performance monitoring experiments. The report contains representative data from the two performance monitoring experiments and results from a preliminary analysis of the data, and compares the performance of the three test cells. The data presented include: solar radiation; wind speed and air infiltration; ambient and room air temperatures; average, centroidal, maximum and minimum room air temperatures in the direct gain and Trombe wall cells; cell floor surface temperatures; and auxiliary energy supplied. The report also contains predicted values of the ratios of various irradiation quantities and the auxiliary energy required to maintain the cells at 20C, and compares the predicted values with the measured data.

401,093

PB85-165645 PC A02/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Validation of Daylight Prediction with CEL-1,
S. Treado, C. Francisco, and D. Holland. Dec 84, 25p NBSIR-84/2937
Sponsored by Civil Engineering Lab. (Navy), Port Huemene, CA.

Keywords: *Illuminance, *Interior lighting, *Daylighting, Tests, Predictions, Office buildings, Commercial lighting, Windows, Solar radiation, Weather, CEL-1 computer program, Computer aided design.

Calculations of interior illuminance levels using the CEL-1 computer program are compared to measurements, for a typical office space. The comparisons are made for a wide range of sky conditions, solar intensities and seasonal intervals using a north facing window. The statistical uncertainty associated with the interior daylight calculations is examined and the sources of the uncertainty are discussed.

13B. Civil Engineering

401,094

PB84-159052 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Jet Diffusion Flame Suppression Using Water Sprays: An Interim Report,
B. J. McCaffrey. Jan 84, 58p NBSIR-84-2812
Sponsored in part by Minerals Management Service, Washington, DC.

Keywords: *Offshore structures, *Blowouts, *Fire fighting, Diffusion flames, Spray quenching, Fire extinguishing agents, *Water sprays.

The feasibility of using water sprays for the control of offshore oil/gas well blowout fires has been addressed. Considering the sheer scale of the problem, knowledge from a fundamental viewpoint is going to be required in order to extrapolate laboratory-sized flame studies up to full scale. Available data and appropriate literature concerned with the application of water sprays as a jet diffusion flame suppression/extinguishment agent have been reviewed. Small pneumatic atomizing nozzles using H₂ gas, both as the flame source as well as the atomizing driver, have been used to scale high momentum jet flames and to study the effect of water on the flame.

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13B—Civil Engineering

401,095
PB84-165448 PC A18/MF A01
National Bureau of Standards, Washington, DC.
Fitness-for-Service Criteria for Pipeline Girth Weld Quality.
Final rept.,
R. P. Reed, M. B. Kasen, H. I. McHenry, and C. M. Fortunko. Nov 83, 404p NBSIR-83-1695
Sponsored in part by Department of Transportation, Washington, DC. Office of Pipeline Safety Regulation. Portions of this document are not fully legible.

Keywords: *Petroleum pipelines, *Weldments, Weld defects, Nondestructive tests, Ultrasonic tests, Cracks.

Criteria have been developed for applying fitness-for-service analyses to flaws in the girth welds of the Alaska Natural Gas Transmission System pipeline. A critical crack-opening-displacement elastic-plastic fracture mechanics model was developed and experimentally verified. Procedures for constructing flaw acceptance criteria curves based on this model are provided. A significantly improved ultrasonic method for detecting and dimensioning significant weld flaws was developed and demonstrated on pipeline sections. The probability of crack initiation from blunt flaws was shown to be very low under severe low-cycle fatigue. Suggestions are offered for technical implementation of field inspection procedures and for practical implementation of the flaw acceptance criteria.

401,096
PB84-217090 PC A08/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Containment of Dioxin Emissions from Refuse Fired Thermal Processing Units: Prospects and Technical Issues,
W. M. Shaub. Apr 84, 151p NBSIR-84-2872

Keywords: *Air pollution control, *Incinerators, *Boilers, *Chemisorption, *Furans, *Solid waste disposal, Feasibility, Field tests, Reaction kinetics, Chemical equilibrium, Chlorine organic compounds, Industrial wastes, Physical properties, Chemical properties, Chemical reactions, Combustion products, *Dioxins, *Polychlorinated dibenzodioxins, Chemical reaction mechanisms, Numerical solution.

This report reviews and addresses the prospects for and technical issues concerned with the utilization of chemisorption as a technique for containment of dioxin emissions from refuse fired thermal processing units. The results developed in this report suggest that containment, through chemisorption of dioxin emissions from refuse fired thermal processing units, may be technically feasible. Suggestions for research objectives and full scale tests are outlined. Refuse fired thermal processing units equipped for energy recovery may be more preferable than those units which are not equipped for energy recovery, if chemisorption occurs more efficiently at temperatures which are substantially lower than furnace gas exit temperatures.

401,097
PB84-218072 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC. Structures Div.
Responses to Questions by the General Accounting Office Related to Construction of the Sunshine Skyway Bridge,
N. J. Carino. Jun 84, 30p NBSIR-84/2892

Keywords: *Construction, *Highway bridges, Investigations, Cracks, Bridge piers, Safety, Loads(Forces), Reinforced concrete, Mixtures, Florida, *Sunshine Highway Bridge.

The General Accounting Office (GAO) requested the assistance of the National Bureau of Standards in the investigation of the construction of the new Sunshine Skyway Bridge in Florida. Specifically, GAO desired answers to questions related to the following: (1) the formation of cracks in the main piers of the bridge span; (2) the materials used in the concrete mixtures; and (3) the procedures used in the placement of concrete in the drilled shaft foundations. The objective of the GAO inquiry is to determine the reasonableness and validity of the positions taken by the Florida Department of Transportation on each of the concerns expressed by a number of individuals in connection with the bridge construction. This report provides answers to the questions and provides explanations for each answer.

401,098
PB84-222108 Not available NTIS
National Bureau of Standards, Washington, DC.
Recent Indoor Air Quality Research in the United States.
Final rept.,
S. Silberstein. 15 Jun 84, 8p
Pub. in Proceedings of Workshop on Indoor Air Quality Energy Conservation, Otaniemi, Finland, June 15, 1984, pIX-1-IX-8.

Keywords: *Air pollution, *Houses, *Office buildings, United States, Research projects, Residential buildings, *Indoor air pollution, *Air quality.

Representative examples of indoor air quality research in the United States are described in order to illustrate recent developments.

401,099
PB84-227404 Not available NTIS
National Bureau of Standards, Washington, DC.
Investigation of East Chicago Ramp Collapse.
Final rept.,
N. J. Carino, H. S. Lew, and W. C. Stone. Mar 84, 18p
Pub. in ACSE Jnl. of Construct. Eng. Manage. 110, n1 p1-18 Mar 84.

Keywords: *Highways, *Ramps, *Collapse, Investigations, Failure, Structural analysis, Accidents, Structural members, Cracking(Fracturing), Concrete structures, Indiana, East Chicago(Indiana).

A summary is presented of the investigation performed by the National Bureau of Standards (NBS), at the request of the Occupational Safety and Health Administration, to determine the most likely cause of the collapse of a portion of a highway ramp in East Chicago, Indiana. The investigative effort included an extensive field study to ascertain the conditions prior to and after the accident. In addition, the NBS performed physical tests on key components of the temporary support system used to build the ramp. A structural analysis was performed to compute the magnitude of the forces acting in various components of the support system prior to the failure. The calculated forces were compared with the expected strengths of the structural components. It was concluded that the most likely triggering mechanism of the collapse was the cracking of concrete pads supporting a shoring tower. It was further concluded that there were four deficiencies that contributed directly to the collapse. Had any of these deficiencies not existed, it is unlikely that the collapse would have occurred.

401,100
PB84-245869 Not available NTIS
National Bureau of Standards, Washington, DC.
Coagulation of Smoke Aerosol in a Buoyant Plume.
Final rept.,
H. R. Baum, and G. W. Mulholland. 1979, 13p
Pub. in Jnl. of Colloid and Interface Science 72, n1 p1-12 1979.

Keywords: *Aerosols, *Coagulation, *Plumes, *Air pollution, Particle size distribution, Smoke, Chimneys, Reprints.

The mechanism of particulate coagulation in a turbulent plume is studied by combining the Morton-Taylor-Turner theory of turbulent buoyant plumes with the present authors earlier analysis of coagulation in a homogeneous system. The conservation of fluid mass, particulate matter, momentum, and energy lead to a set of differential equations for horizontal averages of hydrodynamic quantities. These relations are combined with the horizontally averaged coagulation equation to yield an equation which is transformed to be exactly equivalent to the problem of coagulation in a homogeneous medium. The effective time scale is a known function of the vertical plume height which is determined by solving the plume hydrodynamic equations. This permits the coagulation process in a homogeneous system to be quantitatively related to that in a buoyant plume. Sample calculations are performed illustrating the effects of the initial number and mass concentrations of the particulate, rate of heat release, initial plume momentum, and atmospheric stratification on the aging process. Results indicate that the coagulation process can be "frozen" if the entrainment of uncontaminated air into the plume sufficiently dilutes the particulate concentration. The parameters controlling the "freezing" effect are identified and the magnitude of their influence is assessed.

401,101
PB85-118321 Not available NTIS
National Bureau of Standards, Washington, DC.
Effect of Initial Size Distribution on Aerosol Coagulation.
Final rept.,
G. W. Mulholland, and H. R. Baum. 1980, 3p
Pub. in Physical Review Letter 45, n9 p761-763 Sep 80.

Keywords: *Aerosols, *Coagulation, *Particles, *Air pollution, Particle size distribution, Smoke, Reprints.

The effect of particle coagulation on an aerosol with a truncated Junge initial size distribution was calculated for arbitrary particle size and time by obtaining an exact analytical solution to the Smoluchowski equation. It is found that for times corresponding to values of the coagulation parameter $\lambda < 1$ there is a memory effect for large particle size and for $\lambda < 1$ the distribution approaches an exponential form. The persistence of a Junge type size distribution for atmospheric aerosols and smoke aerosols is shown to be consistent with coagulation theory.

401,102
PB85-131555 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Technical Issues Concerned with PCDD (Polychlorodibenzo-p-dioxins) and PCDF (Polychlorodibenzofuran) Formation and Destruction in MSW (Municipal Solid Waste) Fired Incinerators,
W. M. Shaub. Nov 84, 42p NBSIR-84/2975
Sponsored in part by New York City Dept. of Sanitation.

Keywords: *Incinerators, *Air pollution, *Solid waste disposal, Fly ash, Chlorine organic compounds, Combustion products, Concentration(Composition), Hydrogen chloride, Chemical reactions, Catalysis, *Municipal wastes, *Poly(dibenzofuran/chloro), *Poly(dibenzodioxin/chloro), Dioxins.

Technical issues concerned with underlying factors that can potentially affect the levels of PCDD and PCDF emissions from MSW fired incinerators have been analyzed. Major conclusions of this study are that presorting of municipal waste prior to incineration to remove chlorine does not appear to be a reasonable option and that PCDD and PCDF formation is not likely to take place in the stack of an incinerator.

401,103
PB85-141349 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Transformations of Nitrogen in a Polluted Estuary: Non-Linearities in the Demand for Oxygen at Low Flow.
Final rept.,
S. C. Wofsy, M. B. McElroy, and J. W. Elkins. 1981, 4p
Pub. in Science 213, n4509 p754-757 1981.

Keywords: *Water pollution, *Oxidation, *Sewage, *Bacteria, *Mathematical models, Potomac River, Nitrification, Reprints.

Oxidation of sewage $\text{NH}_4(+)$ in the Potomac River is described in terms of a simple kinetic model with growth of nitrifying bacteria limited by supply of $\text{NH}_4(+)$. The oxidation rate varies inversely with freshwater inflow, Q , and the associated demand for O_2 varies as Q^2 . Similar behavior is observed for the Delaware River. The model accounts for observed concentrations of $\text{NH}_4(+)$ and N_2O .

401,104
PB85-141521 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Minimum Test Chip Sample Size Selection for Characterizing Process Parameters.
Final rept.,
J. S. Suehle, L. W. Linholm, and K. Kafadar. Feb 84, 8p
Pub. in IEEE Jnl. of Solid-State Circuits SC-19, n1 p123-130 Feb 84.

Keywords: *Wafers, *Quality control, Sampling, Statistical analysis, Efficiency, Integrated circuits, Fabrication, Reprints, Complementary metal oxide semiconductors, Test chips.

A method for determining a test chip sample size to estimate effectively the electrical parameter distributions on an integrated circuit wafer is presented. This method gives relations among sample size and the figure of merit for four statistical techniques (trimmed mean, biweighted mean, median, and arithmetic mean) by which estimates are calculated. To demonstrate the use of this method, it has been applied to the evaluation of a CMOS fabrication process. Measurements on wafers completely patterned with identical test chips were used to determine actual parameter distributions for an entire wafer (true parameter values). Estimates of true parameters were determined using a site selection plan which is representative of sampling plans employed in industry.

13C. Construction Equipment Materials, and Supplies

401,105
PB84-165331 PC A99/MF E04
 National Bureau of Standards, Washington, DC.
Construction Materials for Coal Conversion: Performance and Properties Data. Supplement 1,
 H. M. Ondik, B. W. Christ, T. R. Shives, A. Perloff, and B. A. Beck. Dec 83, 776p NBS-SP-642-SUPPL-1
 Also available from Supt. of Docs. as SN003-003-02550-0. See also PB83-121665. Sponsored in part by Department of Energy, Laramie, WY. Laramie Energy Technology Center. Library of Congress catalog card no. 82-600610.

Keywords: *Construction materials, *Coal gasification, *Industrial plants, Alloys, Mechanical properties, Physical properties, Performance evaluation, Failure, Corrosion, Erosion, Tables(Data), Equipment, *Coal liquefaction.

This book expands the information provided in the original NBS SP 642 publication, *Construction Materials for Coal Conversion—Performance and Properties Data*, which was intended to provide a central source of materials information needed for the fossil fuel industry. Data have been collected and evaluated from Department of Energy-sponsored projects. The book is organized so that the information is given both with respect to the various component areas of coal gasification or liquefaction plants and with respect to the properties or possible failure mechanisms, e.g. corrosion, erosion, mechanical properties, and physical properties.

401,106
PB84-221274 Not available NTIS
 National Bureau of Standards, Washington, DC.
Thermal Conductivity of Concrete Mortar.
 Final rept.,
 L. L. Sparks. 1983, 9p
 Sponsored in part by Maritime Administration, Washington, DC.
 Pub. in Proceedings of Thermal Conductivity 17, held at Gaithersburg, Maryland on June 15-18, 1983 p655-663 1983.

Keywords: *Thermal conductivity, *Concrete, Moisture content, Measurement, Low temperature tests, High temperature tests, Mortars(Material), Pressure, Temperature gradients, Reprints, *Guarded hot plate apparatus.

The thermal conductivity of a single concrete mortar specimen with varying moisture content is reported in the temperature range from 95 to 320K. The measurements were made in a guarded hot plate apparatus (ASTM C-177). Moisture migration caused by temperature gradients was minimized by studying the saturated specimen in the low-temperature region. Specimen moisture content and concomitant thermal conductivity were altered by imposing low-pressure, high temperature conditions on the specimen. The effect of changing the moisture content is discussed.

401,107
PB84-221969 Not available NTIS
 National Bureau of Standards, Washington, DC.
Comparison of Analytical with Experimental Internal Strain Distribution for the Pullout Test.
 Final rept.,
 W. C. Stone, and N. J. Carino. Feb 84, 10p
 Pub. in Jnl. of the American Concrete Institute 81, n1 p3-12 Jan-Feb 84.

Keywords: *Concretes, *Strain measurement, *Cracking(Fracturing), Strength, Tests, Determination

of stress, Reprints, Finite element analysis, *Pullout tests.

Axisymmetric, two-dimensional, linear-elastic finite element solutions for the internal strain distribution of the pullout test were compared with experimental data from two large-scale pullout tests. Good agreement was found between experimental and analytical strains up to the load which caused first cracking in the laboratory specimens.

401,108

PB84-221977 Not available NTIS
 National Bureau of Standards, Washington, DC.

Deformation and Failure in Large-Scale Pullout Tests.

Final rept.,
 W. C. Stone, and N. J. Carino. Dec 83, 13p
 Pub. in Jnl. of the American Concrete Institute 80, n6 p501-513 Nov-Dec 83.

Keywords: *Concretes, *Cracking(Fracturing), *Strain measurement, Failure, Crack propagation, Loads(Forces), Compressive strength, Reprints, *Pullout tests.

An experimental study was performed to gain an understanding of the failure mechanism of the pullout test. Two large-scale pullout inserts were fabricated and embedded in large concrete blocks. Micro-embedment strain gages were placed in the concrete to measure the internal strain distribution in critical regions. Insert disk displacements were also measured along the line of load application.

401,109

PB84-229491 Not available NTIS
 National Bureau of Standards, Washington, DC.

Impact Resistance of Concrete.

Final rept.,
 J. R. Clifton, and L. I. Knab. 1 Jun 81, 5p
 Sponsored in part by Defense Nuclear Agency, Washington, DC. See also PB84-228165.
 Pub. in Proceedings of Annual Symposium Role of Behavioral Science in Physical Security (5th), Gaithersburg, MD., June 11-12, 1980, p49-53, 1 Jun 81.

Keywords: *Concrete, *Impact strength, Performance evaluations, Dynamic properties, Dynamic loads, Security.

The effects of dynamic loading on concrete is experimentally investigated, appropriate performance tests are developed, and the materials under consideration for use in the construction of security barriers are delineated.

401,110

PB84-231067 PC A02/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Building Technology.

Selection, Procurement, and Description of Salem Limestone Samples Used to Study the Effects of Acid Rain,

M. Ross, and L. Knab. Jul 84, 23p NBSIR-84/2905
 Sponsored in part by National Park Service, Washington, DC. Prepared in cooperation with Geological Survey, Reston, VA.

Keywords: *Building stones, *Weathering, *Limestone, Exposure, Assessments, Geology, Marking, Surface finishing, Air pollution, *Acid rain, *Air pollution effects(Materials), *Salem limestone, Building materials.

This report describes the selection, procurement, and description of the Salem Limestone to be used in field exposure tests to assess the effects of acid rain on building stone. The rationale for choosing Salem Limestone is given and a brief geological description of the stone is provided. Preparation of the stone samples for field exposure, including cutting, surface finishing and labeling, is presented.

401,111

PB84-232552 PC A08/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Building Technology.

Investigation of Construction Failure of Reinforced Concrete Cooling Tower at Willow Island, WV.

Final rept.,
 H. S. Lew, S. G. Fattal, J. R. Shaver, T. A. Reinhold, and B. J. Hunt. Sep 82, 159p NBS/BSS-148
 Sponsored in part by Occupational Safety and Health Administration, Washington, DC. Library of Congress catalog card no. 82-600602. Also available from Supt. of Docs as SN003-003-02436-8.

Keywords: *Reinforced concrete, *Cooling towers, *Loads(Forces), *Concrete durability, Failure, Electric power plants, Safety, Willow Island(West Virginia).

The collapse of the natural-draft hyperbolic concrete cooling tower unit no. 2 at the Pleasants Power Station at Willow Island, West Virginia, was investigated by the National Bureau of Standards. The investigation included on-site inspections, laboratory tests of construction assembly components and concrete specimens, and analytical studies. Based on the results of these field, laboratory, and analytical investigations, it was concluded that the most probable cause of the collapse was due to the imposition of construction loads on the shell before the concrete of lift 28 had gained adequate strength to support these loads.

401,112

PB84-234509 PC A03/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Building Technology.

Pulse-Echo Method for Flaw Detection in Concrete.

Final rept.,
 N. J. Carino, and M. Sansalone. Jul 84, 42p NBS/TN-1199
 Also available from Supt. of Docs as SN003-003-02601-8.

Keywords: *Concrete, *Ultrasonic tests, Nondestructive tests.

The basic principles of the pulse-echo method for the detection of internal flaws in concrete are presented. As the heterogeneous nature of concrete poses problems not encountered in pulse-echo evaluation of metals, progress in this area of concrete nondestructive testing has been slow. A review of past research shows that pulse-echo techniques have been used successfully to detect flaws within concrete; however, no standardized method currently exists for pulse-echo evaluation of concrete structures. Based on the current state of knowledge, areas of needed research are outlined.

401,113

PB85-106391 PC A04/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.

Ring-on-Ring Tests and Load Capacity of Cladding Glass.

Final rept.,
 E. Simiu, D. A. Reed, C. W. C. Yancey, J. W. Martin, and E. M. Hendrickson. Aug 84, 64p NBS/BSS-162
 Grant NSF-CEE83-08329
 Also available from Supt. of Docs as SN003-003-02605-1. Library of Congress catalog card no. 84-601098.

Keywords: *Sheet glass, Panels, Glass, Heat treated glass, Failure, Computer programs, Surface defects, Estimates, Test equipment, Probability theory, Tests, Buildings, Fracture strength, Loads(Forces).

Although ring-on-ring test results have been used in the past to obtain information on the strength of glass, no methodology has so far been developed in the literature explicitly relating such results to the load capacity of cladding glass. The main purpose of this report is to propose such a methodology. The proposed methodology makes use of recent advances in the modeling of the fracture mechanics behavior of glass and the calculation of stresses in plates exhibiting geometric nonlinearity. Evidence is presented which strongly suggests that the probability distribution of the load capacity of cladding glass panels whose failure is due to surface flaws can be estimated reliably on the basis of results of ring-on-ring tests used in conjunction with (a) numerical methods for the analysis of stresses in

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plates, and (b) information on the elastic and fracture mechanics behavior of glass currently available or that can be obtained routinely.

401,114
PB85-115558 Not available NTIS
National Bureau of Standards, Washington, DC.
Predicción de la Resistencia del Concreto a Partir de su Madurez (Method for Prediction of Strength and Resistance of Concrete Based on the Maturity Concept).
Final rept.,
H. S. Lew, and T. W. Reichard. 1980, 9p
Pub. in Rev. IMCYC 18, n113 p35-40, 43-46, 30 Sep 80.

Keywords: *Concretes, Predictions, Strength, Curing, Compressive strength, Cements, Temperature, Age, Regression analysis, Reprints.

Prediction of potential strength of concrete based on the maturity concept is presented. The maturity, which is expressed as the integral of the curing temperature with respect to time, is related to the compressive strength of standard cylinders cured at 35F, 55F, and 90F. The relationship between the compressive strength and maturity is obtained by regression analysis. Other published data are also used in the analysis of the relationship. It is shown that the function relating the compressive strength with the logarithm of maturity is nonlinear and that the relationship is dependent on type of cement, water/cement ratio, and brand of cement for a given type.

401,115
PB85-119337 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Influence of Vertical Compressive Stress on Shear Resistance of Concrete Block Masonry Walls,
K. Woodward, and F. Rankin. Oct 84, 62p NBSIR-84/2929

Keywords: *Concrete blocks, *Masonry, *Walls, Structural analysis, Mortars(Materials), Shear tests, Shear properties, Axial stress, Compressive properties, Loads(Forces), Displacement, Cracks, Cracking(Fracturing).

The results from tests on eight ungrouted and unreinforced concrete block masonry walls are presented. The emphasis of the research program is the influence of vertical in-plane compressive stress on the lateral in-plane load resistance of the walls. Each wall has nominal dimensions of 64 in. x 64 in. x 8 in. and is fabricated from similar materials by the same experienced mason. The masonry units are hollow concrete block having a nominal compressive strength of 1800 psi based on the gross area. The mortar was proportioned as a Type S. The walls are tested in the NBS Tri-directional Testing Facility using fixed ended boundary conditions at the top and bottom of the wall. Lateral in-plane displacements were applied at the top of the wall while maintaining a constant compressive axial load. The vertical compressive stress varies between 120 and 500 psi (based on net cross-sectional area) in the test program. The test results indicate that there is a linear relationship between increasing amounts of vertical compressive stress and the resulting increased in-plane maximum lateral load resistance.

401,116
PB85-123628 Not available NTIS
National Bureau of Standards, Washington, DC.
Evaluation of the Sulfate Resistance of Cements in a Controlled Environment.
Final rept.,
P. Brown. 1981, 9p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in Cement and Concrete Research 11, n5-6 p719-727 Sep/Nov 81.

Keywords: *Cements, *Corrosion prevention, *Sulfates, pH, Sulfuric acid, Reprints.

It was initially established that the maintenance of the pH of a sulfate solution in which mortar specimens were immersed at a constant and predetermined value through controlled sulfuric acid additions ensured that the sulfate ion concentration in solution remained invariant with time. The rates of sulfate attack of mortar specimens exposed under typical immersion and environmentally controlled conditions were then compared. It was observed that environmental control significantly increased the rate of sulfate attack as meas-

ured either by strength, loss or linear expansion. However, the strength changes and the expansions observed occurred in a manner consistent with the severity of the test conditions imposed.

401,117
PB85-128957 Not available NTIS
National Bureau of Standards, Washington, DC.
Review of Mathematical Modeling Applied to the Manufacture and Use of Portland Cements.
Final rept.,
G. Frohnsdorff, and J. R. Clifton. 1980, 23p
Pub. in Proceedings of the Institute of Electrical and Electronics Engineers Cement Industry Technical Conference, Toronto, Canada, May 19, 1980, 23p.

Keywords: *Portland cements, Mathematical models, Manufacturing, Cement, Industries, Processing, Utilization, Performance, Clinker, Grinding mills, Kilns.

To optimize the manufacture and use of portland cements, whether in respect to cost, energy use, or product quality, the individual operations in the overall manufacturing processes and their interactions must be understood. If they are understood, the processes and their interactions should be describable in mathematical terms. Mathematical models of the chemical and mechanical processes in the manufacture and use of cement, and of the cement industry as a whole, are reviewed. On the basis of the information reviewed, it appears feasible to develop useful macromodels encompassing cement manufacture and use. Such mathematical models could provide important tools for assessing the use of energy and other resources in the cement and concrete industries, and stimulating the development of more refined and realistic models.

401,118
PB85-129401 Not available NTIS
National Bureau of Standards, Washington, DC.
Mechanical Performance Model for Roofing Membranes.
Final rept.,
J. M. Pommersheim, R. G. Mathey, and J. R. Clifton. Jun 83, 19p
Pub. in Jnl. Struct. Eng. 109, n6 p1431-1449 Jun 83.

Keywords: *Roofing, Membranes, Roofs, Bonding, Performance, Mathematical models, Failure, Stresses, Strains, Mechanical properties, Joining, Fabrics, Felts, Bituminous coatings, Reprints.

The mechanical performance of built-up roofing membranes, fully bonded to an underlying deck or substrate was modeled. Both linear and nonlinear stress-strain behaviors were considered in the model development. The model is compared to previously developed models. It was found that the equality of the complementary strain energy of the fabric or felt layer with the strain energy of the bonding adhesive or bitumen layer governs both the conditions under which membrane integrity is lost and the mode of failure. Failure can occur either by membrane splitting or adhesive disbonding. The testing criteria developed are applied to a sample case.

401,119
PB85-133981 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Procedure for Tristimulus Color Measurements on Building Stone,
L. I. Knab. Oct 84, 30p NBSIR-84/2961
Sponsored in part by National Park Service, Washington, DC.

Keywords: *Building stones, *Colorimetric analysis, *Air pollution, Surfaces, Exposure, Field tests, *Air pollution effects(Materials), *Acid rain.

This report describes a procedure used to measure the color of building stone surfaces using a specific tristimulus colorimeter with three color filters. Color changes are to be monitored during a ten year or more outdoor exposure period to determine the effects of acid rain on stone color. A step-by-step procedure is provided, including equipment calibrations and checks using standard reflectance panels, equipment checks using standard stone surfaces, and color measurements of stone surfaces which are to be, or have been exposed at field sites.

401,120
PB85-141505 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Laboratory Study of Flaw Detection in Concrete by the Pulse-Echo Method.
Final rept.,
N. J. Carino. Oct 84, 23p
Pub. in Proceedings of the International Conference on Nondestructive Testing of Concrete, Ottawa, Canada, Oct 3-5, 1984 p557-579.

Keywords: *Concretes, *Nondestructive tests, *Sonic tests.

A study was performed to evaluate the applicability of using the echoes from mechanically produced impact to locate hidden defects within concrete. The expected interactions of spherical waves with concrete-air interfaces are reviewed, and the results of experiments using artificial flaws in a large concrete slab are summarized. The following aspects were studied: type of impact source; distance from impact point to receiver; type of receiving transducer; depth of reflecting interfaces; and diffraction effects by sharp edges. The contact time of the impact is shown to be an important parameter for the success of the technique. The influence of the concrete thickness from impact point to the reflecting interface is an area of needed research.

401,121
PB85-142339 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Uses of Waste Materials and By-Products in Construction.
Final rept.,
J. R. Clifton, P. W. Brown, and G. Frohnsdorff. 1980, 22p
Pub. in Resource Recovery and Conservation 5, n2 p139-160 Jul 80.

Keywords: *Construction materials, Byproducts, Utilization, Wastes, Reprints, *Wastes utilization.

A survey has been made of the sources, amounts and methods of disposal of major mining, industrial and municipal wastes available in the 48 counterterminous states of the United States. This includes the present and potential uses of these wastes as construction materials. While over 3 x 10 to the 9th power tons of waste materials are generated annually in the United States, only small amounts are being used by the construction industry. The low level of use does not yet reflect the advances being made in converting wastes into viable construction materials. In several cases, construction materials produced from wastes have been at least the technological equivalent of materials produced from virgin resources. Factors which are impeding the increased utilization of wastes are discussed and emerging incentives which could facilitate their increased use are covered.

13D. Containers and Packaging

401,122
PB85-129153 PC A13/MF A01
National Bureau of Standards, Gaithersburg, MD.
Checking the Net Contents of Packaged Goods (Second Edition).
Final rept.,
C. S. Brickenkamp, S. Hasko, and M. G. Natrella. Oct 84, 290p NBS/HB-133
Supersedes PB81-220741. Also available from Supt. of Docs as SN003-003-02616-6. Library of Congress catalog card no. 81-600051.

Keywords: *Handbooks, *Packaging, Sampling, Inspection, Measurement, Procedures, Computation, Compliance.

The second edition of NBS Handbook 133, like the first edition, is a procedural manual for compliance testing of the net contents statements on packaged goods. Packaged goods may be labeled by weight, volume, length, area, or count. Two categories of sampling plans are provided for packages subject to the average requirement. Other sampling plans are provided for special products. Test procedures are provided in detail for a wide variety of products. The manual contains information on equipment, test methods, calculations, and test reporting.

13E. Couplings, Fittings, Fasteners, and Joints

401,123
PB84-220896 Not available NTIS
 National Bureau of Standards, Washington, DC.
Fitness-for-Purpose Criteria for Pipeline Girth Welds.
 Final rept.,
 M. B. Kasen, and C. M. Fortunko. Sep 82, 12p
 Sponsored in part by Department of Transportation, Washington, DC. Office of Pipeline Safety Operations and Welding Research Council, New York.
 Pub. in Proceedings of Pipeline Welding Inspection Conference, Houston, Texas, September 21-22, 1982, p181-192.

Keywords: *Welded joints, Weld defects, Nondestructive tests, Pipelines, Radiography, Ultrasonic tests, Fracture(Mechanics).

Results of a program to provide the basis for applying fracture mechanics principles assessment of flaw significance in pipeline girth welds are reviewed. Subjects discussed are: (i) development of appropriate allowable flaw size curves; (ii) development of an improved ultrasonic technique for sizing of sharp flaws; (iii) the significance of blunt flaws; and (iv) the demonstration of inherent limitations on the through-wall depths of blunt flaws. A series of technical options for field implementation of the results is provided and discussed.

401,124
PB84-221613 Not available NTIS
 National Bureau of Standards, Washington, DC.
Study of Fitness-for-Purpose Criteria Shows Promise for Pipeline Girth-Weld Quality.
 Final rept.,
 M. B. Kasen, and C. M. Fortunko. 4 Jul 83, 11p
 Sponsored in part by Department of Transportation, Washington, DC. Office of Pipeline Safety Operations and Welding Research Council, New York.
 Pub. in Technology Oil Gas Jnl., p83-93, 4 Jul 83.

Keywords: *Welded joints, Weld defects, Nondestructive tests, Pipelines, Radiography, Ultrasonic tests, Reprints.

Results of a program to provide the basis for applying fracture mechanics principles to assessment of flaw significance in pipeline girth welds are reviewed. Subjects discussed are: (i) development of appropriate allowable flaw size curves; (ii) development of an improved ultrasonic technique for sizing of sharp flaws; (iii) the significance of blunt flaws; and (iv) the demonstration of inherent limitations on the through-wall depths of blunt flaws. A series of technical options for field implementation of the results is provided and discussed.

401,125
PB84-223940 Not available NTIS
 National Bureau of Standards, Washington, DC.
Long Wavelength Ultrasonic Technique for Detecting and Sizing Weld Defects.
 Final rept.,
 C. M. Fortunko, and R. E. Schramm. 1981, 6p
 Sponsored in part by Welding Research Council, New York.
 Pub. in Proceedings 1981 ANST (American Society for Nondestructive Testing) National Fall Conference, Atlanta, GA., October 12-15, 1981, p346-348.

Keywords: *Ultrasonic tests, *Weld defects, Welded joints, Nondestructive tests, Pipelines.

A new ultrasonic inspection technique is described for detecting elongated defects in butt welds. The technique uses noncoupling, electromagnetic-acoustic transducers (EMATs) that can operate on most unprepared surfaces and under adverse environmental conditions. The operation of the new technique is demonstrated in the context of detection and sizing of elongated, two-dimensional defects in girth welds of 1.22-m (48-in) diameter cross-country pipeline. The ultrasonic inspection is carried out at 454 kHz using shear wave signals polarized in the plane of the weld (SH-waves). The advantage of ultrasonic weld inspections at low frequencies (long-wavelengths) is that the reflected ultrasonic amplitude is relatively insensitive to defect orientation and surface roughness. Since SH waves can propagate at near-grazing angles, the sensitivity to through-wall, two-dimensional defects can be maximized. These features of the SH-wave-EMAT system are particularly attractive when fitness-for-service criteria are used to evaluate welded butt joints.

401,126

PB84-227305 Not available NTIS
 National Bureau of Standards, Washington, DC.
Inherent Through-Wall Depth Limitations on Blunt Discontinuities in Welds.
 Final rept.,
 M. B. Kasen, and G. E. Hicho. Jun 84, 21p
 Sponsored in part by Welding Research Council, New York.
 Pub. in Welding Jnl. 63, n6 p1845-1865 Jun 84.

Keywords: *Weld defects, Pipelines, Porosity, Nondestructive tests, Dimensions, Reprints.

The through-wall depth of weld flaws is required for a fitness-for-purpose analysis of flaw significance. This study examines the extent to which the through-wall depth of porosity and slag can be inferred from projected radiographic dimensions, and the validity of assuming that maximum depth is limited by the welding process. It is found that the width of slag stringers is always less than the slag depth, while the width of porosity is always equal to or larger than porosity depth. The projected size of porosity can therefore serve as an upper limit to porosity depth, but a similar assumption is not valid for slag. It is concluded that the through-wall depth of both types of flaws will not exceed that of the weld pass in which it occurs, or that of the average weld pass depth in a multipass weld. The latter can therefore be conservatively taken as an upper bound on the through-wall dimensions of such flaws.

401,127

PB85-141943 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Fracture Toughness of 25Mn Austenitic Steel Weldments at 4 K.
 Final rept.,
 Y. W. Cheng, H. I. McHenry, P. N. Li, T. Inoue, and T. Ogawa. 1984, 8p
 Sponsored by Department of Energy, Washington, DC.
 Pub. in Advances in Cryogenic Engineering 30, p303-310 1984.

Keywords: *Weldments, Welded joints, Toughness, Cryogenics, Austenitic steels, Reprints, *Fracture toughness.

The fracture toughness of 25Mn steel weldments was measured at 4 K using the single-specimen J-integral procedure. The highest J sub Ic value obtained was from the gas-tungsten-arc weld, followed by the shielded-metal-arc weld; the submerged arc weld had the lowest J sub Ic value. Degradation of fracture toughness of the heat-affected zone was observed because of carbide precipitation along the grain boundary.

401,128

PB85-141950 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Post Yield Crack-Opening Displacement of Surface Cracks in Steel Weldments.
 Final rept.,
 Y. W. Cheng, R. B. King, D. T. Read, and H. I. McHenry. 1984, 16p
 Sponsored by Department of Transportation, Washington, DC. Office of Pipeline Safety Regulation.
 Pub. in American Society for Testing and Materials STP 833, p666-681 1984.

Keywords: *Weldments, Welded joints, Steels, Cracks, Cracking(Fracturing), Reprints, Fracture(Mechanics).

Crack-mouth-opening displacements (CMOD) of surface cracks are measured as function of stress and strain in tensile panels of API 5LX-70 steel plates and welded pipe segments. The experimental results are compared with analytical predictions. For CMOD versus stress, a previously developed model provides good agreement between experiment and analysis for the base metal and the welds. At stresses above net-section yielding, it is observed in 7 of the 9 base metal tests that all of the remote displacement is transferred to the crack tip through slip bands extending from the crack tip to the plate edges at 45 degree angles; the two exceptions are in specimens with small (less than 5 percent of the cross-sectional area) cracks where yielding occurred in the gross section. A model based on this observation is used to calculate CMOD vs. strain for net-section yielding; analysis and experiment agree in the intended range, i.e. net-section yielding.

401,129

PB85-142172 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Nondestructive Evaluation of Thick Austenitic Stainless Steel Weldments by Shear Horizontal Acoustic Waves.
 Final rept.,
 R. E. Schramm, J. C. Moulder, and C. M. Fortunko. 1984, 8p
 Sponsored by Naval Sea Systems Command, Washington, DC.
 Pub. in Advances in Cryogenic Engineering 30, p119-126 1984.

Keywords: *Weldments, *Ultrasonic tests, Signal processing, Nondestructive tests, Welded joints, Austenitic stainless steels, Reprints.

Austenitic stainless steel weldments exhibit a textured columnar structure. Because of this, shear horizontal acoustic waves can be a valuable complement to conventional longitudinal waves. Developments in electromagnetic-acoustic transducers (EMATs) have made it possible to use these SH-waves. Digital processing techniques, particularly synthetic aperture techniques, can improve the detection, sizing and localization of flaws.

13H. Industrial Processes

401,130

PATENT-4 461 680 Not available NTIS
 Department of Commerce, Washington, DC.
Process and Bath for Electroplating Nickel-Chromium Alloys.
 Patent,
 D. S. Lashmore. Filed 30 Dec 83, patented 24 Jul 84, 10p PB85-100113, PAT-APPL-6-567 451
 Supersedes PB84-159953.
 This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.00.

Keywords: *Electroplating, *Patents, *Nickel chromium alloys, Baths, Formic acid, Boric acids, Electrolytes, Nickel chlorides, Chromium chlorides, Sodium citrates, PAT-CL-204-41.

A process for the electrodeposition of a nickel chromium alloy on a cathodic substrate comprises: contacting the substrate with an aqueous electrolyte containing: about 50-125 g/l of CrCl₃·6H₂O; about 10-125 g/l of NiCl₂·6H₂O; about 10-115 g/l of formic acid; about 25-50 g/l of boric acid; and about 50-100 g/l of sodium citrate dihydrate; adjusting the pH of the bath to about 1-5 and the temperature to about 20-60C; and passing a sufficient current through the solution and to the substrate to effect deposition thereon of a nickel-chromium alloy.

401,131

PB84-221407 Not available NTIS
 National Bureau of Standards, Washington, DC.
Nondestructive Testing and Quality Improvement.
 Final rept.,
 L. Mordfin, and H. T. Yolken. Nov 83, 8p
 Pub. in Proceedings of Pan Pacific Conference on Non-Destructive Testing (4th) held at Sydney, Australia on November 15-18, 1983, Society of Automotive Engineers 1, 8p Nov 83.

Keywords: *Nondestructive tests, Ceramics, Process control, Quality control, Ultrasonic tests, Productivity, X ray diffraction.

Efforts to improve the quality of manufactured products and, at the same time, to achieve increased productivity, are nurturing changes in the role of nondestructive testing (NDT). It is becoming more and more evident that it is no longer adequate to use NDT merely to separate good parts from bad at the end of the manufacturing process. Instead, process controls are needed which will prevent the manufacture of defective products. A new role for NDT in the development of manufacturing process controls is proposed. This is illustrated by examples from the Non-destructive Evaluation Program of the National Bureau of Standards of the United States Department of Commerce.

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13H—Industrial Processes

401,132

PB84-224526 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Mfg. Engineering.

Publications of Center for Manufacturing Engineering (of the National Bureau of Standards) 1978-1983.

Bibliography rept.,
P. Nanzetta, and J. Wellington. Mar 84, 68p NBSIR-84-2840

Keywords: *Manufacturing, *Bibliographies, Metrology, Robots, Automatic control equipment, Surface finishing, Documents, Authors, Robotics.

A list of publications by staff of the Center for Manufacturing Engineering for the period 1978-1983, indexed by subject area. Publications cover research done by the Center in the areas of high precision dimensional measurement; sensing and measurement of force, mass, sound, vibration, and surface finish characteristics; and application of advanced controls and sensing techniques to automated machines, manufacturing systems and robot manipulators.

401,133

PB84-224880 Not available NTIS
National Bureau of Standards, Washington, DC.

Bremsstrahlung Generators for Radiation Processing.

Final rept.,
J. P. Farrell, S. M. Seltzer, and J. Silverman. 1983, 10p
Pub. in Radiation Physics and Chemistry, v22 n3-5 p469-478 1983.

Keywords: *Bremsstrahlung, Cobalt 60, Gamma rays, Comparison, Reprints, Industrial applications, Costs.

Bremsstrahlung generated by the stopping of high-energy electrons has been proposed as an alternative to (60)Co gammas for many years. However, it is only recently that advances in accelerator technology have justified serious consideration of this concept. Whether bremsstrahlung is a practical source for industrial radiation processing is ultimately a question of the cost per unit of product treated with a specified dose. In another paper (Seltzer, et al., 1983), we present calculations of bremsstrahlung yields, dose-depth curves, and production capacities within a specified maximum-to-minimum dose ratio for 4 and 5 MeV electron accelerators; the results are summarized in the next two sections. The emphasis of this paper is on the economics of processing by bremsstrahlung and a cost comparison of processing with (60)Co gammas.

401,134

PB84-235597
(Order as PB84-235530, PC A07/MF A01)
National Bureau of Standards, Washington, DC.
Center for Materials Science.

Reconstructing Internal Temperature Distributions from Ultrasonic Time-of-Flight Tomography and Dimensional Resonance Measurements,

S. J. Norton, L. R. Testardi, and H. N. G. Wadley. 7 Nov 83, 10p
Included in Jnl. of Research of the National Bureau of Standards, v89 n1 p65-74 Jan-Feb 84.

Keywords: *Ultrasonic tests, Temperature distribution, Process control, Resonance, Measurement, Tomography.

Two ultrasonic techniques for reconstructing the internal temperature distribution in metal bodies--time-of-flight tomography and dimensional resonance profiling--are described. An analysis of the tomographic reconstruction of temperature (including ray refraction effects) in a cylindrical body is presented together with initial experimental results. Dimensional resonance profiling is a new technique that allows the reconstruction of a one-dimensional distribution of temperature in a structure from measurements of its resonant frequencies. While time-of-flight tomography is well suited for measuring temperature in a cylindrical geometry, a combination of dimensional resonance and (a restricted form of) tomography is the best method for measuring temperature profiles in the most practically important rectangular slab geometry.

401,135

PB84-245976 Not available NTIS
National Bureau of Standards, Washington, DC.

Real-Time Three-Dimensional Vision for Parts Acquisition.

Final rept.,
J. S. Albus, R. Haar, M. Nashman, M. Shneier, and S. Nagalia. 1981, 5p
Prepared in cooperation with Maryland Univ., College Park. Computer Center. Sponsored in part by SPIE-The International Society for Optical Engineering, Bellingham, WA.

Pub. in Society of Photo-Optical Instrumentation Engineers 283, p56-60 1981.

Keywords: *Optical detection, Components, Automation, Cameras, Industrial plants, Manufacturing, Reprints.

The National Bureau of Standards is developing a vision system for use in an automated factory environment. The emphasis of the project is on the real-time acquisition of three-dimensional parts using visual feedback. The system employs multiple light sources in conjunction with object models to establish the position and orientation of an object in the camera's field of view. A flood flash enables shape information to be obtained from an image, while a plane of light can be used to find the three-dimensional positions of points on the object. Because there are only a small number of object types and the objects all have predefined nominal locations, a model can be used to predict how the scene should look from a given viewpoint using a particular light source. This prediction can be compared with the actual image, and the differences used to establish position information. Models are expected to be particularly useful in reducing the number of views of an object necessary to calculate its three-dimensional position.

401,136

PB85-108595 Not available NTIS
National Bureau of Standards, Washington, DC.

Graphical Signatures for Manufactured Surfaces.

Final rept.,
Y. Tanimura, E. C. Teague, F. E. Scire, R. D. Young, and T. V. Vorburger. Oct 82, 5p
Pub. in Jnl. of Lubrication Technology 104, p533-537 Oct 82.

Keywords: *Surface properties, Signatures, Manufacturing, Topography, Precision finishing, Reprints.

Three dimensional surface signatures were calculated from radial profile measurements of two lapped specimens, two ground specimens and a milled specimen. These signatures are polar autocorrelation function (ACF) maps and R sub a maps. The ACF maps were obtained by plotting contours of equal autocorrelation values. The ACF maps reveal more structure than the R sub a maps and their shapes appear to be characteristic of the corresponding manufacturing methods. Therefore, radial profile measurement together with the use of ACF maps is a useful technique for relating surface topographies to manufacturing processes.

401,137

PB85-115475 Not available NTIS
National Bureau of Standards, Washington, DC.

Photoresist Sensitometry and Exposure Modeling.

Final rept.,
D. B. Novotny. 1981, 1p
Sponsored in part by Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in Solid State Technology, v24 n3 p83 1981.

Keywords: Exposure, Photolysis, Sensitivity, Reprints, *Photoresists.

Sensitometric properties were measured for a positive diazo-type photoresist at wavelengths of 365, 405, and 436 nm. It is shown that the exposure data at these three wavelengths may be combined according to Van Kreveld's additivity law to accurately predict both simultaneous and successive exposures made with combinations of these wavelengths. Exposure modeling using Beer's law and first order photolysis kinetics, when combined with the measured sensitometric properties, supports the validity of Van Kreveld's law for simultaneous and successive exposures. The combined modeling and experimental data also support the existence of a critical inhibitor concentration that defines complete exposure and is the same for all wavelengths as well as for monochromatic simultaneous and successive exposures. Applications of char-

acteristic curves of exposure depth as a function of exposure are outlined.

401,138

PB85-123446 Not available NTIS
National Bureau of Standards, Washington, DC.

Laser-Micrometry for Integrated Circuits.

Final rept.,
D. Nyyssonen. 1982, 7p
Pub. in Proceedings of Inspection, Measurement, and Control Symposium, Boston, Massachusetts, September 20-23, 1982, p24-30.

Keywords: *Line width, *Measurement, Lithography, Integrated circuits, Microscopy, Reprints, Laser applications.

The optical microscope measurement of micrometer and submicrometer linewidths during integrated-circuit fabrication utilizes a wide variety of optical microscope system designs including bright-field, dark-field, and focused laser beam scanning systems. The present paper deals with the principle of equivalence in optical system design of both conventional microscope imaging systems and focused-spot scanning systems.

401,139

PB85-129419 Not available NTIS
National Bureau of Standards, Washington, DC.

Bremsstrahlung Beams from High-Power Electron Accelerators for Use in Radiation Processing.

Final rept.,
S. M. Seltzer, J. P. Farrell, and J. Silverman. Apr 83, 5p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Nuclear Science NS-30, n2 p1629-1633 Apr 83.

Keywords: *Bremsstrahlung, Ultraviolet radiation, Electron accelerators, Electron beams, Cobalt 60, Industries, Comparison, Reprints, *Radiation sources.

In this paper, the authors present the results of calculations of bremsstrahlung produced by a high power electron beam that is incident on a water cooled target. The calculation yields the efficiency of conversion of electron beam power to bremsstrahlung, the energy and angular distributions of the photons, and the dose distribution of the resultant photon spectrum in a water phantom. The result is used to estimate radiation processing rates with bremsstrahlung photons and comparison is made with Co-60 radioisotope sources.

13I. Machinery and Tools

401,140

PATENT-4 471 444 Not available NTIS
Department of Commerce, Washington, DC.

Rotating Tool Wear Monitoring Apparatus.

Patent,
K. W. Yee, and D. S. Blomquist. Filed 2 Apr 82, patented 11 Sep 84, 9p PB85-148534, PAT-APPL-6-364 944

Supersedes PB82-197708.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.00.

Keywords: *Cutting tools, *Wear, *Monitors, Predictions, Failure, Comparators, Microcomputers, Drills, Patent, PAT-CL-364-475, Computer aided manufacturing, Computer applications.

A system is provided for predicting when the failure of a rotating machine tool or part is imminent or when a tool is worn. The system includes a transducer for producing an output related to the workpiece vibrations caused by the machine tool and an analog comparator which compares this output with a threshold signal related to the normal operation of the tool and established by a microcomputer which determines whether further signals which exceed the threshold are produced during each of a predetermined number of subsequent time intervals related to the rotational speed of the tool. If so, a 'failure' signal is produced which may be used, for example, to cause retraction of the tool.

401,141

PB85-100139 Not available NTIS
National Bureau of Standards, Washington, DC.
Sensory Interactive Robots.
Final rept.,
J. S. Albus, A. J. Barbera, M. L. Fitzgerald, and M. Nashman. 1981, 4p
Pub. in Ann. CIRP 30, n2 p559-562 1981.

Keywords: *Robots, Automatic control, Interactions, Microcomputers, Reprints, *Hierarchical control, Computer applications.

For robots to operate effectively in the partially unconstrained environment of manufacturing, they must be equipped with control systems that have sensory capabilities. The paper describes a control system that consists of three parallel cross coupled hierarchies. First is a control hierarchy which decomposes high level tasks into primitive actions. Second is a sensory processing hierarchy that analyses data from the environment. Third is a world model processing hierarchy. Deviations between expected and observed data is used by the control hierarchy to modify its task decomposition strategies so as to generate sensory-interaction goal-directed behavior. This system has been implemented on a research robot, using a network of microcomputers and real-time vision system mounted on the robot wrist.

401,142

PB85-128940 Not available NTIS
National Bureau of Standards, Washington, DC.
Industrial Robot Technology and Productivity Improvement.
Final rept.,
J. S. Albus. 1982, 28p
Sponsored in part by Office of Technology Assessment, Washington, DC.
Pub. in Paper in Exploratory Workshop on the Social Impacts of Robotics: Summary and Issues, p62-89 Feb 82.

Keywords: *Robots, Technology, Productivity, Automation, *Robotics, Computer aided manufacturing.

Eight principal technical problem areas in industrial robotics are identified as: (1) absolute positioning accuracy, (2) manipulator dynamics, (3) sensors, (4) control systems, (5) world modeling, (6) software development, (7) interface standards, and (8) mobility. A brief survey of current work in each of these areas is given for university, non-profit, industry, and government laboratories. Future prospects for productivity improvement resulting from robotics in manufacturing and construction are outlined and some of the socio-economic issues addressed.

401,143

PB85-128965 Not available NTIS
National Bureau of Standards, Washington, DC.
Hierarchical Control for Sensory Interactive Robots.
Final rept.,
J. S. Albus, A. J. Barbera, and M. L. Fitzgerald. 1981, 9p
Pub. in Proceedings of International Symposium on Industrial Robots (11th), Tokyo, Japan, October 5-16, 1981, p497-505.

Keywords: *Robots, Microcomputers, Computer networks, Controllers, Real time operations, *Hierarchical control, Control systems, Computer applications.

For robots to operate effectively in the partially unconstrained environment of manufacturing, they must be equipped with control systems that have sensory capabilities. This paper describes a control system that consists of three parallel cross coupled hierarchies. First is a control hierarchy which decomposes high level tasks into primitive actions. Second is a sensory processing hierarchy that analyses data from the environment. Third is a world model hierarchy which generates expectations. These are compared against the sensory data at each level of the sensory processing hierarchy. Deviations between expected and observed data is used by the control hierarchy to modify its task decomposition strategies so as to generate sensory-interactive goal-directed behavior. This system has been implemented on a research robot, using a network of microcomputers and real-time vision system mounted on the robot wrist.

401,144

PB85-130847
(Order as PB85-130078, PC A99/MF A01)
Joint Inst. for Lab. Astrophysics, Boulder, CO.
Super Spring - A Long Period Vibration Isolator,
R. L. Rinker, and J. E. Faller. 1984, 7p
Included in Precision Measurement and Fundamental Constants II, p411-417 1984.

Keywords: *Vibration isolators, Springs(Elastic), Gravity, Measurement, Long period seismometers, Uses.

The authors have devised a new mechanical isolating device which they call a 'super spring.' The super spring isolator makes use of the fact that a mass suspended by a long spring is effectively isolated (from vibrations) for all frequencies higher than the system's natural resonance. The authors have developed a method of electronically terminating a 30 cm-long spring in such a way that the mass suspended from it behaves as if the spring were one kilometer or longer in length. This permits them to provide isolation for frequencies as low as 0.2 Hz. The authors will discuss the principle, the results of shake-table tests, and the implications of this technique for measurement science.

401,145

PB85-135457 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurement and Control Model for Adaptive Robots.
Final rept.,
J. S. Albus, A. J. Barbera, M. L. Fitzgerald, R. N. Nagel, and G. J. VanderBrug. 3 Mar 80, 5p
Pub. in Proceedings of International Symposium on Industrial Robots and Exhibition (10th), Milan, Italy, March 5-7, 1980, p35-39.

Keywords: *Robots, Control equipment, Measurement, Adaptive systems.

For robots to operate effectively in the partially unconstrained environments of manufacturing, they must be equipped with control systems that have measurement and sensory capabilities. This paper presents a model for such a system. It consists of parallel control and measurement hierarchies. The control hierarchy decomposes tasks into subtasks, and the measurement hierarchy analyzes data from sensors. At each level the control hierarchy sends expectations to the measurement hierarchy, which returns computed values of the deviation between the observed and expected data. The control hierarchy uses this information to modify its task decomposition strategies so as to generate sensory-interactive goal-directed behavior. The system has been partially implemented on a research robot using a network of microcomputers and a real-time vision system mounted on the robot's wrist.

401,146

PB85-142875 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Hierarchical Control for Robots in an Automated Factory.
Final rept.,
J. S. Albus, C. R. McLean, A. J. Barbera, and M. L. Fitzgerald. 1983, 15p
Sponsored by Society of Mfg. Engineers, Dearborn, MI., Robotics International, Dearborn, MI., and Robot Inst. of America, Dearborn, MI.
Pub. in Proceedings of International Symposium on Industrial Robots and Robots 7 (13th), Chicago, IL., April 17-21, 1983, Volume 2: Future Directions, p13.29-13.43.

Keywords: *Robots, *Control, Adaptive systems, Automation, Industrial plants, Hierarchical control.

A hierarchical architecture for real-time sensory-interactive control of robots, machine tools, inspection machines, and materials transport and inventory systems is described. Computer-aided design, computer-aided process planning, and management information systems make up the top level in the hierarchy where the highest level goals are selected and the longest range planning horizons exist. Commands and goals generated at this highest level are decomposed through a series of levels (SHOP, CELL, WORKSTATION and EQUIPMENT) until at the lowest level there are generated a series of drive signals to individual actuators on robots, machine tools, and other equipments. Feedback from sensors and from the control hierarchy itself are used at all levels to produce real-time goal seeking behavior. Apriori knowledge and sensor data are combined in a world model which is used to generate ex-

pectations and to plan alternate strategies at every level.

401,147

PB85-145514 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Buckling Loads and Natural Frequencies of Drill Bits and Fluted Cutters.
Final rept.,
E. B. Magrab, and D. E. Gilsinn. Aug 84, 9p
Pub. in Jnl. of Engineering for Industry, Transactions ASME 106, p196-204 Aug 84.

Keywords: *Drill bits, *Cutters, Buckling, Twisting, Loads(Forces), Resonant frequency, Drilling, Grooving, Reprints.

The buckling loads, natural frequencies and mode shapes of twist-drill bits and certain fluted cutters under a variety of combinations of twist angle, cross-section geometry and axial loading have been obtained. The drill bit is modelled as a twisted Euler beam under axial loading that is clamped at both ends. The governing system of differential equations is solved by the Galerkin procedure. Explicit forms for the basis functions used to generate the Galerkin coefficients are presented in general form in an appendix. They may be used for obtaining numerical results for that class of problems which use the Rayleigh-Ritz-Galerkin methods with beam-type functions as the basis functions. The representative set of modes obtained exhibit a complex out-of-plane twisting-type motion that suggests a possible explanation for the out-of-roundness of certain drilled holes.

13J. Marine Engineering

401,148

PB82-244542 PC A04/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Measurement Uncertainties of Level Gages for Liquefied Natural Gas,
J. D. Siegwarth. Jun 82, 52p NBSIR-82-1668
Sponsored in part by Maritime Administration, Washington, DC.

Keywords: *Liquefied natural gas, *Liquid level indicators, *Gas storage, *Cargo transportation, Tanker ships, Measuring instruments, Capacitance meters, Accuracy, Calibration, Hysteresis, Bubbler gages, Cable gages.

The measurement uncertainties of three types of gages commonly used in large liquefied natural gas storage and ship transport tanks have been studied and the results of this study are reported here. The types are bubbler, capacitance, and cable gages. Measurement uncertainties for various types can be determined but the test conditions must be carefully specified because many of the largest errors result from parameters external to the gaging device. The gage installation, the tank design, and the liquid properties all influence gaging accuracy. A modification of cable gage installations that should significantly improve gaging accuracy is presented. Intrinsic accuracies of some representative cable gages are reported from tests done at ambient temperature under nearly isothermal conditions.

401,149

PB83-186189 PC A03/MF A01
National Bureau of Standards, Boulder, CO. National Measurement Lab.
Materials Selection Criteria for Crack Arrestor Strakes in Naval Vessels (Interim Progress Report),
R. B. King. Jan 83, 38p NBSIR-83-1681
Prepared in cooperation with David W. Taylor Naval Ship Research and Development Center, Annapolis, MD. Sponsored in part by Naval Sea Systems Command, Washington, DC.

Keywords: *Ship hulls, *Crack propagation, Naval ships, Steels, Toughness, Metal plates, *Crack arrest, Fracture(Mechanics).

Research has been conducted on the problem of developing quantitative criteria for materials selection for crack arrestor strakes in naval vessels. Quantitative analysis of material performance in service requires application of dynamic elastic-plastic fracture mechan-

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ics. Results of an extensive literature survey in the area of dynamic fracture mechanics with specific attention given to the crack arrest application are presented. The research program that has been developed is described in detail.

401,150
PB85-109809 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Structural Reliability Fundamentals and Their Application to Offshore Structures, E. Simiu, and C. E. Smith. Sep 84, 32p NBSIR-84/2921
Sponsored in part by Minerals Management Service, Reston, VA.

Keywords: *Offshore structures, Structural design, Structural engineering, Reliability, Service life, Safety factor, Design standards, Failure, Probability theory.

The objective of this report is to present an overview of fundamental topics in structural reliability as applied to individual members, which are potentially applicable to ocean engineering problems. These topics include: the estimation of failure probabilities; safety indices; and safety (or load and resistance) factors. Some of the theoretical and practical difficulties in the application of structural reliability tools are mentioned and/or discussed.

401,151
PB85-142883 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Hydrodynamic Drag Versus Roughness for Rotating Disks.
Final rept.,
T. V. Vorburger, F. E. Scire, and E. C. Teague. 1982, 11p
Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in *Wear* 83, n1-2 p339-349 Dec 82.

Keywords: *Disks(Shapes), *Rotation, Drag, Roughness, Hydrodynamics, Surface roughness, Surface properties, Ships, Hulls(Structures), Reprints.

The present paper focuses on stylus measurements of the microroughness of rotating disks and their significant correlation with hydrodynamic drag measurements. The roughest disks were found to have drag coefficients that are about 30% greater than those of the smoothest disks. Other surface parameters and functions were measured, however, at the present state of understanding, it seems that knowledge of an amplitude sensitive parameter and a wavelength sensitive parameter is adequate for characterizing increases in the drag of rotating disks due to surface roughness.

401,152
PB85-159085 PC A04/MF A01
National Bureau of Standards, Boulder, CO. Fracture and Deformation Div.
Materials Selection Criteria for Crack Arrest Strakes in Naval Vessels: Second Interim Progress Report,
R. B. King, T. Teramoto, and D. T. Read. Oct 84, 64p NBSIR-84/3012
See also PB83-186189. Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.

Keywords: *Ship hulls, *Crack propagation, Naval ships, Steels, Toughness, Metal plates, *Crack arrest, Fracture(Mechanics).

Laboratory experiments have been conducted under conditions intended to simulate those in a structural situation. These experiments were designed to include two key features of ship structural behavior: (1) Crack arrest occurs specifically because a step in toughness is encountered; (2) the load on the specimen, simulating dead load in the structure, is transferred to the uncracked ligament after arrest, thus introducing the possibility of reinitiation. A spring-loaded double-cantilever-beam (DCB) specimen has been used in these experiments. An electron-beam weld is made along the crack propagation line, producing a brittle crack propagation path with a step in toughness at its end. The dynamic run-arrest portion of these experiments has been modeled using a modification of Kanninen's DCB model that includes the effect of the loading spring, and using a finite element model. The elastic-plastic reloading portion has been modeled quasistatically using J integral and tearing instability theory. In addition,

a simplified dynamic viscoelastic-plastic model has been developed to analyze the reloading portion of the experiments.

13K. Pumps, Filters, Pipes, Fittings, Tubing and Valves

401,153
PB84-226224 Not available NTIS
National Bureau of Standards, Washington, DC.
Fitness-for-Purpose Criteria for Pipeline Girth Welds.
Final rept.,
M. B. Kasen, and C. M. Fortunko. Sep 82, 12p
Sponsored in part by Department of Transportation, Washington, DC. Office of Pipeline Safety Operations. Welding Research Council, New York.
Pub. in Proc. Pipeline Welding Inspection Conf., Houston, Texas, September 21-22 1982, p181-192.

Keywords: *Pipelines, *Weld defects, *Nondestructive tests, *Ultrasonic tests, Welded joints, Radiography, *Fracture mechanics, *Girth welds, Welds.

Results of a program to provide the basis for applying fracture mechanics principles to assessment of flaw significance in pipeline girth welds are reviewed. Subjects discussed are: (1) development of appropriate allowable flaw size curves; (2) development of an improved ultrasonic technique for sizing of sharp flaws; (3) the significance of blunt flaws; and (4) the demonstration of inherent limitations on the through wall depths of blunt flaws. A series of technical options for field implementation of the results is provided and discussed.

401,154
PB84-226430 Not available NTIS
National Bureau of Standards, Washington, DC.
Significance of Blunt Flaws in Pipeline Girth Welds.
Final rept.,
M. B. Kasen. May 83, 6p
Sponsored in part by Department of Transportation, Washington, DC. Office of Pipeline Safety Operations. Pub. in *Welding Jnl.* p117s-122s May 83.

Keywords: *Pipelines, *Weld defects, *Crack initiation, Fatigue(Materials), Porosity, Reprints, *Girth welds, Welds.

The probability of crack initiation from porosity, slag, and arc burns in pipeline girth welds was investigated by subjecting highly-flawed welds to severe low-cycle, fully-reversed, strain-controlled fatigue. No effect of the flaw type or content was observed on the number of cyclic reversals to fatigue crack initiation. Fracture was in all cases dominated by the geometrical discontinuity formed by the weld reinforcement. As the applied strain levels were well above yield, these results indicated that the probability of crack initiation from such flaws would be negligible under the essentially static loading to which pipelines are normally subjected. This was corroborated by static tensile testing of flawed welds.

401,155
PB85-120756 Not available NTIS
National Bureau of Standards, Washington, DC.
Fracture-Mechanics Evaluation of Flaws in Pipeline Girthwelds.
Final rept.,
R. P. Reed, H. I. McHenry, M. B. Kasen, and H. M. Ledbetter. 1979, 23p
Pub. in *Welding Research Council Bulletin*, n245 23p 1979.

Keywords: *Pipelines, *Weld defects, Weldments, Pipeline transportation, Welded joints, Shielded metal arc welding, Fracture tests, Mechanical tests, Fracture properties, Fatigue(Materials), Radiography, Inspection, Regulations, Reprints.

Fracture-mechanics analysis was used to evaluate flaws in a buried arctic oil pipeline. The pipe is 1.22-m-diameter, API 5LX-65 steel with nominal wall thicknesses of 12 and 14 mm. It was field welded by a shielded metal-arc process using AWS E7010G and E8010G electrodes. Mechanical-property and simulated-service tests were made on welds cut from the pipeline. Methods were assessed for estimating weld-flaw depths and arc-burn depths from field radiographs. Fracture-mechanics analyses were used to calculate allowable flaw-size curves in accordance

with worst-case requirements set by the Office of Pipeline Safety Operations. Allowable flaw-size curves were used to evaluate girth-weld flaws whose size exceeded the weld-quality requirements of API Standard 1104 and arc burns, which are prohibited by Federal Regulation 49CFR195.

401,156
PB85-131878 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Field Hydraulic Performance of One- and Two-Story Residential Plumbing Systems with Reduced-Size Vents,
R. S. Wyly, and L. S. Galowin. Oct 84, 106p NBSIR-84/2860
Sponsored in part by Department of Defense, Washington, DC., and Department of Housing and Urban Development, Washington, DC.

Keywords: *Plumbing, Residential buildings, Vents, Performance.

The report describes hydraulic tests of drain-waste-vent systems with reduced-size vents installed in single-family housing units at Andrews Air Force Base, Camp Springs, Maryland. The vent systems of six field units were sized according to a procedure based on findings in prior laboratory investigations. The tests reported were conducted on three of the units before occupancy. Principal measurements made were trap-seal reduction and pneumatic pressure excursions in selected vents, using test procedures developed in the laboratory and adapted to field conditions. Results of the preoccupancy tests showed adequate performance with the reduced-size vents. A procedure for the design of reduced-size vent systems is presented that should be of interest to plumbing designers and groups engaged in updating plumbing codes.

401,157
PB85-142461 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Automated Pressure Regulator.
Final rept.,
M. Waxman, H. A. Davis, M. Horowitz, and B. Everhart. Sep 84, 4p
Contract DOE-EA-77-A-01-6010
Pub. in *Review of Scientific Instruments* 55, n9 p1467-1470 Sep 84.

Keywords: *Pressure regulators, Automatic control, Pressure measurement, Automation, Control equipment, Indicating instruments, Rigidity, Pumps, Pressure sensors, Experimentation, Reprints.

A pressure regulator has been constructed that automatically nulls a sensitive differential pressure indicator of the type used in high-quality PVT experiments, thus permitting at least partial automation of such experiments. Distinguishing features are: high resolution, sufficient rigidity for operation in a pressure range up to 100 MPa, and a control logic that permits nulling of the pressure transducer even if the initial state is very far from balance.

13L. Safety Engineering

401,158
PB84-155209 PC A03/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Buoyant Source in the Lower of Two, Homogeneous, Stably Stratified Layers: A Problem of Fire in an Enclosure,
L. Y. Cooper. Dec 83, 27p NBSIR-83-2789

Keywords: *Fires, Plumes, Buoyancy, Flame propagation, Heat transfer, Smoke, Mathematical models, Fire tests, *Room fires.

A point source of buoyancy is located at a specified elevation within the lower of two homogeneous, stably stratified layers. A turbulent buoyant plume is formed above the source, and it impinges on the layers' interface. Depending on the strength of the source, its position below the interface and on the density difference of the two layers, it is conjectured that either a central portion of the impinging plume flow will penetrate and continue upward into the far field of the upper layer as a buoyant plume, the outer portion of the flow penetrating but then dropping down toward the interface

because of negative relative buoyancy, or none of the impinging plume flow will penetrate the upper layer (in-depth) because of its being uniformly of negative relative buoyancy. Associated with these possible conditions will be an effective horizontal outflow of fluid at the interface. The paper derives and solves a set of model equations for these plume-interface interactions, and the results are applied to a generic heat transfer problem related to fires in enclosures.

401,159
PB84-155639 PC A07/MF A01
 National Bureau of Standards, Washington, DC. National Engineering Lab.
Fire Performance of Furnishings as Measured in the NBS Furniture Calorimeter. Part 1,
 J. R. Lawson, W. D. Walton, and W. H. Twilley. Jan 84, 137p NBSIR-83-2787
 Sponsored in part by Department of Health and Human Services, Washington, DC.

Keywords: *Calorimeters, *Furniture, *Fire prevention, Heat transfer, Oxygen, Heat resistant materials, Chairs, Seats, Upholstery, Office equipment, Hospitals, Public health, Thermal radiation, Smoke, Losses.

A heat release rate calorimeter developed at the National Bureau of Standards was used to measure the fire performance of a wide range of furnishings. The heat release rates measured in the calorimeter are determined through the use of oxygen consumption techniques. Data are presented on the free burning characteristics of 28 tests involving 23 different types of furnishings. The furnishings evaluated are classed into the following groups: easy chairs, sofas, waiting room and patient chairs, wardrobe closets, bookcase and bedding. The information presented in this report will provide a basis for selecting types of furniture to be used in health care facilities, hospitals and other living facilities.

401,160
PB84-155829 PC A05/MF A01
 Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
Investigation of Axisymmetric Buoyant Turbulent Diffusion Flames: Flow Structure and Radiation Properties,
 S.-M. Jeng, M.-C. Lai, and G. M. Faeth. Jan 84, 98p NBS-GCR-84-458
 Contract NB81-NADA-2044
 See also PB82-165176.

Keywords: *Fires, *Flame propagation, Heat flux, Temperature distribution, Thermal radiation, Mathematical models, *Buoyant flames, Fire models.

A theoretical and experimental study of flow structure and nonluminous radiation properties of turbulent, buoyant, axisymmetric, methane diffusion flames burning in still air is reported. Past measurements of velocities, temperatures and species concentrations in the same buoyant flames were used to evaluate a Favre-averaged k - ϵ - g turbulence model of the process - with all empirical constants fixed by earlier measurements in noncombusting flows. The model yielded reasonably good predictions of mean properties. Turbulence predictions were less satisfactory, generally underestimating fluctuation levels and Reynold stress in highly buoyant regions of the flow.

401,161
PB84-177146 PC A03/MF A01
 National Bureau of Standards, Washington, DC. National Engineering Lab.
Thermal Actuation of Extinguishing Systems,
 D. D. Evans. Mar 84, 29p NBSIR-83-2807

Keywords: *Fire extinguishers, Actuation, Fire detection systems, Sprinkler systems, Responses, Thermal actuation.

A brief review of the Response Time Index (RTI) method of characterizing the thermal response of commercial sprinklers and heat detectors is presented. Measured ceiling layer flow temperature and velocity histories from a bedroom fire test are used to illustrate the use of RTI in calculating sprinkler operation times. In small enclosure fires, a quiescent warm gas layer confined by the room walls may accumulate below the ceiling before sprinkler operation. The effects of this warm gas layer on the fire plume and ceiling-jet flows are accounted for by substitution of an equivalent point source fire. Relationships are given for the location and strength of the substitute source relative to a point source representation of the actual

fire. Encouraging agreement was found between measured ceiling-jet temperatures from steady fires in a laboratory scale cylindrical enclosure put into dimensionless form based on parameters of the substitute fire source, and existing empirical correlations from fire tests in large enclosures in which a quiescent warm upper gas layer does not accumulate.

401,162
PB84-177153 PC A08/MF A01
 American Inst. of Architects Foundation, Washington, DC.
Escape and Rescue Model: A Simulation Model for the Emergency Evacuation of Board and Care Homes,
 D. M. Alvord. Dec 83, 154p NBS-GCR-83-453
 Grant NB81-NADA-2037

Keywords: Computerized simulation, Mathematical model, Handicapped persons, Time, Safety, Routes, Buildings, Layout, Rescue systems, Fire safety, Fortran, *Emergency plans, *Evacuation(Transportation), *Boarding homes, *Nursing homes, Mental disabilities, SIMSCRIPT 2.5 programming language, User manuals(Computer programs).

The Escape and Rescue Model is a discrete-event simulation program that simulates the emergency movement involved in escape and/or rescue of people from a Board and Care Home housing a group of persons with varying degrees of physical or mental disabilities, along with a small live-in staff. It can handle a variety of resident disabilities, delays, speeds, and other factors. The Model is designed to be run with specific building layouts inputted by the user, and can reasonably handle a facility with up to 100 residents and 50 rooms. The model computes and prints the time to safety for each resident as well as his egress route, the total time to clear the building, and a record of various significant events that occur in the course of evacuation. The Escape and Rescue Model is structured in a fashion that facilitates easy modification of the simulated situation. Once a facility layout has been converted into network form, many factors may be easily altered and the resultant changes in the evacuation times observed. The Model is written in SIMSCRIPT 11.5, a simulation language. It may be implemented on any machine with a SIMSCRIPT compiler and with sufficient memory. Conversion of the model into the standard programming language FORTRAN would greatly increase its availability to users.

401,163
PB84-217066 PC A02/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Fire Research Publications, 1983
 N. H. Jason. Apr 84, 20p NBSIR-84-2871
 See also PB83-238915.

Keywords: *Fires, Bibliographies, Meetings, Contracts, Grants, *Fire research.

Only publications prepared by members of the Center for Fire Research (CFR), by other National Bureau of Standards (NBS) personnel for CFR, or by external laboratories under contract or grant from the CFR are cited. For documents that are available for purchase from either the Government Printing Office (GPO) or the National Technical Information Service (NTIS), the specific order number has been included in the citation.

401,164
PB84-217082 PC A06/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Decision Analysis Model for Passenger-Aircraft Fire Safety with Application to Fire-Blocking of Seats.
 Rept. for Nov 82-Dec 83,
 J. R. Hall, Jr., and S. W. Stiefel. Mar 84, 105p NBSIR-84-2817, DOT/FAA/CT-84/8
 Contract DTFA30-83-A-0034

Keywords: *Fire safety, *Passenger aircraft, *Aircraft seats, Aircraft fires, Benefit cost analysis, Mathematical models, Upholstery, Risk assessment, Cost models.

This report develops a generic model for analysis of the costs and benefits of fire-risk reducing strategies related to passenger airlines. The model calculates incremental costs for installing and operating these options. It also calculates estimated lives saved and property damage avoided, and it provides rules for

combining costs and benefits into a single measure of attractiveness for an alternative. This model is then applied to the strategy of fire-blocking seats on passenger airlines, either on U.S. airlines or on all world airlines.

401,165
PB84-217496 PC A03/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Park Service Room Fire Test Simulations Using the Harvard Level 5.2 Computer Fire Model,
 J. A. Rockett. Jun 84, 46p NBSIR-83-2805
 Sponsored in part by Department of Health and Human Services, Washington, DC., and National Park Service, Washington, DC.

Keywords: *Furniture, *Fire tests, Ignition, Hotels, Calorimeters, Fuels, Heat transfer, Computerized simulation, Area, Mathematical models, *Rooms.

The Fire Center has conducted a series of full-scale tests of hotel-like rooms. The furnishings were a bed with headboard 'made up' with bedding, and a wooden sidetable. The ignition source was a wastebasket. The furniture was burned in the new NBS furniture calorimeter and in a 2.44 x 3.66 x 2.44 high room. As an adjunct to analysis of the test results, a series of simulations of the fire tests were run using the Harvard Fire Simulation. This report describes the simulations and their results. The principal finding of the simulations was that the room had little effect in augmenting the burning of this fuel package. The simulation result was partially due to the burn algorithm used and partially due to the relatively large fire area and short assumed flame radiation extinction length.

401,166
PB84-217520 PC A02/MF A01
 Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
Network Models of Building Evacuation: Development of Software System.
 Final rept.,
 T. M. Kisko, and R. L. Francis. May 84, 25p NBS/GCR-84/457
 Contract NB81-NADA-2057
 See also PB83-197509.

Keywords: *Fire safety, *Buildings, *Evacuation(Transportation), Networks, Algorithms, Mathematical models, EVACNET computer program, Computer applications.

This report summarizes the efforts of the second year of a project to develop user friendly software for the network modeling of building evacuation. When the evacuation of a building involves the flow of people through well defined passageways, it is natural to consider the evacuation problem to be a network flow problem. EVACNET+ is a user friendly interactive computer program that accepts a user defined network model of a building, converts that model to a time expanded dynamic 'transshipment' network, and solves the dynamic network using a capacitated minimum cost network flow algorithm. The solved dynamic network gives a time-dependent plan to evacuate the building in a minimum time, and identified building evacuation bottlenecks.

401,167
PB84-217926 PC A06/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Fire Tests of Amtrak Passenger Rail Vehicle Interiors.
 Final rept. 1978-83,
 R. D. Peacock, and E. Braun. May 84, 119p NBS/TN-1193
 Also available from Supt. of Docs as SN003-003-02590-9. Sponsored in part by Federal Railroad Administration, Washington, DC.

Keywords: *Fire safety, *Railroad cars, Passenger vehicles, Tests, Combustion, Flammability, Materials, Calorimeters, Smoke, Rail transportation, Amtrak system, Vehicle interiors.

A series of fire tests was conducted to assess the burning behavior of the interior of passenger rail vehicles. Three types of tests were performed: (1) small-scale laboratory tests to study the flammability and smoke generation characteristics of the individual materials, (2) full-scale calorimeter tests on the seats to determine the rate of heat release from burning seat

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assemblies, and (3) full-scale tests on mock-ups of the interior of the cars to investigate the potential for fire hazard in the fully furnished vehicles.

401,168
PB84-218387 Not available NTIS
National Bureau of Standards, Washington, DC.
Prediction of Corridor Smoke Filling by Zone Models.
Final rept.,
W. W. Jones, and J. G. Quintiere. 1984, 15p
Pub. in Combustion Science and Technology, v35 n5-6 p239-253 1984.

Keywords: *Buildings, *Fire safety, Mathematical models, Smoke, Rooms, Gas flow, Graphs(Charts), Reprints, *Fire spreading, Compartments.

Several zone models which are being used to predict the growth and spread of fires in compartments have been examined. The authors have benchmarked these models against a set of experiments which were designed to isolate the phenomenon of smoke filling in a room adjacent to a fire source, and connected by a variable opening. Good agreement is achieved between multi-compartment models and experiment. As an adjunct, the authors have implemented correlation based on a simple theory which collapses all of the data into a single graph by using dimensionless groups. These groups then contain most of the significant variables important in describing the flow of a gas from one compartment to another.

401,169
PB84-218734 Not available NTIS
National Bureau of Standards, Washington, DC.
Aspects of Stochastic Modeling for Structural Fire Safety.
Final rept.,
D. Gross. May 83, 12p
Pub. in Fire Technology, v19 n2 p103-114 May 83.

Keywords: *Buildings, *Fire safety, Mathematical models, Stochastic processes, Risk, Structures, Floors, Reprints.

A brief review is presented of methods for stochastic modeling of fires of sufficient severity to threaten the structural safety of buildings. Information is provided on the rate of fire occurrences according to the floor area at risk for the major occupancy types.

401,170
PB84-221241 Not available NTIS
National Bureau of Standards, Washington, DC.
How Close Are We to Scientifically Based Fire Protection Engineering.
Final rept.,
H. E. Nelson. 1984, 6p
Pub. in Proceedings of International Fire Protection Engineering Institute (4th) held at Brunnen, Switzerland on February 26-March 10, 1984, 6p 1984.

Keywords: *Fire protection, *Fire safety, Engineering, Mathematical models, Technology transfer, Reprints, *Foreign technology.

It is proposed that fire science advances of recent years are now reaching a state of knowledge that permits the emergence of a scientifically based fire protection engineering technology. It is proposed that a clear overview of an effective engineering approach is apparent and to at least an initial degree supported by engineering capabilities.

401,171
PB84-221423 Not available NTIS
National Bureau of Standards, Washington, DC.
Calculating Sprinkler Actuation Time in Compartments.
Final rept.,
D. D. Evans. Mar 84, 29p
Pub. in Proceedings of Symposium Computer Applications Fire Protection: Analysis, Modeling, Design held at Leesburg, Virginia on March 19-21, 1984, 29p.

Keywords: *Fire protection, *Sprinklers, Automatic control, Heat, Thermal measurement, Buildings, Fires.

A generalized method is presented for determining the response time for thermally actuated sprinklers installed near the ceiling of both large and small compartments. A substitute source for the actual fire is calculated to account for the effects of a warm gas layer in the upper portion of the enclosure on ceiling-layer flow temperatures. Illustrative examples are given for

the change in response time for sprinklers. For comparative purposes sprinkler response is also calculated for the limiting case of an unconfined ceiling.

401,172
PB84-221431 Not available NTIS
National Bureau of Standards, Washington, DC.
Smoke Movement in Rooms of Fire Involvement and Adjacent Spaces.
Final rept.,
L. Y. Cooper. 1984, 14p
See also PB83-250951. Sponsored in part by Department of Health and Human Services, Washington, DC. and Department of the Interior, Washington, DC.
Pub. in Fire Safety Jnl. 7, p33-46 1984.

Keywords: *Fires, *Buildings, *Periodicals, Combustion products, Fire detection, Hazards, Smoke, Growth, Mathematical models, Doors, Fire fighting, Fire safety, Reprints.

Key to the solution of fire safety design problems is the capability to predict the dynamics of enclosure fire environments. This paper presents a detailed qualitative description of the generic phenomena which occur during typical fire scenarios. The focus of attention is on the effects within building compartments of fire involvement, i.e., compartments made up of a single enclosed space or a space of two or more rooms interconnected by significant penetrations such as open doors or windows. Throughout the discussion reference is made to quantitative methods for predicting some of the most significant of these effects. Reference is also made to available mathematical/computer models which use these latter methods to quantitatively predict the overall fire environment. The basic topics that are covered are: fire growth in combustibles of fire origin; development of the fire plume and interaction of the plume with the ceiling surface.

401,173
PB84-221605 Not available NTIS
National Bureau of Standards, Washington, DC.
Rate of Heat Release: Implications for Engineering Decision.
Final rept.,
C. Huggett. 1980, 13p
Pub. in Proceedings of Engineering Applications Fire Technology Workshop held at Gaithersburg, Maryland on April 16-18, 1980, p233-245 1980.

Keywords: *Fire safety, Mathematical models, Tests, Heat transfer, Research, Measurements, Ignition, Oxygen, Consumption, Heat release.

The purpose of this paper is to review the present status of rate of heat release measurements and to explore the potential applications of such measurements to the design of a more fire safe environment. The rate of heat release is an essential input to the solution of the central problem of fire research to predict the course of a fire given the pre-fire state of the system and a source of ignition. Modern rate of heat release measurements fall into two categories; laboratory methods designed to characterize a fire property of a material under carefully controlled conditions, and system tests designed to characterize the burning of large and complex systems and structures under conditions simulating a real fire. The oxygen consumption technique of rate of heat release measurement shows promise in both applications.

401,174
PB84-221696 Not available NTIS
National Bureau of Standards, Washington, DC.
Fire Test Methods: Classification and Application.
Final rept.,
A. F. Robertson. 1983, 10p
Pub. in American Society for Testing and Materials 816, p3-12 1983.

Keywords: *Fire safety, *Fire tests, Model tests, Tables(Data).

It is shown that traditional fire test methods have in many cases represented physical models of real prototype fires. The results of applying them serve in a significant way to predict the behavior of a prototype system when exposed to fire. Consequently, the fire safety community has thought of fire tests as yielding information on the behavior of a fire system. Most of the new consumer protection fire tests adopted by the government may be considered as typical of the fire system type. Recently, there has been a trend toward introduction of a new series of tests that measure, often in technical terms, one or more specific fire prop-

erties. Many of these properties must usually be considered together to predict the behavior of a fire system. Thus, it becomes important for the user of the fire test to understand the nature of the test he plans to apply. It is unfortunate that explanatory material to assist the user in such understanding is usually not considered an integral part of the test method and is often omitted by those adopting the test for regulatory purposes. Action is proposed to correct such a defect. A table is provided to show the way in which the author has classified representative fire tests.

401,175
PB84-222074 Not available NTIS
National Bureau of Standards, Washington, DC.
Detector Response in Large Buildings.
Final rept.,
I. A. Benjamin. 1980, 23p
Pub. in Proceedings of Engineering Applications Fire Technology Workshop, National Bureau of Standards, Gaithersburg, Maryland, April 16-18, 1980, 23p.

Keywords: *Detectors, Design, Maintenance, Buildings, Fire safety, *Smoke detection.

Presentation of some background on the operations of two types of detectors the thermal detector, usually a fixed temperature or rate of rise detector; and the aerosol detector, usually of either photoelectric or ion chamber design. Some discussion was given on the characteristics of the detectors and experience with them. Sets of design data have been presented and are available for the location of both types of detectors under flat and beamed typed of ceilings. The thermal detector data is based on the U.L. spacings, as a measure of the detector response. The design data for the aerosol detectors is based on a material response number and L value, characteristics length, both of which characteristics are not currently available but must be obtained from the manufacturer.

401,176
PB84-225671 Not available NTIS
National Bureau of Standards, Washington, DC.
Using the Harvard Fire Simulation.
Final rept.,
J. A. Rockett, M. Morita, and T. Handa. 1983, 6p
Prepared in cooperation with Tokyo Univ. (Japan).
Pub. in Fire Science and Technology, v3 n1 p57-62 1983.

Keywords: *Fires, *Simulation, Vents, Walls, Algorithms, Combustion, Mathematical models, Reprints, Computer application.

Use of the Harvard Fire Simulation during the winter and spring of 1982 for the modeling of some Japanese fire situations is summarized for the Joint United States-Japan Natural Resources meeting. Enrichments to the 'official' level V version of the simulation are discussed. These include interlayer mixing in the vicinity of vents and its effect on the room heat balance, and the inclusion of a wall burning algorithm as an option of the simulation.

401,177
PB84-226471 Not available NTIS
National Bureau of Standards, Washington, DC.
Modeling of NBS (National Bureau of Standards) Mattress Tests with the Harvard Mark V Fire Simulation.
Final rept.,
J. A. Rockett. 1982, 16p
See also PB82-176082.
Pub. in Fire and Materials 6, n2 p80-95 1982.

Keywords: *Bedding equipment, *Fires, *Simulation, Combustion, Burning time, Residential buildings, Smoke, Combustion products, Mathematical models, Gases, *Mattresses, Nursing homes, Harvard Mark 5 fire model.

NBS burned eleven mattresses made up with bedding in two different rooms, typical of a residential bedroom and a nursing home patient room, respectively. Seven of the mattresses flamed and burned vigorously, the other four were of a construction or so heavily flame inhibited that they only smoldered. The burning behavior of the seven that flamed was modeled with the Harvard Mark V fire simulation. The experimental burn behavior for tests conducted in one room was well reproduced using only total weight of combustible, surface area and heat of combustion. Smoke production values were found to have little effect on the predicted behavior except for the smoke production itself. Fires

in a second room, whose ventilation was intentionally restricted by the configuration of the adjoining space, could not be as well reproduced by the present, single room fire model. During this study several changes were made to the simulation. The most significant change was the inclusion of mixing of the hot, exiting fire gases with the cold incoming air. As a part of this, the inter-layer radiation exchange was reformulated to include the effect of smoke contamination of the lower layer. The reformation of the radiation model had a marked effect on the predicted upper layer gas temperatures generally improving the quality of the simulation.

401,178
PB84-226877 Not available NTIS
 National Bureau of Standards, Washington, DC.
Minutes of Ad Hoc Mathematical Fire Modeling Group Workshop on Modeling of Fire Suppression.
 Final rept.,
 R. S. Levine. May 84, 17p
 Pub. in Fire Technology 20, n2 p47-63 May 84.

Keywords: *Fire extinguishers, *Fire fighting, Fire extinguishing agents, Heat transfer, Methodology.

I conclude, tentatively, from the several research projects on extinguishment, that there are two important extinguishment mechanisms, and both of them can be incorporated into the models: (1) diluting the combustion air with vaporized extinguishing agent until the oxygen content of the lower layer is too small to sustain combustion; and (2) removing thermal energy from the pyrolyzing solid surface as by water droplets impacting on it. Method 1 requires enough extinguishing agent so that its heat of vaporization is of the order of the heat stored in the ceiling layer plus the thermal output of the fire. It is possible that the stirring caused by a sprinkler in a small room will rapidly carry vaporized extinguishing agent into the lower layer. Method 2 requires only a few percent of the amount of extinguishing agent in method 1, provided it can be efficiently delivered to the fuel surface.

401,179
PB84-244318 Not available NTIS
 National Bureau of Standards, Washington, DC.
Human Behavior in the MGM Grand Hotel Fire.
 Final rept.,
 J. L. Bryan. Mar 82, 10p
 Pub. in Fire Jnl. 76, n2 p37-41, 44-48 Mar 82.

Keywords: *Fires, *Hotels, *Behavior, Questionnaires, Responses, Evacuation(Transportation), Surveys.

Immediately after the MGM Grand Hotel fire occurred in Las Vegas, Nevada, on the morning of November 21, 1980, the NFPA expressed interest in a systematic study of the responses of the hotel's guests during the fire. The four-page questionnaire consisted of 28 check-off, fill-in, and completion items. On the last page was a diagram of the Tower-floor arrangement of the hotel on which guests were asked to indicate their movements within the building and their egress route from the building. This questionnaire was developed from an interview questionnaire previously used and from the questionnaire used by the NFPA after the Beverly Hills Supper Club fire of 1977.

401,180
PB84-244664 Not available NTIS
 National Bureau of Standards, Washington, DC.
Human Awakening and Subsequent Identification of Fire Related Cues.
 Final rept.,
 M. J. Kahn. Feb 84, 7p
 Pub. in Fire Technology 20, n1 p20-26 Feb 84.

Keywords: *Warning systems, *Reaction time, *Arousal, Detection, Smoke, Tests, Sleep, Auditory perception, Fires, Heat, Fire safety, Human factors.

Twenty-four college-age male subjects, employed for one night each, were evaluated on their ability to awaken and then identify fire cues. Twelve subjects were exposed to smoke alarm warning signals of three intensities, while the second twelve subjects were exposed to a smoke odor, a heat presentation, and a single smoke alarm warning signal. Subjects were, in all cases, awakened by alarms that reached their ears at signal/noise ratios of 34 dB. They were considerably less likely to be awakened by heat, the smoke odor, and alarm sounds that reached their ears at signal/noise ratios of 10 dB or less. Upon awakening, subjects repeatedly failed to correctly label radiant heat presentations and smoke alarm warnings as fire cues.

401,181
PB85-101129 PC A05/MF A01
 California Univ., Berkeley. Dept. of Mechanical Engineering.
Fire Propagation in Concurrent Flows.
 Final progress rept. 1 Jun 83-31 May 84,
 A. C. Fernandez-Pello. Aug 84, 85p NBS/GCR-84/471
 Contract NB83-NADA-4020
 See also PB84-100155.

Keywords: *Fire tests, *Flame propagation, Heat transfer, Fuels, Flow, Convection, Combustion, Burning rate, Enclosures.

Experimental and Theoretical Studies of the process of flow assisted fire spread over the surface of combustible surfaces have been carried out. Research efforts have concentrated on two aspects of this mode of fire spread: (1) Fire spread in a concurrent forced (or mixed) flow; and (2) Fire spread along the walls of an enclosure in natural convection. During this reporting period a series of experiments of the dependence on the velocity and oxygen concentration of the concurrent forced flow of the rate of flame spread over thick PMMA sheets have been completed. The results indicate that this form of fire spread is primarily controlled by heat transfer from the flame to the unburnt combustible. Experiments with thin paper sheets are currently underway. Efforts on the second task have concentrated on the numerical analysis of the structure of a diffusion flame, established over a burning fuel surface. The results indicate the existence of significant longitudinal diffusion of heat and species ahead of the flame front. An analysis on the spread of flames in an enclosure is currently in progress.

401,182
PB85-102739 Not available NTIS
 National Bureau of Standards, Washington, DC.
Zone Smoke Control.
 Final rept.,
 J. H. Klote. Nov 83, 3p
 Pub. in Building Design and Construction 24, n11 p90-92 Nov 83.

Keywords: *Fire protection, *Smoke abatement, Ventilation, Exhaust systems, Air flow, Fumes, Reprints.

From its inception on the late 1960's, smoke control technology has advanced to the point where there are numerous buildings in the United States and Canada with systems to control smoke from building fires. This paper discusses the principles of smoke control and the concept of zoned smoke control systems. The advantage of having the smoke zone coincide with the heating, ventilating, and air-conditioning (HVAC) zones is discussed.

401,183
PB85-105518 PC A05/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Fire Safety Evaluation System for National Park Service Overnight Accommodations.
 Final rept.,
 H. E. Nelson, A. J. Shibe, B. M. Levin, S. D. Thorne, and L. Y. Cooper. Sep 84, 100p NBSIR-84/2896
 Sponsored in part by National Park Service, Washington, DC.

Keywords: *Fire safety, *National parks, *Hotels, Evaluation, Requirements, Smoke, Houses, Residential buildings.

A fire safety evaluation system for overnight accommodations has been developed and is ready for use in evaluating the fire safety of National Park Service residential accommodations. The system can be used to determine combinations of widely accepted fire safety equipment and building construction features that provide a level of safety equivalent to that required by the Life Safety Code of the National Fire Protection Association. An approach for controlling smoke from fires in atrium-like arrangements is also presented.

401,184
PB85-109130 PC A04/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Model for the Transport of Fire, Smoke and Toxic Gases (FAST),
 W. W. Jones. Sep 84, 66p NBSIR-84/2934

Keywords: *Fires, Smoke, Gases, Growth, Computerized simulation, Structural forms, Transport properties, Toxic hazards.

A numerical implementation of a zone model which will transport fire, smoke and toxic gases in a multi-compartment structure is described. The areas covered are the equations which are solved, the numerical technique for the solution of these equations, species transport and the other relevant physical phenomena which govern fire growth and spread, and the transport of smoke. Also included in the model are the calculations necessary for a toxic hazard evaluation of a structure with a specific material loading. Forced ventilation is not yet included (version 15). A machine readable copy of the model (FAST) is available through NTIS. The tape includes the data file listed in the appendices of this report.

401,185
PB85-118388 Not available NTIS
 National Bureau of Standards, Washington, DC.
Criteria for Assuring Safety during Erection of Concrete Shell Structures.
 Final rept.,
 E. O. Pfrang, and H. S. Lew. 1980, 3p
 Sponsored in part by Laboratorio Central de Estructuras y Materiales, Madrid (Spain).
 Pub. in Bulletin of the International Association for Shell and Spatial Structures 21-3, n74 p5-8 1980.

Keywords: *Safety engineering, *Construction, Criteria, Shells(Structural forms), Hyperbolic parabolic shells, Personnel, Hoisting, Personnel development, Reinforced concrete, Reprints.

This paper summarizes criteria for assuring safety during construction of reinforced concrete hyperbolic shell structures. The criteria are based on the current U.S. regulations for concrete construction. The criteria highlight important provisions in regulations affecting the safety of workers. Special attention is given to those provisions covering construction loadings, construction sequences, hoisting systems and personnel safety training.

401,186
PB85-120707 Not available NTIS
 National Bureau of Standards, Washington, DC.
Experimental and Theoretical Analysis of Quasi-Steady Small-Scale Enclosure Fires.
 Final rept.,
 J. G. Quintiere, B. J. McCaffrey, and K. DenBraven. 1979, 13p
 Pub. in Proc. Symp. Int. Combustion 17, University of Leeds, England, August 20-25 1978, p1125-1137 1979.

Keywords: *Fires, *Enclosures, Experimental data, Analysis(Mathematics), Burning rate, Doors, Heat, Pressure measurement, Temperature measurement.

Forty-six small-scale experiments were conducted to measure the characteristics of horizontal plastic (PMMA) pool fires in an enclosure as a function of doorway width and fuel area. A 0.30 m high enclosure was instrumented to measure sample mass loss, the upper gas layer and ceiling temperatures, heat flux to the floor, and the pressure drop across the doorway. Results are reported for the maximum steady burning period; however, a few cases do not seem to have reached a steady state. For small sample sizes a distinct plume could be perceived in the enclosure, while for larger sample sizes flames tended to fill the enclosure (sometimes to within 2 to 3 cm of the floor), and extended out the door opening.

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13L—Safety Engineering

401,187

PB85-123404 Not available NTIS
National Bureau of Standards, Washington, DC.
Credible Engineering Methodologies (As a Solution to Bridging the Technology Gap).
Final rept.,
H. E. Nelson. 1983, 46p
Pub. in Proceedings of Communications between Fire Research Community Owner-Operators of Buildings, Washington, DC, November 10, 1983, p51-96 1984.

Keywords: *Fire safety, *Fire protection, *Buildings, Methodology, Engineering, Mathematical models, Design, Hazards, Human factors.

There is a technical communications gap between the fire research community and the community of owner/operators of buildings seeking to understand and manage fire safety requirements. The emerging fire protection engineering technology is proposed as the best means of bridging this gap. The paper presents an example to demonstrate the present and potential capabilities of creditable fire protection engineering methods. An approach to addressing specific problems is also offered. The fire protection engineering method proposed involves the combination of empirical data; formulae; and mathematical models that trace the impact of fire induced stress, the response of the structure, the impact of fire safety design, and the actions of people in case of fire.

401,188

PB85-128858 Not available NTIS
National Bureau of Standards, Washington, DC.
Control of Blowout Fires with Water Sprays.
Final rept.,
D. D. Evans. 1984, 7p
Sponsored in part by Minerals Management Service, Reston, VA.
Pub. in Proceedings of Technology Assessment and Research Program for Offshore Minerals Operations, Reston, VA, March 28-29, 1984, p89-95.

Keywords: Blowouts, Fires, Fire extinguishing agents, Fire fighting, Fire protection, Fire safety, Hydrocarbons, Offshore drilling, Offshore structures, Water, Spraying.

An overview of the fire suppression research studies directed at understanding the effects of water spray on hydrocarbon fires is presented. Fire protection system design concepts for the protection of offshore oil and gas platforms in the event of a blowout fire are discussed.

401,189

PB85-132918 PC A08/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Benefit-Cost Model of Residential Fire Sprinkler Systems.
Final rept.,
R. T. Ruegg, and S. K. Fuller. Nov 84, 153p NBS/TN-1203
Also available from Supt. of Docs as SN003-003-02622-1

Keywords: *Sprinkler systems, Houses, Residential buildings, Benefit cost analysis, Fire protection, Economic analysis, Risk, Fire safety, Decision making, Economic models, Breakeven point, Cost benefit analysis.

This paper develops and applies decision models for evaluating the economic efficiency of providing fire loss mitigation in houses through the use of a new technology: fast-response sprinkler systems. A model is developed for calculating present value net benefits as they would accrue to an owner-occupant or an owner of a rental house who installs a sprinkler system. Costs and benefits of owning a system are estimated for selected hypothetical cases pertaining to a new, single-family dwelling in the United States. The estimates are then used to illustrate the model. Minimum or maximum values that key decision variables must take in order for sprinkler systems to be cost effective in the selected applications are calculated through break-even analysis. Related models are developed for evaluating the economic merits of sprinkler systems from the standpoint of developers and local governments. Implications for the research and building communities are discussed.

401,190

PB85-135440 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Estimating Effectiveness of State-of-the-Art Detectors and Automatic Sprinklers on Life Safety in Residential Occupancies.
Final rept.,
E. K. Budnick. Aug 84, 18p
See also PB84-153980.
Pub. in Fire Technology 20, n3 p5-22 Aug 84.

Keywords: *Fire detection systems, *Sprinkler systems, *Fire protection, Fire safety, Residential buildings, Fire losses, Evaluation, Effectiveness.

The report provides a qualitative assessment of the life safety impact of early warning fire detection and automatic sprinkler technology in residential occupancies. This assessment is based on the results of full-scale studies and statistics on residential fire fatalities from the NFIRS data base. Estimates of the impact of three alternatives, smoke detectors, standard automatic sprinklers, and residential sprinklers, are provided for major fire hazard scenarios in residential occupancies. The results of this study indicate that significant life safety benefits can be derived from broad application of detectors and sprinklers in all residential buildings.

401,191

PB85-137677 PC A03/MF A01
Dayton Univ., OH. Research Inst.
Furniture Fire Model.
M. A. Dietenberger. Nov 84, 49p NBS/GCR-84/480
Grant NB83-NADA-4056

Keywords: *Furniture, *Fires, Mathematical models, Flame propagation, Upholstery, Fabrics, Ignition, Burning rate, Buildings, Houses.

A sub-model describing upholstered furniture burning is being developed for installation within a general room fire model. Current computer room fire codes do not have algorithms for determining the burning rates of upholstered furniture. Since upholstered furniture items are a major factor in many room fires, a requirement for such a sub-model was seen. As a consequence, the University of Dayton Research Institute undertook to develop such an algorithm. This report represents the first year's efforts towards that objective.

401,192

PB85-137685 PC A06/MF A01
Factory Mutual Research Corp., Norwood, MA.
Modeling of Aircraft Cabin Fires.
M. A. Delichatsios. Sep 84, 116p FMRC-J-I-OHOJ2-BU1, NBS/GCR-84/473
Grant NB82-NADA-3041
Sponsored in part by Federal Aviation Administration Technical Center, Atlantic City, NJ.

Keywords: *Aircraft cabins, *Fires, Mathematical models, Flame propagation, Fuselages, Walls, Predictions.

In this work, simple fire dynamic models for various components of an aircraft cabin fire are developed. These simple integral models can be incorporated in global zone models for aircraft cabin fires occurring in flight or caused by an impact-survivable crash. The major accomplishment of this work was the development of simple expressions for the burning of vertical walls, simulating, for example, the burning of wall panels in the fuselage. Flame heights of vertical wall fires are predicted and correlated by a simple expression. In addition, critical conditions for extinction of rapid flame spread have been investigated for fires in vertical walls consisting of charring materials, allowing for the prediction of flame spread rates.

401,193

PB85-137727 PC A02/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Field Tests of the Smoke Control System at the San Diego VA (Veterans Administration) Hospital.
J. H. Klote. Nov 84, 21p NBSIR-84/2948

Keywords: *Smoke abatement, *Hospitals, Fire safety, Field tests, Control equipment, Fans, Air flow, Design, Pressure, Acceptability, Smoke detectors.

The Veterans Administration (VA) has sponsored a project at the Center for Fire Research of the National Bureau of Standards to study smoke control in VA hos-

pitals and to develop new design approaches and methods of acceptance testing. This paper is one report of this ongoing project. It presents the results of a field test on the San Diego VA Hospital.

401,194

PB85-140291 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Remarks to NFPA (National Fire Protection Association) Board of Directors on Center for Fire Research Programs and Implications to NFPA.
Final rept.,
J. E. Snell. Jul 84, 7p
Pub. in Fire Jnl. 78, n4 p64-66, p68-70, p72 Jul 84.

Keywords: *Fire safety, *Fires, Research, Utilization, Project management, Research management, Reprints.

An overview is presented of the purpose and content of the fire research programs at the National Bureau of Standards. Written for a meeting of the Board of Directors of the National Fire Protection Association (NFPA), the paper emphasizes the necessary role of the NFPA in facilitating the application of the resulting practical tools to reduce the loss and cost of unwanted fires.

401,195

PB85-141869 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Control Units for Intrusion Alarm Systems.
Final rept.,
M. L. Kite, M. Juberts, G. N. Stenbakken, and D. E. Frank. Jun 84, 15p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in NIJ (National Inst. of Justice) Standard-0321.00, 15p Jun 84.

Keywords: *Warning systems, *Control equipment, Standards, Performance, Reliability, Tests, Acceptability, Detection, Reprints, *Alarm systems, *Intrusion, Tamperproofing.

This standard establishes performance requirements and test methods for intrusion alarm control units used in protecting residential or commercial premises. Upon actuation of an intrusion sensing device or the detection of a trouble condition, the control unit may initiate a local audible alarm, transmit an alarm signal to a police department, or transmit an alarm signal to a central station. The performance characteristics addressed are those that affect the reliability of the device with emphasis on those that affect false alarms susceptibility and tamper resistance.

401,196

PB85-142222 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Jet Diffusion Flame Suppression Using Water Sprays - An Interim Report.
Final rept.,
B. J. McCaffrey. 1984, 30p
See also PB84-159052.
Pub. in Combustion Science and Technology 40, p107-136 1984.

Keywords: *Fire fighting, *Blowouts, Fire extinguishing agents, Flames, Spraying, Water, Gas wells, Oil wells, Reprints.

The feasibility of using water sprays for the control of offshore oil/gas well blowout fires has been addressed. Considering the sheer scale of the problem, knowledge from a fundamental viewpoint is going to be required in order to extrapolate laboratory-sized flame studies up to full scale. Available data and appropriate literature concerned with the application of water sprays as a jet diffusion flame suppression/extinguishment agent have been reviewed. Small pneumatic atomizing nozzles using H₂ gas, both as the flame source as well as the atomizing driver, have been used to scale high momentum jet flames and to study the effect of water on the flame. Thermodynamic equilibrium was shown to be an effective guide in interpreting the results. The effect of flame temperature reduction due to water sprays has been observed to correlate with a single spray parameter—the median drop diameter. Directions for further study have been indicated.

401,197
PB85-143964 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Assessment of Fire Induced Flows in Compartments.
 Final rept.,
 J. G. Quintiere, K. Steckler, and D. Corley. 1984, 14p
 Pub. in Fire Prevention Science and Technology 4, n1
 p1-14 1984.

Keywords: *Fire tests, *Flow rate, Enclosures, Temperature, Predictions, Vents, Windows, Doors, Reprints, *Compartments.

An experimental study was conducted to measure flow rates of air and fire products through wall vents, namely windows and doors. A burner (diffusion flame) was used to simulate a line fire of various heating rates and line widths along a wall of the enclosure. Analysis of the data showed the temperatures followed a two-layer profile with both upper and lower average gas temperatures correlated by dimensionless groups. Estimates of vent mixing rates into the lower layer and estimates of wall vertical boundary layer flows were made. The former were up to 30 per cent of the vent flow rate and the latter were up to 100 per cent of the vent flow rate. This estimate for the wall flows appears high due to inconsistencies in the analysis. The primary result shows that a prediction, based on a two-layer (hot and ambient) model with only plume entrainment manifesting flow between the layers, gives results to within 50 per cent of the experimental vent flows.

401,198
PB85-148153 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Thermal Actuation of Extinguishing Systems.
 Final rept.,
 D. D. Evans. 1984, 14p
 See also PB84-177146.
 Pub. in Combustion Science and Technology 40, p79-92 1984.

Keywords: *Fire extinguishers, Temperature, Plumes, Fire detection systems, Extinguishing, Fire protection, Actuation, Sprinkler systems, Responses, Reprints, Thermal actuation, Building systems.

A brief review of the Response Time Index (RTI) method of characterizing the thermal response of commercial sprinklers and heat detectors is presented. Measured ceiling layer flow temperature and velocity histories from a bedroom fire test are used to illustrate the use of RTI in calculating sprinkler operation times. In small enclosure fires, a quiescent warm gas layer confined by the room walls may accumulate below the ceiling before sprinkler operation. The effects of this warm gas layer on the fire plume and ceiling-jet flows are accounted for by substitution of an equivalent point source fire. Relationships are given for the location and strength of the substitute source relative to a point source representation of the actual fire. Encouraging agreement was found between measured ceiling-jet temperatures from steady fires in a laboratory scale cylindrical enclosure put into dimensionless form based on parameters of the substitute fire source, and existing empirical correlations from fire tests in large enclosures in which a quiescent warm upper gas layer does not accumulate.

401,199
PB85-156560 PC A06/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Clearances and Methods of Protection for Wall and Ceiling Surfaces Exposed to Radiant Heating Appliances.
 Final rept.,
 J. J. Loftus, and R. D. Peacock. Dec 84, 116p NBS/TN-1205
 Sponsored by Consumer Product Safety Commission, Washington, DC., and Department of Energy, Washington, DC.

Keywords: *Barriers, *Thermal resistance, *Fire protection, *Clearances, Chimneys, Fire safety, Residential buildings, Tests, Walls, Ceilings(Architecture), Stoves, Radiant heating, Fire code.

The Center for Fire Research in the National Bureau of Standards has evaluated the fire hazard potential associated with the installation and use of solid fuel burning appliances (and chimney connectors) in residential housing. For this three-part study, mock-up and full

scale room walls and ceilings were exposed to radiant energy from chimney connectors and an appliance operated under normal and overfire conditions at various distances or clearances from the room members. Peak surface temperature rise measurements were made on exposed and protected walls and ceilings and comparisons were made with surface temperature rise limitations established by building and fire codes.

401,200
PB85-158160 PC A04/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Evaluation of Thimble-Chimney Connector (Wall Pass-Through) Systems for Solid Fuel Burning Appliances,
 J. J. Loftus, and R. D. Peacock. Nov 84, 68p NBSIR-84/2969
 Sponsored by Department of Energy, Washington, DC., and Consumer Product Safety Commission, Bethesda, MD.

Keywords: *Connectors, *Chimneys, Fire safety, Performance evaluation, Residential buildings, Stoves, Walls, Thermal resistance, Radiant heating, Fire code.

This report is part of an ongoing project at the National Bureau of Standards (NBS) to evaluate the fire safety of solid fuel burning appliance installations in residential homes and buildings. Previous work included evaluations of different protection devices designed to shield room walls and ceilings from the effects of radiant energy from hot appliance and chimney connector pipe surfaces, the objective being to determine which systems would help maintain surface temperatures on combustibles within code recommended temperature levels. For this segment a total of 17 different thimble-chimney connector (wall pass-through) systems connected to chimney connector pipes from a stove were evaluated for their ability to provide thermal protection for combustibles (wood studs and headers, etc.) in room walls.

401,201
PB85-166759 PC A02/MF A01
 Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
Negative Exponential Solution to an Evacuation Problem.

Research rept.,
 R. L. Francis. Dec 84, 21p RR-84-36, NBS/GCR-84/482
 Grants NB81-NADA-2057, NSF-CEE82-15437

Keywords: *Evacuating(Transportation), *Buildings, Fire safety, Personnel, Applications of mathematics, *Fire models.

We consider a building evacuation problem for which the number of people inside a lobby affects the rate at which people exit the lobby. We model the problem as a linear functional optimization problem for which the number of people exiting the lobby is to be maximized. We use duality theory to establish the optimality of a solution for which the number of people exiting as a function of time is given by a negative exponential function.

13M. Structural Engineering

401,202
PB83-164152 PC A05/MF A01
 National Bureau of Standards, Boulder, CO. National Measurement Lab.
Fracture Toughness of Steel Weldments for Arctic Structures.
 Interim progress rept.,
 T. L. Anderson, and H. I. McHenry. Dec 82, 86p
 NBSIR-83-1680
 Sponsored in part by Minerals Management Service, Reston, VA.

Keywords: *Weldments, *Structural steels, Cold weather construction, Welds, Toughness, Fracture properties, Arctic regions, J integrals.

The report summarizes the progress in the development of fracture criteria for steel weldments in arctic structures. Tensile, Charpy-impact, and fracture toughness properties have been measured as a function of temperature for a 25.4 mm (1 in) thick plate of normalized steel. Fracture toughness tests were performed on five geometries of single-edge notched bend

(SENB) specimens. Critical values of the J-integral and the crack-tip opening displacement (CTOD) were computed and plotted versus temperature. The ductile-to-brittle transition temperature increased with increasing specimen thickness, and crack length. The effect of specimen geometry on fracture toughness is attributed to changes in crack-tip region constraint with geometry. Initial attempts to model this behavior have been moderately successful. Various aspects of the SENB fracture toughness test are being examined.

401,203
PB84-142231 PC A09/MF A01
 National Bureau of Standards, Washington, DC.
Comparative Analysis of Thermographic Inspections Performed on Retrofitted Homes,
 Y. L. Chang, and R. A. Grot. May 83, 191p NBSIR-83-2701
 Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Residential buildings, *Thermal insulation, Heat loss, Temperature measuring instruments, Infrared equipment, Field tests, Performance evaluation, *Thermographic inspection.

An applied research program was sponsored by the Department of Energy to analyze and compare the results from inspections that utilized infrared sensing systems to identify thermal deficiencies in buildings. This research consisted of both the laboratory evaluation of the commonly used infrared sensing equipment for building inspections and the field evaluation of the accuracy and consistency of the results of thermographic surveys performed by various thermographic inspectors. The field evaluation of thermographic inspection performed by infrared contractors was undertaken using residences previously inspected by the National Bureau of Standards (NBS) as part of the Community Services Administration Weatherization Program. The results of the first phase was carried out in 1978-79 and published in a previous report. The present report contains the analysis and comparison of thermal anomalies detected by NBS and infrared contractors, during the second phase of this research program, on twenty single-family residences in five cities in 1980-81.

401,204
PB84-155894 PC A05/MF A01
 National Bureau of Standards, Washington, DC. National Engineering Lab.
Documentation and Assessment of the GSA/PBS (General Services Administration/Public Buildings Service) Building Systems Program: Final Report and Recommendations,
 F. T. Ventre. Dec 83, 85p NBSIR-83-2777
 Sponsored in part by Public Buildings Service, Washington, DC. See also PB83-192807.

Keywords: *Buildings, *Project management, National government, Evaluation, Technology innovation, Procurement, Environments.

This report assesses the General Services Administration/Public Buildings Service's (GSA/PBS) Building Systems Program (BSP) and recommends methods for furthering the program's objectives. Lighting, air movement and temperature, acoustics, and the flexibility of interior space division in the six buildings completed under the BSP are evaluated by comparing field measurements made in February-April 1982 with the performance specifications for those four attributes at the time of procurement. The wider effects of the BSP innovations on the building community are qualitatively evaluated.

401,205
PB84-159789 PC A04/MF A01
 National Bureau of Standards, Washington, DC. National Engineering Lab.
Analysis of Electrical Fire Investigations in Ten Cities.
 Final rept.,
 J. R. Hall, Jr., R. Bukowski, and A. Gomberg. Dec 83, 66p NBSIR-83-2803
 See also PB83-200113. Sponsored in part by Consumer Product Safety Commission, Washington, DC.

Keywords: *Residential buildings, *Fires, Electric devices, Fire safety, Circuit breakers, Electric fuses, Electric wire, Wiring, Fire damage, *Electrical fires.

This report describes the results of an analysis of electrical fire cases by the Center for Fire Research, Na-

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13M—Structural Engineering

tional Bureau of Standards for the Consumer Product Safety Commission. The report describes the 105 detailed electrical fire investigation reports from 10 participating cities and discusses findings resulting from analysis of the data from those reports. These findings include the effects of tampering, alterations and other system problems, factors that may cause overcurrent devices to fail to operate, the role of extension cords misused as permanent extensions of building wiring, the problems of loose connections between receptacles and wiring, and other scenarios and sequences of events that lead to electrical fire ignition.

401,206
PB84-160993 PC A08/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
On-Site Calibration of Flow Metering Systems Installed in Buildings.

Building science series,
D. W. Baker, and C. W. Hurley. Jan 84, 157p NBS-BSS-159
Also available from Supt. of Docs. as SN003-003-02551-8. Library of Congress catalog card no. 83-600626. Sponsored in part by Civil Engineering Lab. (Navy), Port Hueneme, CA.

Keywords: *Flowmeters, *Buildings, Flow rate, Calibrating, *Energy management systems, *Energy conservation.

This report summarizes the various types of flowmetering devices used in energy management and control systems (EMCS), various methods for their initial calibration and, when practical, techniques for maintaining their calibration while they are in service. Emphasis is placed on the use of transfer reference meter systems, where the working meter is calibrated on site by connecting it in series with a calibrated transfer meter of any variety. Other methods of calibration are also described. Reference tables and the necessary equations for flow calculations are presented throughout the text and in the appendices. Illustrative examples are given in detail for the calculation of flow using each type of metering device described.

401,207
PB84-167758 PC A23/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.

Wind and Seismic Effects. Proceedings of the Joint Panel Conference of the U.S.-Japan Cooperative Program in Natural Resources (12th) Held at Gaithersburg, Maryland on May 19-23, 1980.

E. V. Leyendecker, and R. M. Chung. Jan 84, 549p NBS-SP-665
Also available from Supt. of Docs. as SN003-003-02557-7. See also PB83-252791. Library of Congress catalog card no. 83-600593.

Keywords: *Bridges(Structures), *Buildings, *Earthquakes, *Wind pressure, *Meetings, Seismic waves, Gust loads, Earth movements, Dynamic structural analysis, Dynamic loads, Dynamic response, Soil mechanics, Tsunamis, *Seismic design, *Ground motion, Earthquake engineering.

The Twelfth Joint Meeting of the U.S.-Japan Panel on Wind and Seismic Effects was held in Gaithersburg, Maryland on May 19-23, 1980. The proceedings of the Joint Meeting include the program, the formal resolutions, the Task Committee Reports, and the technical papers. The subjects covered in the papers include: (1) the characterization of seismic ground motion, (2) the characterization of natural wind and extreme wind records, (3) structural response to earthquake loading, (4) storm surge and tsunamis, (5) recent developments in seismic design criteria, (6) technical cooperation with developing countries, (7) earthquake hazard mitigation, and (8) structural response to wind loading.

401,208
PB84-171172 PC A22/MF A01
California Inst. of Tech., Pasadena.
Natural Convection Flows and Associated Heat Transfer Processes in Room Fires.
Doctoral thesis,
W. S. Sargent. c1983, 524p NBS-GCR-83-447
Contract NB82-NADA-3033

Keywords: *Fires, *Heat transfer, Fire tests, Convection, Temperature gradients, Heat transfer coefficient, Plumes, Mathematical models, Theses, *Room fires.

This report presents the results of experimental investigations of natural convection flows and associated

heat transfer processes produced by small fires in rooms with a single door or window opening. Calculation procedures have been developed to model the major aspects of these flows. Two distinct sets of experiments were undertaken. First, in a roughly 1/4 scale facility, a slightly dense solution of brine was allowed to flow into a tank of fresh water. The resulting density difference produced a flow which simulated a very small fire in a room with adiabatic walls. Second, in an approximately 1/2 scale test room, a nearly stoichiometric mixture of air and natural gas was burned at floor level to model moderate strength fires. In this later facility, we directly measured the heat conducted through the walls, in addition to determining the gas temperature and composition throughout the room.

401,209
PB84-171610 PC A07/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Status of Building Code Provisions for Solar Energy Systems.

Final rept.,
D. R. Conover. Feb 84, 140p NBS-GCR-84-460
Sponsored in part by Department of Energy, Washington, DC. Prepared in cooperation with National Conference of States on Building Codes and Standards, Inc., Herndon, VA.

Keywords: *Building codes, *Solar energy, Solar heating, Residential buildings, Technology assessment, Guidelines, *Solar cooling.

The recent increase in the use of solar energy systems has concurrently brought about an increased concern for health and life safety issues in buildings using solar energy systems. Some of these concerns, such as electrical connections and plumbing system design, have been addressed for years in the building codes used throughout the United States. Others, such as separation of potable water and toxic heat transfer fluids, have not received as much attention (especially in residential construction) until the increased use of solar energy systems. Regardless, those responsible for ensuring the safety of the U.S. building stock have needed code provisions with which to address the safety aspects of solar energy systems. The purpose of this report is to outline the current status of technical criteria the code enforcement community utilizes in regulating solar energy systems design and installation in new and existing building construction.

401,210
PB84-178284 PC A05/MF A01
National Bureau of Standards, Washington, DC.
Economizer Algorithms for Energy Management and Control Systems,

C. Park, G. E. Kelly, and J. Y. Kao. Feb 84, 82p NBSIR-84-2832
Sponsored in part by Department of Energy, Washington, DC. Office of Building and Community Systems, and Civil Engineering Lab. (Navy), Port Hueneme, CA.

Keywords: *Buildings, *Environmental engineering, Heating, Cooling, Algorithms, Computer programs, Fortran, Dry bulb temperature, *Energy management, *Energy conservation, Fortran 77 programming.

Economizer cycles have been recognized as important energy conservation measures for building air handling systems and have been included in most Energy Management and Control Systems (EMCS). This report describes the psychrometric processes of the most commonly used economizer cycles and presents algorithms for implementing these cycles on a typical Energy Management and Control System.

401,211
PB84-178847 PC A07/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.

Directional Extreme Wind Speed Data for the Design of Buildings and Other Structures.

Building science series (Final),
M. J. Changery, E. J. Dumitriu-Valcea, and E. Simiu. Mar 84, 127p NBS-BSS-160
Library of Congress catalog card no. 84-601008. Prepared in cooperation with National Climatic Center, Asheville, NC.

Keywords: *Structures, *Wind velocity, *Meteorological data, Data acquisition, Climatology, Statistical data, Periodic variations, Wind direction, Aerodynamics.

The purpose of this report is to provide largest yearly fastest-mile wind speed data corresponding to winds

blowing from each octant at 37 airport stations in the United States. Four sets of data are presented. The first set consists of largest yearly fastest-mile wind speeds at 24 stations as extracted from original records. The second set consists of largest yearly fastest-mile wind speeds at 13 stations as extracted from Local Climatological Data (LCD) summaries. The third and fourth sets consist of the data from the first and second sets reduced to a height of 10 m above ground. The report also provides information on possible differences between extreme data extracted from original records on the one hand and from LCD summaries on the other hand. Procedures for estimating extreme wind effects that take into account the directional characteristics of the extreme wind climate and of the aerodynamic behavior of the structure are briefly reviewed, and it is noted that additional research on sampling errors in the estimation of extreme wind effects appears to be warranted.

401,212
PB84-216472 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.

Buoyancy-Induced Wall Flow Due to Fire in a Room.

Final rept.,
Y. Jaluria. May 84, 97p NBSIR-84-2841
Prepared in cooperation with Rutgers - The State Univ., New Brunswick, NJ.

Keywords: *Buildings, *Walls, *Fires, Boundary layer flow, Buoyancy, Flow rate, Plumes, Fire tests, *Room fires.

A study of buoyancy-driven flow generated adjacent to the vertical walls of a room due to fire in the room has been carried out. The boundary layer flow that arises over the vertical walls due to the resulting difference between the wall and gas temperatures was analyzed, employing the integral analysis method. The flow rate, momentum and convected energy in the downward flow that arises in the heated upper layer and those in the upward flow that is generated in the cooler lower layer were determined. The separation point and the region near it where the flow starts separating from the wall are studied. Though more detailed and more accurate computations are included, an approximate method for evaluating the wall effects for a two-layer model and for an experimental study is outlined.

401,213
PB84-216480 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.

Need and Availability of Test Methods for Measuring the Smoke Leakage Characteristics of Door Assemblies,

L. Y. Cooper. May 84, 35p NBSIR-84-2876

Keywords: *Buildings, *Fires, *Smoke, Doors, Leakage, Fire tests, Pressure gradients, *Room fires.

This paper identifies and places into perspective relevant information that would assist in focusing future research and development on test methods to measure the smoke leakage characteristics of door assemblies. The concept of smoke compartmentation is introduced and developed. The importance of cross-door pressure differential in establishing the performance of door assemblies in fire generated environments is discussed. Door assembly performance is then related to life safety, in general, and to the design of compartments of safe refuge, in particular. All of the discussion suggests a listing of required door assembly test methods, and, finally, leads to a review of the availability and development status of existing and potential future test method candidates.

401,214
PB84-216514 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC. Building Equipment Div.

Test Procedures for Rating Residential Heating and Cooling Absorption Equipment,

B. Weber, R. Radermacher, and D. Didion. Apr 84, 79p NBSIR-84-2867
Sponsored in part by Oak Ridge National Lab., TN.

Keywords: *Residential buildings, *Heating, *Cooling, Gas heating, Gas cooling, Air conditioning equipment, Heat pumps, Seasonal variations, Performance evaluation.

Test and rating procedures are presented for gas-fired absorption devices operating in either the heating or cooling modes. These procedures are designed to include the effects of part-load and cyclic operation, variations in outdoor temperature, and frost formation during the heating mode. Both air-source and ground water source absorption heat pumps are considered, as well as air cooled and ground water cooled air-conditioners and water chillers. A calculation procedure is presented for estimating the heating and cooling seasonal performance and cost of operation of residential water chillers, air-conditioners, and heat pump units.

401,215
PB84-216522 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Wind-Tunnel Study of Wind Loading on a Compliant Offshore Platform,
T. A. Morreale, P. Gergeley, and M. Grigoriu. Mar 84, 36p NBS-GCR-84-465
Prepared in cooperation with Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering. Sponsored in part by Minerals Management Service, Reston, VA. Color illustrations reproduced in black and white.

Keywords: *Offshore structures, *Platforms, Wind tunnel models, Wind direction, Static tests, Torsion, Loads(Forces), Structural engineering, *Wind loads.

Two models, with scales of 1/250 and 1/500, of an offshore oil platform were tested in a wind tunnel to obtain static forces for various wind directions. Two peak wind velocities were used: 54 fps and 108 fps. The measured shears and moments along wind were generally in reasonably good agreement with previous results obtained in a different wind tunnel using larger models. The agreement for transverse forces and moments and for torsion was not as satisfactory.

401,216
PB84-216548 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Thermal Response of Unconfined Ceilings Above Growing Fires and the Importance of Convective Heat Transfer,
L. Y. Cooper. Apr 84, 37p NBSIR-84-2856

Keywords: *Buildings, *Ceilings(Architecture), *Fires, Flame propagation, Heat transfer, Thermal radiation, Plumes, Boundary value problems, *Room fires.

A procedure is developed to calculate the thermal response of unconfined ceilings above growing fires. The procedure uses an algorithm for conduction into the ceiling material. It takes account of heat transfer due to radiation from the combustion zone to the ceiling surface, and due to reradiation from the ceiling to the floor and furnishings. Finally, the procedure uses a previously developed algorithm for convective heat transfer to the ceiling from the fire-plume-driven ceiling jet. The procedure is used to predict radial-dependent surface temperature histories of typical ceiling materials under a variety of different realistic levels of hazardous fire energy generation rates and combustion zone-ceiling separation distances. The results give an indication of the influence of convective heat transfer on peak ceiling thermal response, losses from fire plume gases, and radial variations and peak values of ceiling-to-floor irradiation during enclosure fires.

401,217
PB84-217025 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Air Flow Calibration of Building Pressurization Devices,
A. K. Persily. Apr 84, 31p NBSIR-84-2849

Keywords: *Buildings, *Air flow, Air circulation, Doors, Calibration, Pressurizing.

Whole building pressurization devices, or blower doors, have been used to quantify building air-tightness and to determine compliance with air tightness standards. Using pressurization testing in air-tightness standards requires knowledge of the accuracy of the air flow rate measurement techniques employed by blower doors. The quantitative accuracy of existing air flow calibrations are not known and have been questioned. The blower doors considered in this report employ calibration formula relating the air flow rate through the door to the fan speed and the pressure difference across the door. Such fan speed calibrations must be done accurately over a wide range of fan

speed/pressure difference combinations and in a physical setting that closely approximates the manner in which the blower doors are used in the field.

401,218
PB84-217041 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Fire Research.
Field Tests of the Smoke Control System at the Bay Pines VA (Veterans Administration) Hospital,
J. H. Klote. May 84, 51p NBSIR-84-2868
Sponsored in part by Veterans Administration, Washington, DC.

Keywords: *Hospitals, *Fire tests, *Smoke, Field tests, Pressurizing, Air circulation, Florida, *Smoke, *Health care facilities, Bay Pines hospital.

The Veterans Administration (VA) has sponsored a project at the Center for Fire Research of the National Bureau of Standards to study smoke control in VA hospitals and to develop new design approaches and methods of acceptance testing. This paper is the first report of this project, and it presents the results of a field test on the VA Bay Pines Hospital. In general the smoke control systems at this hospital performed well, however, there were some problems. These problems are discussed along with specific recommendations for their corrections and general recommendations to prevent similar problems in future hospitals. It was observed that the bidirectional double doors in the hospital acted in a manner similar to barometric dampers to limit pressure differences.

401,219
PB84-217413 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC. Building Equipment Div.
Control Algorithms for Building Management and Control Systems -- Hot Deck/Cold Deck/Supply Air Reset, Day/Night Setback, Ventilation Purging, and Hot and Chilled Water Reset,
W. B. May, Jr. Mar 84, 75p NBSIR-84-2846
Sponsored in part by Department of Energy, Washington, DC. Office of Building and Community Systems, and Naval Civil Engineering Lab., Port Hueneme, CA.

Keywords: *Buildings, *Environmental engineering, Automatic control equipment, Air conditioning equipment, Ventilation, Heating equipment, Controller characteristics, Computer programs.

Software is an important component of building management and control systems (BMCS). This report describes concepts, algorithms, and software used in BMCS components developed in the NBS building systems and controls laboratory. The basic concepts, considerations and general algorithms for hot deck/cold deck supply air setpoint reset, day/night thermostat and ventilation setback, ventilation purging, and hot/chilled water supply setpoint reset are presented. Reset is the changing of a setpoint on a Heating, Ventilating and Air Conditioning (HVAC) system controlled by a feedback controller to match the system output to the system load. Setback is the changing of HVAC system operation to reduce energy use during unoccupied periods. Purging is the use of outdoor air during unoccupied periods to reduce mechanical conditioning requirements. Specific implementations of the algorithms in software on an actual BMCS are presented as examples.

401,220
PB84-217918 PC A06/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Effectiveness of Solar Shading for an Office Building.
Final rept.,
S. Treado, J. Barnett, and W. Remmert. May 84, 115p NBS/BSS-161
Also available from Supt. of Docs as SN003-003-02584-4. Library of Congress catalog card no. 84-601038. Sponsored in part by General Services Administration, Washington, DC., Naval Facilities Engineering Command, Alexandria, VA., Directorate of Civil Engineering (Air Force), Washington, DC. and Office of the Chief of Engineers (Army), Washington, DC.

Keywords: *Shades, *Commercial buildings, *Cooling, Solar radiation, Windows, Cost effectiveness, Savings, Computerized simulation, Heating, Performance evaluation, Climate, United States, *Solar screens, *Energy consumption.

The impact of solar shading of windows on building energy consumption, energy costs and occupant com-

fort is examined for a typical office building. Measurements of the solar and thermal performance characteristics of three solar screens are reported. Using the DOE-2 computer program, annual building energy simulations were performed for seven climatic locations in the United States. Thirteen combinations of window thermal transmittance and shading coefficient are examined for each location. The analysis includes separate evaluations for buildings with all-year cooling and summer-only cooling. The results indicate that solar shading can reduce building energy consumption and improve comfort conditions in buildings with significant cooling loads. The optimum shading device characteristics vary with climatic location.

401,221
PB84-218064 PC A02/MF A01
National Bureau of Standards, Washington, DC. Office of Product Standards Policy.
National Voluntary Laboratory Accreditation Program Proficiency Testing for Thermal Insulation Materials Laboratory Accreditation Program Round 9 - August 1983.
Final rept.,
J. Horlick. Jun 84, 21p NBSIR-84/2890

Keywords: *Buildings, *Fire tests, Laboratories, Flammability testing, Combustion, Insulation, Thermal conductivity, *Accreditation.

The National Voluntary Laboratory Accreditation Program (NVLAP) is a federal program which accredits testing laboratories satisfying published criteria. One Laboratory Accreditation Program (LAP) accredits laboratories for thermal insulation materials test methods. Participation in proficiency testing is required for certain test methods including: settled density, smoldering combustion, surface flammability, and thermal conductivity. Analyses and summaries of the test data returned by 30 laboratories for these methods for Insulation LAP Proficiency Testing Round 9 are reported. A description of NVLAP proficiency testing and how it fits into the laboratory evaluation process is given.

401,222
PB84-218353 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Offshore Concrete Structures in the Arctic: Research Needs.
Final rept.,
N. J. Carino. Apr 84, 56p NBS/TN-1192
Also available from Supt. of Docs as SN003-003-02582-8. Sponsored in part by Minerals Management Service, Reston, VA.

Keywords: *Concrete structures, *Offshore structures, *Arctic regions, Reviews, Meetings, Design, Materials, Construction, Inspection, Maintenance, Research.

A study of research needs to enhance the capability to design, maintain, and approve concrete offshore structures for the Arctic was carried out by the National Bureau of Standards on behalf of the Minerals Management Service, Department of the Interior. The study was composed of three activities: a letter survey of key individuals in the field; an international workshop on the subject; and a review of available literature. Data gathered from these activities were used to develop a comprehensive list of research needs in the following areas: design, materials, construction, inspection and repair.

401,223
PB84-218882 Not available NTIS
National Bureau of Standards, Washington, DC.
Structural Serviceability. Floor Vibrations.
Final rept.,
B. Ellingwood, and A. Tallin. Feb 84, 1p
Pub. in Jnl. of the Structural Engineers, v110 n2 p401-418 Feb 84.

Keywords: *Floors, *Deflection, *Vibration, Dynamic response, Structural design, Motion, Stiffness, Mathematical models, Humans, Acceptability, Reprints.

Floor vibrations arising from normal human activity may affect the serviceability of modern building structures, which are becoming lighter and more flexible than before. Existing serviceability criteria for floors are reviewed in the light of research dealing with human perception of structural motion. The dynamic response of floors to realistic pedestrian movement excitation models is analyzed. Tentative serviceability criteria to

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13M—Structural Engineering

minimize floor vibrations that are objectionable to building occupants are presented.

401,224
PB84-218965 Not available NTIS
National Bureau of Standards, Washington, DC.
Development of Hazardous Conditions in Enclosures with Growing Fires.
Final rept.,
L. Y. Cooper. 1983, 19p
See also PB83-164368.
Pub. in Combustion Science and Technology 33, p279-297 1983.

Keywords: *Buildings, *Fires, Flame propagation, Combustion, Heat transfer, Fire hazards, Mathematical models, Reprints, *Room fires, *Flame spread.

A mathematical model for stimulating the environment in enclosures during the growth stage of hazardous fires was developed previously. To use the model one must specify the energy release rate of the fire, certain heat transfer parameters, the area and height of the enclosure and the elevation of the fire above the floor. Solution to the model's equations would yield the time-varying thickness, temperature, and product of combustion concentrations of an upper smoke layer which starts to drop from the enclosure ceiling at the time of ignition. In this paper the model equations are solved for the general class of fires whose energy release rate, Q , and product of combustion generation rates, C , are approximately proportional to t to the n th power (t is time and $n > 0$). For such fires, general results for the complete solution history of the enclosure environment are obtained and presented in the form of graphs, and, where possible, by closed form analytic expressions. Use of the results is illustrated in two example problems. The first of these involves a problem in smoldering combustion where, according to experimental data, the combustion zone can be simulated by an $n = 1$ fire. The second involves a prediction of the environment produced in an enclosure which contains an $n = 2$ fire, which simulates a specific, large-scale, flaming fire hazard.

401,225
PB84-221258 Not available NTIS
National Bureau of Standards, Washington, DC.
CIB (Conseil International du Batiment) National Committees as a Mechanism for Communication: An Example.
Final rept.,
N. J. Raufaste. May 84, 7p
Pub. in Proceedings of Build, Take Care What We Have Built With Limited Resources, Conseil International du Batiment 83, held at Stockholm, Sweden on August 15-19, 1983, paper on Making Use of Building Research 5, p355-361 May 83.

Keywords: *Communications, *Buildings, Assessments, Technology.

An example is given of the use of a National Committee as a mechanism to link a nation's building community to CIB. The newly focused goals, objectives, and activities of the U.S. National Committee for CIB are presented. The rationale for these are related to the needs of the U.S. building community for more effective information exchange with the international building community and to the roles of CIB. During the past two years this National Committee has made improvements in its coordination among U.S. building researchers to form linkages for information exchange and to assess building technology needs on a national and international scale.

401,226
PB84-221365 Not available NTIS
National Bureau of Standards, Washington, DC.
Probability-Based Loading Criteria for Codified Design.
Final rept.,
B. Ellingwood. 1983, 12p
Pub. in Proceedings of Int. Conf. for Application Statistics Probabilities Soil Structural Engineering (4th) held at Florence, Italy on June 13-17, 1983, p237-248 1983.

Keywords: *Building codes, *Loads(Forces), Safety, Design standards, Design criteria, Regulations.

Traditional structural design criteria lack consistency in the levels of safety and serviceability they accord different structures. Considerable improvements have been obtained recently using the unifying concept of limit states design along with a probabilistic approach to treating uncertainties invariably found in engineering

practice. The paper describes some of these recent developments, illustrating how reliability-related research can be transformed into safety and serviceability criteria in codes and other regulatory documents.

401,227
PB84-221456 Not available NTIS
National Bureau of Standards, Washington, DC.
Probability-Based Wind Load Description for Cladding and Structural Members Sensitive to Wind Direction Effects: A Survey of Recent Research.
Final rept.,
E. Simiu. 1983, 8p
Pub. in Proceedings of International Conference on Application Statistics Probability Soil Structural Engineering held at Florence, Italy on June 13-17, 1983, p273-280.

Keywords: *Meetings, *Buildings, Loads(Forces), Design, Wind(Meteorology), Risk, Aerodynamics, Structural members, Probability, *Wind loads.

A review is presented of procedures for describing wind loads in both well-behaved and hurricane-prone regions. In addition, recent research is described pertaining to the risk-consistent design of wind-sensitive structures with both specified and unknown orientation.

401,228
PB84-221944 Not available NTIS
National Bureau of Standards, Washington, DC.
Turbulent Wind Effects on Tension Leg Platform Surge.
Final rept.,
E. Simiu, and S. D. Leigh. Apr 84, 18p
See also PB83-207464. Sponsored in part by Minerals Management Service, Reston, VA.
Pub. in Jnl. of Structural Eng. 110, n4 p785-802 Apr 84.

Keywords: *Offshore structures, *Platforms, Structural engineering, Wind(Meteorology), Turbulence, Aerodynamics, Hydrodynamics, Reprints, *Wind loads.

A procedure is presented for estimating surge response to turbulent wind in the presence of current and waves. The procedure accounts for the nonlinearity of the hydrodynamic forces and for the coupling of aerodynamic and hydrodynamic effects. It is shown that current wind spectra do not model correctly the wind speed fluctuations at very low frequencies and an alternative model of the wind spectrum, consistent with fundamental principles, is presented. The equation of surge motion under turbulent wind in the presence of current and waves is solved for a typical tension leg platform and it is shown that the damping provided by the hydrodynamic forces precludes the occurrence of significant wind-induced resonant amplification effects even if the drag coefficient in the Morison equation is very small.

401,229
PB84-222249 PC A07/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Building Technology.
Building Technology Project Summaries, 1983-1984 (of the National Bureau of Standards (NEL) Center for Building Technology).
Final rept.,
N. J. Raufaste, and M. Olmert. Jun 84, 141p NBS/SP-446-8
See also PB83-259622.

Keywords: *Construction industry, *Buildings, *Research projects, Structural engineering, Building codes, Earthquake resistant structures, Structural design, Environmental engineering, Technology innovation, Solar energy concentrators, Cost effectiveness, Quality assurance, Construction materials, Thermal insulation, Acoustics, Earthquake engineering, Energy conservation, Cement hydration.

The Center for Building Technology (CBT) of the National Bureau of Standards (NBS) is the national building research laboratory. It works cooperatively with other organizations, private and public, to improve building practices. It conducts laboratory, field, and analytical research. It develops technologies to predict, measure, and test the performance of building materials, components, systems, and practices. This knowledge is required for responsible and cost-effective decisions in the building process and cannot be obtained through proprietary research and development. CBT provides technologies needed by the building community to achieve the benefits of advanced computation and automation. CBT does not promulgate building

standards or regulations, but its technologies are widely used in the building industry and adopted by governmental and private organizations that have standards and codes responsibilities. CBT programs include: computer-integrated construction, structural safety, earthquake hazards reduction, building physics, building equipment, quality of building materials, and cement hydration.

401,230
PB84-223262 Not available NTIS
National Bureau of Standards, Washington, DC.
Conduction Transfer Functions and the Heat Balance Method for Thermal Simulation of Multiroom Buildings.
Final rept.,
T. Kusuda, and G. N. Walton. 1983, 178p
Pub. in Proceedings of Thermal Mass Effects Buildings, Oak Ridge National Laboratory, Knoxville, TN, June 2-3, 1982, COF-8206130, p99-176 1983.

Keywords: *Buildings, *Heat balance, Finite element analysis, Finite difference theory, Heat transfer, Air circulation, Time dependence.

Methods for modeling thermal mass are reviewed: finite difference and finite element techniques, recent developments in time domain and frequency domain conduction transfer functions, and a new analytic solution for three dimensional heat transfer in a slab-on-grade configuration. Convective and radiative processes which thermally connect the building masses with the room air and each other are briefly discussed. The equations for single and multiroom energy balances are described. These include new methods for inter-room air movement. A set of sample calculations are presented to show the influence of various simulation methods, particularly as they relate to multiroom analysis, on comfort and energy use.

401,231
PB84-226117 Not available NTIS
National Bureau of Standards, Washington, DC.
Tether Deformation and Tension Leg Platform Surge.
Final rept.,
E. Simiu, and A. Carasso. Jun 84, 4p
Sponsored in part by Minerals Management Service, Reston, VA.
Pub. in Jnl. of Structural Engineers, v110 n6 p1419-1422 Jun 84.

Keywords: *Offshore structures, *Platforms, Loads(Forces), Hydrodynamics, Waves, Structural engineering, Dynamic structural analysis, Reprints.

A preliminary numerical investigation is conducted into the question whether tether deformation under the action of hydrodynamic loads can affect the surge response of tension leg platforms (TLP's). The motion of the tethers subjected to a forced oscillation at the platform level is represented by a nonlinear wave equation. The numerical solution of this equation showed that the lateral deformation of the tethers had no significant effect on the surge of deep water TLPs investigated in this note.

401,232
PB84-237197 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Building Technology.
Building Technology Publications, Supplement 8: 1983.
Final rept.,
L. Beavers. Jun 84, 92p NBS/SP-457/8
Also available from Supt. of Docs as SN003-003-02600-0. See also PB83-250241.

Keywords: *Abstracts, *Construction industry, Buildings, Technology, Structural engineering, Structural design, Solar energy, Construction materials, Bibliographies, *Energy conservation, *Earthquake engineering.

This report presents NBS' Center for Building Technology (CBT) publications for 1983. It is the eighth supplement to NBS Special Publication 457, Building Technology Publications, and lists CBT reports issued during January 1 - December 31, 1983. It includes titles and abstracts of each CBT publication and those papers published in non-NBS media, key word and author indexes, and general information and instructions on how to order CBT publications. This document is divided into three main sections. The first, Titles and Abstracts, provides the report title, author(s), date of

publication, selected key words, and an abstract of each NBS publication and each paper published in an outside source. The Author Index cites CBT authors and their publication number which is listed in this supplement. The Key Word Index is a subject index, listing word summaries of the building research topics for each publication and paper. By selecting a main word or subject, the user is able to locate reports of interest through these subject-related words.

401,233
PB84-241421 PC A09/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Applied Mathematics.
Economic Evaluation of Building Design, Construction, Operation and Maintenance. Seminar Workbook.

Technical note (Final).
 R. T. Ruegg. Jun 84, 182p NBS/TN-1195
 Sponsored in part by Public Buildings Service, Washington, DC. Also available from Supt. of Docs as SN003-003-02597-6.

Keywords: *Public buildings, *Economic analysis, *Cost effectiveness, Engineering costs, Operating costs.

This workbook has been prepared for participants in the seminar, 'Economic Evaluation of Building Design, Construction, Operation and Maintenance.' It has two main functions: (1) to provide basic resource materials, references, and introductions to methods employed in the seminar and (2) to provide instructional problems for solution by the participants. Specifically, it contains brief discussions of key elements in performing economic evaluations: discounting, escalation, establishing a study period, project selection techniques, and treatment of uncertainty; explanations of supporting analysis techniques: break-even analysis and replacement theory; and problems, worksheets, and solutions.

401,234
PB84-241728 PC A04/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Building Technology.
Weatherization of Residences: Criteria for Retrofit Materials and Products.

Technical note.
 W. J. Rossiter, Jr., and R. G. Mathey. Aug 84, 72p NBS/TN-1201
 Sponsored in part by Department of Energy, Washington, DC. Also available from Supt. of Docs as SN003-003-02599-2.

Keywords: *Weatherproofing, *Houses, Materials, Thermal insulation, Storm windows, Doors, Weatherstripping, Thermostats, Fire safety, Energy conservation.

Criteria are given for retrofit materials and products included in the DoE Weatherization Assistance Program. These materials and products are thermal insulation, storm windows and doors, replacement windows and doors, caulks and sealants, weatherstripping, vapor retarders, clock thermostats, and replacement glazing. The criteria are based on a consideration of factors such as thermal performance, fire safety, durability, quality, conformance to building codes, use, and ease of installation. The retrofit materials and products are listed by generic type along with pertinent standards and specifications. Precautions to be followed during their insulation are also given for each of the items. Fire safety requirements for thermal insulations are recommended with regard to the use and locations where they are installed.

401,235
PB85-100634 PC A14/MF A01
 National Bureau of Standards (NEL), Washington, DC. Center for Applied Mathematics.
Instructor's Manual: Economic Evaluation of Building Design, Construction, Operation and Maintenance.
 Final rept.,
 R. T. Ruegg, and H. E. Marshall. Jun 84, 322p NBS/TN-1194
 Also available from Supt. of Docs as SN003-003-02596-8. Sponsored in part by Public Buildings Service, Washington, DC.

Keywords: *Buildings, *Economic analysis, Construction costs, Cost effectiveness, Cost engineering, Benefit cost analysis, Return on investment, Manuals.

This instructor's manual describes each section of a three-day technical seminar on how to measure the

economic impact of alternative designs, systems, and operation and maintenance strategies in Federal buildings. The manual was prepared to help instructors of the General Services Administration conduct technically sound and comprehensive seminars.

401,236
PB85-106839 PC A03/MF A01
 National Bureau of Standards (NEL), Washington, DC. Structures Div.
Construction Research in Japan,
 H. S. Lew. Sep 84, 28p NBSIR-84/2834

Keywords: *Construction industry, *Research, Construction equipment, Laboratories, Development, Japan, Trends, Public works.

The construction industry is one of the key industries in Japan. The annual volume of business of the industry accounts for over 20 percent of the GNP of Japan. Partially due to large investments in the public works projects by the Japanese Government, the industry maintained a steady growth during the past two decades. During this period of steady growth, many large construction firms established research laboratories to place themselves in a favorable position in the domestic, as well as international, construction market. The construction machinery industry of Japan also grew steadily during the same period, and their share of the world market increased significantly. In order to meet foreign competition, the industry has also made significant investments in their research and development efforts. This report examines the research and development efforts of Japan's construction and construction machinery industries and their trends.

401,237
PB85-120673 Not available NTIS
 National Bureau of Standards, Washington, DC.
Influence of Wind Direction on the Response of a Square-Section Tall Building.

Final rept.,
 T. A. Reinhold, P. R. Sparks, H. W. Tieleman, and F. J. Maher. 1980, 14p
 Pub. in Proc. Int. Conf. Wind Eng. (5th), Colorado State University, Fort Collins, Colorado, July 8-14 1979, v2 p685-698 1980.

Keywords: *Buildings, *Wind direction, Superstructure, Wind pressure, Wind tunnels, Tests, Dynamic loads, Dynamic response, Dynamic structural analysis.

This paper presents the results of a wind-tunnel investigation into the effect of wind direction on the wind loads on a square cross-section building model with sharp corners and an aspect ratio of 8.33 to 1. The studies were carried out in a flow which simulated the mean and turbulent properties expected for an urban boundary layer wind. The static and dynamic wind loads were determined at 6 levels throughout the height of the model. From these loads, local and overall force coefficients were determined for forces normal to the model's faces and for torques about the vertical axis through the geometrical center of the model cross-section. These coefficients are presented together with spectra for the modal forces and modal torques associated with the fundamental translational and modes of the corresponding full structure.

401,238
PB85-123651 Not available NTIS
 National Bureau of Standards, Washington, DC.
Reliability Based Criteria for Reinforced Concrete Design.
 Final rept.,
 B. Ellingwood. 1979, 15p
 Pub. in American Society of Civil Engineers Jnl. Struct. Div. 105, n4 p713-727, 4 Apr 79.

Keywords: *Reinforced concrete, *Buildings, *Design criteria, Reliability, Construction materials, Design standards, Resistance, Loads(Forces), Structural engineering, Probability theory, Reprints.

Probabilistic limit states design concepts have evolved over the past decade because of the potential that they afford for simplifying the design process and placing it on a consistent basis for various construction materials. Several different criteria formats have been proposed, which have the common feature that their various load and resistance factors have a reliability basis. Two such criteria for reinforced concrete design are examined in this paper. The development of practical reliability based design criteria is also illustrated. While these are consistent with appropriate measures of design uncertainty and reliability and have a well es-

tablished rationale, they retain the simple characteristics of existing criteria with which designers in the US feel comfortable.

401,239
PB85-136232 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Statistical Tests of Environmental Load Data.
 Final rept.,
 B. Ellingwood. Jun 84, 5p
 Pub. in Jnl. of Structural Engineers 110, n6 p1400-1404 Jun 84.

Keywords: *Structural design, *Climatology, Loads(Forces), Statistical tests, Snow, Wind pressure, Probability theory, Statistical analysis, Structural engineering, Reprints.

Basic climatological variables such as wind speed, ground snow and other environmental effects are needed to calculate structural design loads. The design loads are contingent on the selection of suitable probability distributions for these climatological variables. This note compares the probability plot correlation criteria as a tool for statistical analysis and testing of environmental data to other common methods as a tool for testing and analyzing environmental data.

401,240
PB85-137420 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Probability - Based Design for Engineered Masonry Construction.

Final rept.,
 B. Ellingwood, and A. Tallin. Jan 84, 4p
 Pub. in Proceedings of American Society of Civil Engineers, Specialty Conference on Probability Mechanics and Structural Reliability, Berkeley, CA., January 11-13, 1984, p82-85.

Keywords: *Masonry, *Construction, Buildings, Design, Structural engineering, Specifications, Probability theory, Criteria, Limits, Reliability, Walls, Loads(Forces).

Specifications for masonry and other construction materials are expected to move gradually over the next several years toward the adoption of probability-based limit states design. This paper summarizes how such criteria might be developed for brick and concrete masonry construction using, as an example, walls loaded in combinations of axial compression and out-of-the-plane flexure.

401,241
PB85-140424 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
West Virginia Cooling Tower Collapse Caused by Premature Form Removal.

Final rept.,
 H. S. Lew. 1980, 6p
 Sponsored by Occupational Safety and Health Administration, Washington, DC.
 Pub. in Civil Engineering 50, n2 p62-67 Feb 80.

Keywords: *Cooling towers, *Collapse, Failure, Loads(Forces), Stresses, Formwork(Construction), Concrete construction, Concretes, Shells(Structural forms), Reprints.

The collapse of the natural-draft hyperbolic concrete cooling tower unit no. 2 at the Pleasants Power Station at Willow Island, West Virginia was investigated by the National Bureau of Standards. The investigation included onsite inspections, laboratory tests of construction assembly components and concrete specimens, and analytical studies. Based on the results of these field, laboratory and analytical investigations, it was concluded that the most probable cause of the collapse was due to the imposition of construction loads on the shell before the concrete of lift 28 had gained adequate strength to support these loads. The analysis of the shell indicated that the collapse initiated at the part of the shell in lift 28 where cathead no. 4 was located. It further showed that calculated stress resultants at several points in that part equaled or exceeded the strength of the shell in compression, bending and shear.

Field 13—MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Group 13M—Structural Engineering

401,242
PB85-144020 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Multidirectional Analysis of Extreme Wind Speed Data.
Final rept.,
E. Simiu, E. M. Hendrickson, W. A. Nolan, I. Olkin,
and C. H. Spiegelman. Aug 84, 4p
Sponsored by National Science Foundation, Wash-
ington, DC.
Pub. in Proceedings of Engineering Mechanics Divi-
sion Specialty Conference (5th), Laramie, WY., August
1-3, 1984, Eng. Mech. Civ. Eng. 2, p1196-1199 Aug 84.

Keywords: *Structural engineering, *Wind velocity, Di-
rectional measurement, Analysis(Mathematics), Wind
pressure, Gust loads, Extreme-value problems.

An extended abstract is presented in which: (1) Exist-
ing methods for taking wind directionality into account
in structural engineering calculations are reviewed; (2)
A new such method is proposed; (3) It is shown that
published data issued by the National Oceanic and At-
mospheric Administration are sufficient to characterize
the directional extreme wind climate.

401,243
PB85-144939 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Dynamic Response of Structural Systems Subjected to Horizontal Propagating Shear Waves.
Final rept.,
S. T. Wu, and E. V. Leyendecker. Jul 84, 8p
Pub. in Proceedings of World Conference on Earth-
quake Engineering (8th), San Francisco, CA., July 21-
28, 1984, p355-362.

Keywords: *Dynamic structural analysis, Secondary
waves, Seismic waves, Dynamic response, Structures,
Eccentricity, Analysis(Mathematics), Building codes,
Earthquake resistant structures, *Earthquake engi-
neering, Case studies.

This paper presents the numerical results of a para-
metric study for structures subjected to shear horizon-
tal propagating waves. Dynamic behavior of coupled
lateral-torsional systems subjected to seismic excita-
tions is investigated analytically. Case studies are pro-
vided to show the contribution of each of the selected
parameters to the rotational response of the system.
Dynamic eccentricity is selected as an index to repre-
sent the level of the response. The dynamic character-
istics of the systems and motions are also discussed
based on this proposed approach.

401,244
PB85-144947 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
**Some Statistical Aspects of Wind and Snow Load-
ing.**
Final rept.,
R. B. Corotis, and B. R. Ellingwood. Aug 84, 4p
Pub. in Proceedings of Engineering Mechanics Divi-
sion Specialty Conference (5th), University of Wyo-
ming, Laramie, WY., August 1-3, 1984, p1200-1203.

Keywords: *Structural engineering, *Snow, *Wind
pressure, Loads(Forces), Statistical analysis, Structur-
al design, Mathematical models, Building codes.

Economic loss due to natural hazards in the United
States is well in excess of ten billion dollars a year.
However, research into improved probabilistic model-
ing of these hazards, and structural advances to limit
the loss, attract only relatively small support outside
the earthquake engineering community. This paper
discusses some particular probabilistic modeling as-
pects of two widespread hazards; wind and snow.

401,245
PB85-159069 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Building Technology.
**Innovative Office Building Structures and Enclo-
sures: A Survey of Experts,**
G. Turner, S. T. Margulis, M. Brill, and C. Coburn.
Nov 84, 120p NBSIR-84/2950
Prepared in cooperation with Buffalo Organization for
Social and Technical Innovation, Inc., NY., and State
Univ. of New York at Buffalo. Sponsored by Public
Buildings Service, Washington, DC.

Keywords: *Office buildings, Construction, Design,
Surveys, Structural engineering, Enclosures, Con-
struction materials.

This report presents the results of a study undertaken
to identify probable trends affecting the form/design,
materials and construction technologies of future
office buildings. A literature review was conducted that
addressed emerging technologies for structural sys-
tems and exterior enclosures of office buildings. Issues
identified in the review were used to develop question-
naires for surveying expert opinions about technologi-
cal innovations. Experts estimated the availability and
importance of various structural and enclosure innova-
tions, and provided their perceptions of the benefits
and constraints of up to 10 innovations of their choos-
ing.

401,246
PB85-159960 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Building Technology.
**Implementation of Compressible Shoring Analysis
for Multistory Concrete Construction,**
J. L. Gross. Dec 84, 61p NBSIR-84/2964

Keywords: *Concrete construction, *Shoring, *Struc-
tural analysis, Buildings, Loads(Forces), Safety, Com-
puterized simulation, Concrete structures.

The report presents an analytical procedure for deter-
mining the loads on the shoring system and supporting
slabs in multistory cast-in-place concrete construction.
The procedure assumes that the slabs are supported
by evenly distributed compressible shores and re-
shores and employs the stiffness method of analysis
to solve for the loads on the shoring system and slabs
as construction advances. The number of shores and
reshores; shore, reshore and base support stiffnesses;
casting rate; and concrete strength gaining character-
istics are considered in the analysis. Details of the im-
plementation of the shoring analysis in the form of a
computer program are presented. The strategy for deter-
mining the next phase in the casting cycle is de-
scribed and the details are given for formulating the
stiffness equations and loads for each phase. Several
example problems are presented to demonstrate the
use of such a procedure in assisting to make critical
decisions regarding planning of the casting schedule
and determining when formwork can be safely re-
moved.

form it consists of a single sheet with a small central
poled piezoelectric area and with very thin metallic
electrodes deposited on the sheet on opposite sides
of the piezoelectric area and having fine conductive
leads extending from the electrodes and adapted to be
connected to a suitable amplifier or transmission line.

401,248
PATENT-4 445 389 Not available NTIS
Department of Commerce, Washington, DC.
Long Wavelength Acoustic Flowmeter.
Patent,
J. E. Potzick, and B. Robertson. Filed 10 Sep 81,
patented 1 May 84, 19p PB84-187137, PAT-APPL-6-
300 830
Supersedes PB82-197690.
This Government-owned invention available for U.S. li-
censing and, possibly, for foreign licensing. Copy of
patent available Commissioner of Patents, Washing-
ton, DC 20231 \$1.00.

Keywords: *Patents, *Flowmeters, *Acoustic measur-
ing instruments, *Fluid flow, Pipes, Tubes, PAT-CL-73-
861.27.

A nonintrusive instrument for measuring the volume
flowrate of, and the speed of sound in, an arbitrary fluid
in a pipe, tube, or duct. The sound speed measured is
that of a stationary fluid even though the measurement
is made while the fluid may be flowing. The instrument
uses sound whose wavelength is much longer than the
diameter of the pipe, tube or duct. As a result, the tem-
perature and flow measurements are independent of
the profiles of those quantities across the pipe profiles.

401,249
PATENT-4 447 743 Not available NTIS
Department of Energy, Washington, DC.
High Pressure Liquid Level Monitor.
Patent,
V. E. Bean, and F. G. Long. Filed 28 Apr 82,
patented 8 May 84, 12p PB85-149680, PAT-APPL-6-
372 861
Supersedes DE83-006900. Prepared in cooperation
with National Bureau of Standards, Gaithersburg, MD.
This Government-owned invention available for U.S. li-
censing and, possibly, for foreign licensing. Copy of
patent available Commissioner of Patents, Washing-
ton, DC 20231 \$1.00.

Keywords: *High pressure tests, *Patents, *Monitors,
Design criteria, Performance evaluation, Coal, Mag-
netic fields, PAT-CL-307-118, *Fuel slurries.

A liquid level monitor for tracking the level of a coal
slurry in a high-pressure vessel including a toroidal-
shaped float with magnetically permeable bands
thereon disposed within the vessel, two pairs of mag-
netic field generators and detectors disposed outside
the vessel adjacent the top and bottom thereof and
magnetically coupled to the magnetically permeable
bands on the float, and signal processing circuitry for
combining signals from the top and bottom detectors
for generating a monotonically increasing analog con-
trol signal which is a function of liquid level. The control
signal may be utilized to operate high-pressure control
valves associated with processes in which the high-
pressure vessel is used.

401,250
PB83-111658 PC A04/MF A01
National Bureau of Standards, Boulder, CO. National
Engineering Lab.
**Metrology for Electromagnetic Technology: A Bib-
liography of NBS Publications,**
R. A. Kamper, and K. E. Kline. Aug 82, 64p NBSIR-
82-1677
See also COM73-11971.

Keywords: *Metrology, *Bibliographies, Electronics,
Cryogenics, Electromagnetic radiation, Lasers, Fiber
optics, Superconductors, Microwaves, Time domain,
National Bureau of Standards.

This bibliography lists the publications of the personnel
of the Electromagnetic Technology Division of NBS
in the period from January 1970 through December
1981. A few earlier references that are directly related
to the present work of the division are included.

14. METHODS AND EQUIPMENT

14B. Laboratories, Test Facilities, and Test Equipment

401,247
PATENT-4 433 400 Not available NTIS
Department of Health and Human Services, Wash-
ington, DC.
Acoustically Transparent Hydrophone Probe.
Patent,
A. S. DeReggi, and G. R. Harris. Filed 24 Nov 80,
patented 21 Feb 84, 9p PB84-165638, PAT-APPL-6-
210 044
Supersedes PB81-162299.
This Government-owned invention available for U.S. li-
censing and, possibly, for foreign licensing. Copy of
patent available Commissioner of Patents, Washing-
ton, DC 20231 \$1.00.

Keywords: *Hydrophones, *Patents, Probes, Piezo-
electric materials, Membranes, Polymeric films, Vinyl-
idene resins, PAT-CL-367-163.

An acoustically transparent hydrophone probe consist-
ing of a rigid hoop structure in which is secured an as-
sembly of very thin piezoelectric polymer sheet materi-
al, such as polyvinylidene fluoride, with one or more
very small central sensitive portions. In its simplest

Laboratories, Test Facilities, and Test Equipment—Group 14B

401,251

PB84-155902 PC A02/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.

Measurement Techniques for High-Resistivity Detector-Grade Silicon: Progress Report, July 1, 1982 to June 30, 1983,
R. D. Larrabee, and J. R. Lowney. Dec 83, 22p
NBSIR-83-2792

Sponsored in part by Army Electronics Research and Development Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.

Keywords: *Silicon, *Nondestructive tests, *Electrical resistivity, Helium neon lasers, Near infrared radiation, Measurement, *Carrier lifetime, Carrier recombination, Laser applications.

Techniques for nondestructively characterizing the resistivity and excess-carrier recombination lifetime in ingots of high-resistivity, long-lifetime detector-grade silicon are being evaluated. In particular, three interrelated techniques for nondestructively: (1) measuring an average resistivity, (2) profiling the low-level excess-carrier lifetime, and (3) profiling the resistivity of cylindrical ingot specimens are proposed and are in the process of being evaluated. All three techniques treat the ingot under test as a large van der Pauw specimen and require removable silver-paste contacts or pressed-on capacitive contacts. The profiling measurements use a highly penetrating 1.15 micrometer He-Ne laser beam as an optical probe. The conceptual and theoretical background for these measurements and the results of feasibility experiments obtained to date are presented.

401,252

PB84-164110 PC A02/MF A01
National Bureau of Standards, Washington, DC.

Techniques in High-Temperature Resistance Thermometry: 1. Construction of the NBS-Design High-Temperature Platinum Resistance Thermometer. 2. Toroidal Resistor for High-Temperature Platinum Resistance Thermometers.

Final rept.,
N. Bass, J. P. Evans, and S. B. Tillett. Jan 84, 20p
NBS-TN-1183
Also available from Supt. of Docs. as SN003-003-02549-6.

Keywords: *Resistance thermometers, Design, Resistors, Platinum, High temperature.

This Technical Note consists of two papers dealing with design and construction aspects of high-temperature platinum resistance thermometers intended for use as standard interpolating instruments up to the gold point (1064 C). Performance experience with the thermometers has been or will be presented elsewhere. The first paper describes the construction of a thermometer utilizing a resistor of reference-grade platinum wire wound in a single-layer, bifilar helix. The supports and insulators are made of high-purity fused silica, and the thermometer incorporates an electrical guard system to minimize the effects of electrical leakage. The second paper describes a new type of resistor for high-temperature platinum resistance thermometers, the 'toroidal' resistor. The resistor is designed to be easy to make from readily available materials, and it features robustness, small size, and freedom from strain.

401,253

PB84-165158 PC A12/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.

2.0 GHz to 4.0 GHz Automated Radiometer Operation and Service Manual,
G. J. Counas. Jan 84, 266p NBSIR-83-1697

Keywords: *Radiometers, Microwave frequencies, Manuals, Noise measurement, Standards, Cryogenics, Automation, Reflectometers.

The equipment described by this manual is the 2.0 to 4.0 GHz subsystem of the automated radiometer. This section of the multiband automated radiometer is a coaxial total power radiometer which implements a six-port reflectometer for impedance characterization and correction and utilizes a newly developed broadband cryogenic noise standard. NBS noise measurement capability in this frequency band has been expanded by the addition of this system which adds continuous frequency coverage to existing services along with the capability to measure cryogenic noise sources. This

manual describes the 2.0 to 4.0 GHz frequency band of the NBS automated radiometer and provides operation and service information.

401,254

PB84-190636 PC A04/MF A01
National Bureau of Standards, Boulder, CO.

Residual-Stress Measurements Using Shear-Horizontal Waves from Electromagnetic Acoustic Transducers,

R. B. King, and C. M. Fortunko. Mar 84, 59p NBSIR-84-3002

Sponsored in part by David W. Taylor Naval Ship Research and Development Center, Bethesda, MD.

Keywords: *Ultrasonic tests, *Residual stress, Determination of stress, Transducers, Secondary waves.

The collection of technical papers covers a two-year effort on a novel approach to measuring residual stresses using changes in ultrasonic wave velocities of horizontally polarized shear waves produced by electromagnetic-acoustic transducers. The initial three papers deal with the theoretical developments pointing to the measurement of in-plane residual stress as well as preliminary experimental verification. The later two papers generalize this theory and extend it to include surface residual stress measurement in an arbitrary plane; again, empirical validation is included.

401,255

PB84-203322 PC A04/MF A01
National Bureau of Standards, Washington, DC.

NVLAP (National Voluntary Laboratory Accreditation Program) Annual Report and Directory of Accredited Laboratories (5th),

P. S. Unger. Sep 82, 61p NBS/SP-636
See also PB84-109875. Also available from Supt. of Docs as SN003-003-02421-0.

Keywords: *Laboratories, *Acceptability, Test facilities, Standards, Directories.

This annual report of the National Voluntary Laboratory Accreditation Program (NVLAP) is prepared in accordance with NVLAP Procedures (Title 15 CFR Parts 7a, 7b, and 7c). Part I summarizes significant activities, including program changes, accreditation actions, and ongoing discussions concerning laboratory accreditation on the national and international levels. Part II is a directory of laboratories currently accredited on behalf of the Secretary of Commerce.

401,256

PB84-216951 Not available NTIS
National Bureau of Standards, Washington, DC.

Relation between Two-Probe and Four-Probe Resistances on Nonuniform Structures.

Final rept.,
J. Albers, and H. Berkowitz. Feb 84, 7p
Pub. in Jnl. of the Electrochemical Society, v131 n2 p392-398 Feb 84.

Keywords: *Probes, *Electrical resistance, Electrochemistry, Spreading, Separation, Calibrating, Reprints, Numerical solution.

A general relation between the two-probe resistance (spreading resistance) and the four-probe resistance on nonuniform structures is derived. Numerical techniques are presented and discussed for the evaluation of these equations for nonuniform structures. The relation between the four-probe resistance, $Z(x,S)$, and the incremental sheet resistance, $R(x)$, is shown to arise in the limit as the probe spacing becomes large compared to the distance to an insulating boundary. Specific examples are drawn from calculations on implant-type structures into substrates having insulating boundaries near the end of the implanted region (junction isolation) as well as those where the insulating boundary is far from the implanted region (emulating the back surface of a same conductivity type substrate). Also presented is a method for the self-consistent calibration of spreading resistance profiles utilizing $Z(x,S)$.

401,257

PB84-216985 Not available NTIS
National Bureau of Standards, Washington, DC.

Use of 'Corner Microphones' for Sound Power Measurements in a Reverberation Chamber.

Final rept.,
T. W. Bartel, S. L. Yaniv, and D. R. Flynn. Dec 83, 7p
Pub. in Jnl. of the Acoustical Society of America, v74 n6 p1794-1800 Dec 83.

Keywords: *Acoustic measurement, Reverberation, Test chambers, Microphones, Power measurement, Reprints,

A comparison was made between acoustic measurements conducted with microphones mounted in the trihedral corners of the 425-m³ NBS reverberation chamber and similar measurements using microphones located in the room interior, away from the room boundaries. Measurements of broad-band and discrete-frequency sound pressure and of reverberation time were included.

401,258

PB84-217017 PC A03/MF A01
National Bureau of Standards (NML), Washington, DC. Polymers Div.

Development of a Polymer Pressure Gage with Temperature Compensation,

A. J. Bur, and S. C. Roth. Apr 84, 32p NBSIR-84-2862

Sponsored in part by Air Force Armament Lab., Eglin AFB, FL.

Keywords: *Pressure gages, Thin films, Vinylidene resins, Temperature compensation.

The development of a temperature compensated pressure transducer is described. The pressure sensing element of this transducer is a thin film of polyvinylidene fluoride which is both piezoelectrically and pyroelectrically active. In order to measure a pressure pulse which is also accompanied by a temperature pulse due to adiabatic heating, it is necessary to correct for the pyroelectric signal. The temperature compensation technique which we use is to measure the temperature with a fast response thermocouple, to amplify the thermocouple signal in accordance to the pyroelectric response to the transducer and to combine the transducer and amplified thermocouple signals to produce an output voltage proportional to pressure only. A compensation circuit with a frequency range of 1 Hz to 10,000 Hz was constructed and tested. The transducer was calibrated and tested using pressure pulses whose peak value was 2.1×10 to the 7th power Pa (3000 psi) and whose pulse width was approximately 5 to 10 ms.

401,259

PB84-217074 PC A10/MF A01
National Bureau of Standards (NML), Washington, DC. Office of Nondestructive Evaluation.

Technical Activities 1983, Office of Nondestructive Evaluation.

Annual rept.,
L. Mordfin. Jan 84, 203p NBSIR-84-2815
See also PB81-132466.

Keywords: *Nondestructive tests, Reviews.

A review of the Nondestructive Evaluation Program at NBS, for FY 1983, is presented in this annual report.

401,260

PB84-217298 Not available NTIS
National Bureau of Standards, Washington, DC.

Production of Gold-Thickness Standard Reference Materials.

Final rept.,
H. Brown, D. Lashmore, and F. Ogburn. Sep 83, 3p
Pub. in Plating and Surface Finishing, v70 n9 p76-78 Sep 83.

Keywords: *Thickness, *Standards, *Gold, Electrodeposition, Reprints, *Standard reference materials.

The procedure used to fabricate Gold Standard Reference Materials is reviewed along with the procedure used to certify their thickness. Among the topics presented are (a) the purpose of the standards, (b) the electrodeposition technology used in their fabrication, and (c) quality control and the certification procedures used. Both beta backscatter and x-ray fluorescence techniques are employed in the certification process

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

and each will be discussed as will automation of the certification process.

401,261
PB84-217462 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Building Technology.
NBS (National Bureau of Standards) Tri-Directional Test Facility,
K. Woodward, and F. Rankin. May 84, 45p NBSIR-84-2879

Keywords: *Structural analysis, *Buildings, *Earthquake resistant structures, *Test facilities, Loads(Forces), Hydraulic servomechanisms, Actuators, Lateral pressure, Computer applications.

A general description of a unique structural testing apparatus is presented. The apparatus is called the NBS Tri-directional Test Facility (NBS/TTF). The NBS/TTF can subject large structural elements to a wide variety of three-dimensional loadings including both translations and rotations in three orthogonal directions. The facility is computer based with all aspects of data acquisition, reduction, and display coordinated and controlled by a minicomputer. The minicomputer also controls the loading of test specimens as directed by the operator. The loads are applied by a closed-loop hydraulic system having seven independently servo-controlled hydraulic actuators. Test specimens having dimensions as large as 3 m long by 3 m deep by 3.5 m high may be installed and tested in the facility. Lateral forces of up to + or - 900 kN may be imposed on the test specimen in combination with vertical forces of up to + or - 1800 kN.

401,262
PB84-217827 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Applied Mathematics.
Economic Model of Calibration Improvements for Automatic Test Equipment.
Final rept.,
S. F. Weber, and A. P. Hillstrom. Apr 84, 98p NBS/SP-673
Also available from Supt. of Docs as SN003-003-02580-1. Library of Congress catalog card no. 84-601027.

Keywords: *Calibrating, *Economic models, *Test equipment, Performance evaluation, Automation, Specifications, Maintenance, Mathematical models, Error analysis, Computer programs, *Automatic test equipment, Numerical solution.

This paper presents a model for measuring the benefits of improved accuracy in test equipment. The model permits calculation of the probability of accepting a unit under test (UUT) that is out of specifications (i.e., Consumer's Loss) and the probability of rejecting a UUT that is within specifications (i.e., Producer's Loss) for alternative levels of test equipment accuracy. Accuracy is defined in terms of both the systematic and the random measurement error of the equipment. Other parameters that are taken into account by the model are the mean and variance of the UUT attribute of interest, the performance specifications of the UUT, and the test specifications which define acceptance and rejection in terms of test measurement results. A discussion of the economic consequences of Consumer's Loss and Producer's Loss is included. The model may be used to optimize both procurement policy for new test equipment as well as maintenance and calibration policy for existing test equipment.

401,263
PB84-217868 PC A04/MF A01
National Bureau of Standards (NML), Washington, DC.
Office of Physical Measurement Services.
Measurement Assurance Programs. Part 1: General Introduction.
Final rept.,
B. Belanger. May 84, 74p NBS/SP-676-1
See also PB84-217876. Also available from Supt. of Docs as SN003-003-02587-9. Library of Congress catalog card no. 84-601030.

Keywords: *Quality assurance, *Metrology, *Calibrating, Measurement, Quality control, *Measurement assurance program, National Bureau of Standards.

This publication is Part I of a two-part guide describing NBS Measurement Assurance Program (MAP) Services and how to use them for measurement quality control. Part I describes the general philosophy of MAP Services and how they are used; Part II (Develop-

ment and Implementation, by C. Croarkin) describes the statistical tools used in MAP's. MAP's constitute a more rigorous method for ascertaining and controlling measurement uncertainty than traditional NBS calibration services.

401,264
PB84-217876 PC A07/MF A01
National Bureau of Standards (NEL), Washington, DC.
Statistical Engineering Div.
Measurement Assurance Programs. Part 2: Development and Implementation.
Final rept.,
C. Croarkin. Apr 84, 128p NBS/SP-676-2
See also PB84-217868. Also available from Supt. of Docs as SN003-003-02574-1.

Keywords: *Quality assurance, *Metrology, *Calibrating, *Statistical analysis, Measurement, Random error, Quality control, *Measurement assurance program, National Bureau of Standards, Systematic errors, Uncertainty.

This document is a guide to the logical development of a measurement assurance program in which the tie between a measurement and its reference base is satisfied by measurements on a transfer standard. The uncertainty of values reported by the measurement process is defined; and the validation of this uncertainty for single measurements is developed. Measurement sequences for executing the transfer with NBS and procedures for maintaining statistical control are outlined for eight specific measurement situations with emphasis on characterizing parameters of the measurement process through use of a check standard.

401,265
PB84-217884 PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Coaxial Noise Standard for the 1 GHz to 12.4 GHz Frequency Range.
Final rept.,
W. C. Daywitt. Mar 84, 48p NBS/TN-1074
Also available from Supt. of Docs as SN003-003-02564-0.

Keywords: *Standards, *Thermal noise, Microwaves, Error analysis, Computer programs, Cryogenics, Design, *Noise standards, Coaxial configurations.

This note describes the design and construction of a coaxial thermal noise standard. The standard is designed to operate at the boiling point of liquid nitrogen with a noise temperature accurate to + or - 1 K in the frequency range from 1 GHz to 12.4 GHz.

401,266
PB84-218429 Not available NTIS
National Bureau of Standards, Washington, DC.
XRD Quantitative Phase Analysis Using the NBS QUANT82 System.
Final rept.,
C. R. Hubbard, C. R. Robbins, and R. S. Snyder.
1983, 8p
Pub. in *Advances in X-Ray Analysis* 26, p149-156 1983.

Keywords: *X ray diffraction, *Phase measurement, Fortran, Reprints, *Computer applications.

The NBS*QUANT82 system of Fortran 77 programs permit x-ray powder diffraction quantitative phase analysis by the spiking, intensity ratio, and internal standard methods. The programs can use multiple lines and multiple data sets as input. Output includes error estimates based on propagation of counting statistics and the root means square deviation from the average. For the internal standard method, line overlap, elemental chemical data, and weight fraction constraints can be used.

401,267
PB84-218841 Not available NTIS
National Bureau of Standards, Washington, DC.
Pulsed Thermal Atom Source for Resonance Ionization Mass Spectrometry.
Final rept.,
J. D. Fassett, L. J. Moore, R. W. Shideler, and J. C. Travis. Feb 83, 4p
Pub. in *Analytical Chemistry*, v56 n2 p203-206 Feb 84.

Keywords: *Chemical analysis, *Laboratory equipment, *Pulse transmitters, Mass spectroscopy, Ion, Reprints, *Resonance ionization mass spectrometry.

A pulsed thermal atom source has been developed for use with a resonance ionization mass spectrometer system based on a low-duty cycle-pulsed laser. The nature of the thermal atom pulse has been evaluated by temporal scanning of the atomization pulse relative to the laser ionization pulse. Changes in the design of the atomizing filament are required to achieve a sharp atomization pulse. The system has been tested by using the element Iron. A 30-fold improvement in sample utilization efficiency was demonstrated for the pulsed thermal source relative to a continuous thermal source.

401,268
PB84-218973 Not available NTIS
National Bureau of Standards, Washington, DC.
Modified Indentation Toughness Technique.
Final rept.,
R. F. Cook, and B. R. Lawn. Nov 83, 2p
Sponsored in part by Office of Naval Research, Arlington, VA.
Pub. in *Jnl. of the American Ceramic Society*, v66 n11 pC-200-C-201 Nov 83.

Keywords: *Ceramics, *Toughness, Measurement, Residual stress, Indentation, Reprints.

A modified indentation technique for measuring toughness is described. The method retains the elastic/plastic basis of previous contact fracture descriptions, but eliminates explicit reference to residual stress parameters in the toughness formulation. Accordingly, improved correlations between indentation data and 'conventional' K sub c values are obtained, even for materials (e.g. anomalous glasses) with non-ideal deformation responses.

401,269
PB84-219047 Not available NTIS
National Bureau of Standards, Washington, DC.
Thin Plastic Radiochromic Dye Films as Ionizing Radiation Dosimeters.
Final rept.,
A. E. Buenfil-Burgos, R. M. Uribe, A. de la Piedad, W. L. McLaughlin, and A. Miller. Sep 83, 8p
Pub. in *Radiation Physics and Chemistry*, v22 n3-5 p325-332 Sep 83.

Keywords: *Polymeric films, *Dosimeters, *Dyes, *Radiation measuring instruments, Stability, Temperature, Humidity, Plastics, Curing, Storage, Nylon, Reprints, Poly(butylal/vinyl).

Radiochromic dye films were fabricated by casting polyvinyl butyral (PVB) in weakly acidic solution with the leucocyanide of pararosaniline. The effects of temperature, humidity, and period of storage on the response of these films were studied in the range from -5 to 60 C and from 11.8 to 96.6% r.h. for up to four months between irradiation and spectral analysis, and within nominal experimental uncertainty (about 10%), we found that all the radiochromic films studied can be stored for extended periods under steady-state conditions in the temperature range from -5 to 30 C and from 11.8-75.6% r.h. without correction factors for instability, but under extreme conditions of moisture at elevated temperatures the radiochromic image showed a fading effect on storage.

401,270
PB84-219476 Not available NTIS
National Bureau of Standards, Washington, DC.
Triple Point of Succinonitrile and Its Use in the Calibration of Thermistor Thermometers.
Final rept.,
B. W. Mangum. Dec 83, 6p
Pub. in *Review of Scientific Instruments* 54, n12 p1687-1692 Dec 83.

Keywords: *Thermistors, *Temperature measuring instruments, Laboratory equipment, Calibrating, Performance evaluation, Reprints, *Triple point, Succinonitrile.

Results are reported of an investigation of the triple point of succinonitrile as a temperature-fixed point and of its use in the calibration of thermistor thermometers. The average value of the triple point of several samples of this material was determined to be 58.0805C, with an estimated uncertainty of + or - 0.0015C relative to the International Practical Temperature Scale of 1968. Three-point calibrations of thermistor thermometers, using temperature-fixed points provided by succinonitrile, gallium, and water were compared with 15-point comparison calibrations performed with a stand-

Laboratories, Test Facilities, and Test Equipment—Group 14B

ard platinum resistance thermometer (SPRT). Equations, solved by simultaneous solution using data obtained at the three calibration points, yield values of temperatures in the range from 0 to 70C which agree to within about + or - 1 mK with those obtained by calibration with a SPRT in a bath.

401,271

PB84-219492 PC A06/MF A01
National Bureau of Standards (NML), Boulder, CO. Fracture and Deformation Div.
Electromagnetic-Acoustic-Transducer/Synthetic-Aperture System for Thick-Weld Inspection.
Final rept. 1 Jul 81-31 Dec 83,
C. M. Fortunko, R. E. Schramm, J. C. Moulder, and J. D. McColskey. May 84, 123p NBS/TN-1075
Sponsored in part by Ames Lab., IA. Also available from Supt. of Docs as SN003-003-02578-0.

Keywords: *Nondestructive tests, *Ultrasonic tests, *Weldments, *Welded joints, *Electroacoustic transducers, Signal processing, Computer programs, Basic programming language.

This report describes a system based on electromagnetic-acoustic transducers (EMATs) as an approach to automated nondestructive evaluation of thick weldments (= or > 25 mm). Applications include a new type of ultrasonic inspection system for thick, butt welds used in ship construction. Good signal-to-noise ratios, often a problem with EMATs, were possible through careful design of the transducers and associated electronic circuits and the use of signal averaging. At 454 kHz, the transducers produce shear-horizontal waves of approximately 7-mm wavelength in steel. The long wavelength permits determination of through-thickness flaw depth from the amplitudes of scattered ultrasonic waves. A minicomputer controlled transducer positioning and acquired the digitized ultrasonic waveforms for synthetic aperture processing. The synthetic aperture technique further improved signal quality and yielded flaw localization through the weld thickness. Measurements on artificial flaws demonstrated a detectability threshold of 0.5 mm (through thickness) and sizing ability up to 2.5 mm, in agreement with theoretical predictions. Details include the design of the transducers and electronics, as well as the mechanical positioner, signal processing algorithms, and complete computer program listings.

401,272

PB84-219559 PC A15/MF A01
National Bureau of Standards (NEL), Washington, DC. Semiconductor Materials and Processes Div.
RADC/NBS (Rome Air Development Center/National Bureau of Standards) Workshop. Moisture Measurement and Control for Semiconductor Devices, 3,
B. A. Moore, and S. Ruthberg. May 84, 329p NBSIR-84/2852
Sponsored in part by Rome Air Development Center, Griffiss AFB, NY. Proceedings of the RADC/NBS Workshop held at Gaithersburg, MD, on 2-4 November 1983. See also PB82-217985.

Keywords: *Semiconductor devices, *Integrated circuits, *Moisture content, *Meetings, Measurement, Hermetic seals, Mass spectroscopy, Moisture meters, Packaging, Quality control, Reliability(Electronics).

The workshop, one of a series concerned with measurement problems in integrated circuit processing and assembly, served as a forum to examine the continuing progress that has been made in the measurement and control of moisture in hermetically packaged semiconductor devices. Thirty-four presentations are included which contain detailed information for securing hermetic packages with low moisture content. Agreement in measurement has been obtained with the mass spectrometer for cerdip and metal packages at the 5000 ppmv level of moisture through the use of suitable moisture generators, a 3-volume calibrator, calibrated dewpoint hygrometers, and appropriate operational procedures. An approach is given for a reproducible and reliable transfer package. However, the increased use of organic materials in new and rapidly expanding technologies such as VLSI/VHSIC and hybrid packaging presents new and more complex challenges to accurate measurement of interior moisture.

401,273

PB84-219823 Not available NTIS
National Bureau of Standards, Washington, DC.
Measurement of Nonuniform Power Frequency Electric Fields.
Final rept.,
M. Misakian, and P. M. Fulcomer. Dec 83, 5p
Pub. in Institute of Electrical and Electronics Engineers, Trans. Electr. Insul. EI-18, n6 p657-661 Dec 83.

Keywords: *Electric fields, Measurement, Frequency measurement, Power lines, Reprints.

The performance of free-body electric fieldmeters which have been calibrated for use in nearly uniform power frequency electric fields is examined under non-uniform field conditions. Theoretical and experimental results are presented which indicate that measurements can be made with small error.

401,274

PB84-220003 Not available NTIS
National Bureau of Standards, Washington, DC.
Possibilities for Ultrasensitive Mass Spectrometry Based on Two-Photon, Sub-Doppler Resonance Ionization.
Final rept.,
T. B. Lucatoro, C. W. Clark, and L. J. Moore. 15 Jan 84, 5p
Pub. in Optics Communications 48, n6 p406-410, 15 Jan 84.

Keywords: *Mass spectroscopy, *Ionization, *Doppler effect, Chemical analysis, Isotope separation, Strontium 90, Performance evaluation, Reprints, *Laser spectroscopy, *Resonance ionization spectrometry, Strontium 88.

An ultrasensitive mass spectrometer is proposed in which the chemical and isotopic selectivity possible with laser ionization is combined with the mass selectivity of a conventional mass spectrometer to achieve abundance sensitivities in the range of 10 to the 13th power. The ionization stage incorporates two-photon sub-Doppler resonance ionization in order to achieve optimum isotopic enhancement of the selected species and to provide high ionization efficiency for the entire maxwellian distribution of the sample. The limits on selectivity and sensitivity due to charge exchange and laser power broadening effects are discussed for the case of (88)Sr/(90)Sr, an example which is of practical interest and which poses a difficult test for any mass spectrometric technique.

401,275

PB84-220946 Not available NTIS
National Bureau of Standards, Washington, DC.
Precision Time-Domain Dielectric Spectrometer.
Final rept.,
F. I. Mopsik. Jan 84, 9p
Pub. in Review of Scientific Instruments 55, n1 p79-87 Jan 84.

Keywords: *Dielectric properties, Measurement, Dielectrics, Step response, Laplace transformation, Reprints, Time domain.

A description is given for an automated method for determining dielectric constant and loss by the measurement of the time response of the dielectric to a step voltage. Attention is paid to the circuits necessary to achieve high accuracy (0.1%) and high sensitivity (tan delta = 0.00001) over audio and subaudio frequencies (10,000 Hz to 0.0001 Hz). These include a 100 V step generator accurate to 5 ppm, a charge detector with a time-independent bias current of 30 fA and a clock that can control sampling time for 5 microsec to 10 s. In addition, a numerical Laplace Transform, based on a cubic spline, is described that preserves the accuracy of the time data when they are transformed into the frequency domain.

401,276

PB84-220953 Not available NTIS
National Bureau of Standards, Washington, DC.
Ultrasonic Weld Inspection for Nuclear Power Plant Structures.
Final rept.,
L. Mordfin. Jan 84, 2p
Pub. in Materials Evaluation, n42 p30-31 Jan 84.

Keywords: *Ultrasonic tests, Structures, Nuclear power plants, Nondestructive tests, Welded joints, Reprints.

Book review of 'Advances in Non-Destructive Examination in Relation to Structural Integrity,' R.W. Nichols, editor, xvi = 447 pp, Applied Science Publishers, London, 1982. Distributed in the USA and Canada by Elsevier Science Publishing Co., New York, \$90.25.

401,277

PB84-221324 Not available NTIS
National Bureau of Standards, Washington, DC.
Laser Frequency Measurements and the Redefinition of the Meter.
Final rept.,
K. M. Evenson. Nov 81, 3p
Pub. in Laser Focus 17, n11 p61-63 Nov 81.

Keywords: *Frequency measurement, *Standards, *Length, Light(Visible radiation), Measurement, Iodine, Accuracy, Reprints, *Meter, Laser radiation.

Scientists at the U.S. National Bureau of Standards (NBS), Boulder, CO, and the Canadian National Research Council (NRC) in Ottawa, have accomplished the highest direct frequency measurement ever made on an electromagnetic wave. The joint experiment involved the direct frequency measurement of the frequency of a particular transition of the iodine molecule near 520 terahertz. The group demonstrated that it is possible to measure the very high frequencies of visible light in terms of the fundamental standards for frequency and time. Such frequency-based measurements are potentially a thousand times more accurate than measurements of wavelengths. The measured visible frequency is some 57,000 times the primary standard frequency near 9.2×10^9 to the 9th power Hertz. Thus the way is paved for extremely accurate spectroscopic investigations in the visible spectral region and an eventual new definition of the meter. This new definition would not immediately have any effect on the consumer, but it has a far-reaching impact on the science of measurement.

401,278

PB84-221647 Not available NTIS
National Bureau of Standards, Washington, DC.
Analysis of Electromagnetic-Acoustic Transducer Arrays for Nondestructive Evaluation of Thick Metal Sections and Weldments.
Final rept.,
C. M. Fortunko, and R. E. Schramm. 1983, 24p
Sponsored in part by Naval Sea Systems Command, Washington, DC. and Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in Proceedings of Review Progress in Quantitative Non-Destructive Evaluation held at San Diego, California on August 1-6, 1982, p283-307 1983.

Keywords: *Ultrasonic tests, *Transducers, Arrays, Nondestructive tests, Welded joints.

A new type of electromagnetic-acoustic transducer (EMAT) has been developed that may be particularly suitable for use as an element of ultrasonic arrays. The new transducer can generate and receive compact ultrasonic pulses that exhibit a component of polarization parallel to the free surface. In the plane of symmetry that is normal to the free surface and bisects the EMAT (the sagittal plane), the ultrasonic signals generated by the new transducer are SH waves. In addition, the new transducer can efficiently receive ultrasonic signals from a very wide range of direction in the sagittal plane. This property is required to realize very long synthetic aperture lengths, which are needed to maximize the transverse resolution of ultrasonic inspection systems. The focusing performance of different linear synthetic array configurations using the new EMAT is compared analytically with that of a linear end-fire system using periodic-permanent-magnet (PPM) EMATs that have been used in the past in weld inspection. The advantages and inherent limitations of such systems are examined using analytical and numerical methods.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,279
PB84-221688 Not available NTIS
National Bureau of Standards, Washington, DC.
Extension of the Congruent Electromagnetic Scale to Gamma-Rays.

Final rept.,
R. D. Deslattes. 1983, 18p
Pub. in Proceedings of NATO Advanced Study Inst. Quantum Metrology Fund. Phys. Constants held at Erice, Italy on November 16-28, 1981, p365-382 1983.

Keywords: *Gamma rays, *X rays, Utilization, Measurement, Spectroscopy.

Precision spectroscopy in the region of X-rays and gamma-rays has a considerable range of application in determination of fundamental constants, tests of basic theory and determination of masses of elementary particles. The current panoply of such applications is addressed in the following lecture. The aim of this first presentation is to focus on the measurement technology required to establish secondary reference standards. Intrinsic limitations due to X-ray line shapes and the measurement technologies are summarized. A new stage in this work has now been established using X-ray interferometry followed by small angle diffraction to cover six orders of magnitude in two steps thereby tying gamma-rays to visible light in a way not limited by the characteristics of X-ray lines and without the accumulation of errors characteristic of previous multistep procedures. Present and future limitations are indicated.

401,280
PB84-221779 Not available NTIS
National Bureau of Standards, Washington, DC.
Chemical Dosimetry by UV Spectrophotometry of Aqueous Ascorbic Acid Solutions.

Final rept.,
A. Alian, N. B. El-Assy, F. Abdel-Rehim, N. Amin, and W. L. McLaughlin. 1984, 6p
Pub. in Radiation Physics and Chemistry, v23 n4 p435-440 1984.

Keywords: *Ultraviolet spectroscopy, *Chemical dosimeters, *Ascorbic acid, Solutions, Additives, Stability, Gamma radiation, Performance evaluation, Reprints, Chemical reaction mechanisms, Hydroxyl radicals.

The decrease in the ultraviolet absorption of aqueous solutions of ascorbic acid brought about by large doses of gamma radiation has been investigated as a means of developing a new chemical dosimeter. Because of spontaneous ring opening under various conditions after dissolution in water, some additives were examined as possible stabilizers against such denaturing of aqueous ascorbic acid. A mechanism of radiation chemistry has been proposed based on hydroxyl radical and hydroxyl adduct intermediates, leading to dehydroascorbic acid through the ascorbate complex.

401,281
PB84-221787 Not available NTIS
National Bureau of Standards, Washington, DC.
Flexure Pivot Mirror Support.

Final rept.,
A. Henins, E. G. Kessler, Jr., and P. L. Cowan. 1983, 3p
Pub. in Nuclear Instruments and Methods 208, p287-289 1983.

Keywords: *Mirrors, *Supports, Monochromators, Adjusting, Cylindrical bodies, Design, Toroids, Rotation, Reprints.

Part of a two-mirror and separated crystal monochromator UHV beamline for the 0.5 to 5 keV region being constructed at the NSLS at Brookhaven is a toroidally bent cylindrical mirror. The design of the support architecture for this mirror is here presented. It is desirable that all degrees of freedom are independently adjustable with a minimum of cross-coupling between adjustments.

401,282
PB84-221860 Not available NTIS
National Bureau of Standards, Boulder, CO.
Redundancy: A Monitor of Six-Port Performance.

Final rept.,
G. F. Engen. 1983, 2p
Pub. in Proceedings of Advances in S-Parameter Measurement Micro-Wavelengths, London, England, May 23, 1983, p4-1-4-2.

Keywords: *Network analyzers, *Six port.

By almost any standard of comparison, today's automated network analyzers represent a highly complex and sophisticated measuring instrument, with its own set of maintenance problems and potential failure modes. While certain types of malfunction are immediately evident to the operator, there may be others whose effect is less obvious. One of the more interesting features of the six-port network analyzer is that its response is 'overdetermined' in the sense that four (scalar) detectors are employed to obtain three pieces of information—namely the emergent wave amplitude and the complex reflection coefficient as they exist at the measurement port. With proper interpretation, this additional piece of information can be used, not only to improve the overall accuracy, but also as a continuous monitor of the system performance, and to flag a very large fraction of potential malfunctions. (While some reference to this feature has been made in earlier papers, it apparently is still not fully appreciated by the microwave community).

401,283
PB84-221902 Not available NTIS
National Bureau of Standards, Washington, DC.
New Method for the Experimental Determination of the Detectable Quantum Efficiency of X-Ray Screens.

Final rept.,
C. E. Dick, J. W. Motz, and H. Roehrig. 1980, 5p
Sponsored in part by Arizona Univ. Health Sciences Center, Tucson.
Pub. in Society of Photo-Optical Instrumentation Engineers 233, p11-15 1980.

Keywords: *Quantum efficiency, Measurement, Calcium tungstates, Rare earth compounds, Experimental data, Reprints, *X ray screens, Oxy-sulfides.

The authors developed a new experimental method to determine the detective quantum efficiency (DQE) of any given x-ray screen for different x-ray energies. This method employs fast (10 ns) counting and coincidence techniques to directly measure the number, m , of photons emitted from the screen per absorbed x ray, and to determine both the statistical distribution and average value of m . These experimental data have been obtained for a calcium tungstate and a rare earth oxy-sulfide screen with quasi-mono-energetic x-ray beams in the region from approximately 15 to 70 keV.

401,284
PB84-221910 Not available NTIS
National Bureau of Standards, Washington, DC.
Possibilities for the Use of Electron Spin Polarization in Scanning Electron Microscopy.

Final rept.,
R. J. Celotta, and D. T. Pierce. 1982, 3p
Pub. in Proceedings of the Joint Meeting Microbeam Analysis Society, Electron Microscope Society of America, Washington, DC, 11 Aug 82, Paper in Microbeam Analysis, p469-471.

Keywords: *Electron microscopy, Polarization (Spin alignment), Electron beams, Magnetic moments, Feasibility, *Electron spin polarization, *Scanning electron microscopy, *Polarized beams.

No use has been made to date of the intrinsic magnetic moment of the electron in scanning electron microscopy, with good reason: methods for orienting or detecting the orientation of the free electron's moment have traditionally been cumbersome and inefficient. Since the technology for the production and detection of polarized electrons has improved dramatically recently, the time seems appropriate to consider more seriously the possibility of a 'polarized electron microscope'.

401,285
PB84-221928 Not available NTIS
National Bureau of Standards, Washington, DC.
Rutherford Backscatter Analysis of Multilayered Cr-Ni Structures to Be Used for Sputtering Standards.

Final rept.,
D. G. Simons, M. D. Brown, J. Fine, T. D. Andreadis, and B. Navinsek. 1983, 4p
Sponsored in part by Department of the Navy, Washington, DC.
Pub. in Nuclear Instruments and Methods in Physics Research 218, p585-588 1983.

Keywords: *Sputtering, *Standards, *Thin films, *Laminates, Backscattering, Metal films, Chromium, Nickel, *Standard reference materials, *Rutherford scattering.

Rutherford backscatter spectrometry (RBS) has been used to characterize multi-layered Cr/Ni structures which are being prepared for future distribution as sputter profiling standards. The ability to resolve the periodic bilayered structure provides a sensitive determination of the component film thicknesses by direct comparison with computer simulated spectra. The RBS analyses show that the sample preparation was well controlled and that film thicknesses of like layers of any one sample, as well as between any two samples, were uniform to better than 3%. This accuracy holds for any two samples within one batch or from batch to batch.

401,286
PB84-222033 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of Silicon Density to High Precision Using a Submersible, Servo-Controlled Balance.

Final rept.,
R. S. Davis. 1982, 9p
Pub. in Metrologia 18, p193-201 1982.

Keywords: *Weight measurement, *Density (Mass/volume), *Standards, *Silicon, Single crystals, Weight indicators, Hydrostatics, Precision, Reprints, Standard reference materials, Balances.

Novel use has been made of a high-precision, servo-controlled balance for the hydrostatic weighing of solid objects. The balance is completely immersed in a fluorocarbon fluid. Extensive experience has been gained by using the apparatus in the assignment of density to 70 silicon objects which will be issued as a Standard Reference Material (SRM). The balance contributes about 0.00001 to the relative uncertainty of the final results.

401,287
PB84-222066 Not available NTIS
National Bureau of Standards, Washington, DC.
Introduction to Papers Presented at the Symposium on Ultrasonic Measurements of Stress.

Final rept.,
T. M. Proctor, Jr. Sep 82, 3p
Pub. in Jnl. of Testing and Evaluations 10, n5 p199-201 Sep 82.

Keywords: *Ultrasonic tests, *Determination of stress, Residual stress, Modulus of elasticity, Reprints.

Ultrasonic measurements of the variation of elastic modulus with stress have been done for more than 30 years. The inverse problem of measuring residual stress by ultrasonic means is still poorly understood. As a result, the measurement of residual stress by ultrasonic means has not been a successful engineering method. A symposium describing the present state of the art has been held and the written record of some of the contributors to it is presented by the following set of papers.

401,288
PB84-222082 Not available NTIS
National Bureau of Standards, Washington, DC.
Isotopic Analysis with the Laser Microprobe Mass Analyzer.

Final rept.,
D. S. Simons. 1982, 3p
Pub. in Microbeam Analysis, p390-392 1982.

Keywords: *Isotopes, *Mass spectroscopy, Laboratory equipment, Performance evaluation, Sampling, Reprints, *Laser spectroscopy, *Laser microprobe mass analyzers, Osmium 187, Rhenium 187.

The capability of the laser microprobe mass analyzer (LAMMA) to perform isotopic ratio measurements has been investigated. The dynamic range is limited by the 8-bit resolution of the transient waveform recorder, but can be increased by using independent recording channels operated at different input sensitivities. An abundance sensitivity for uranium of 0.1% was measured on the low-mass side of the major peak. Measurement precision is limited by the finite number of ions in a pulse and by the dynamic bit resolution of the transient recorder. The major limitation for isotopic accuracy is a decrease in gain of the electron multiplier as the output pulse amplitude increases. This effect can be quantified using a calibration procedure. Isotopic ratio measurements were made on nanogram quantities of osmium with non-natural isotopic abundances. Relative accuracies better than 3% (1 sigma) were obtained for ratios larger than 0.2. These results give confidence that the LAMMA can be used to determine

directly the radioactive decay constant of (187)Re by measuring the ingrowth of (187)Os.

401,289
PB84-222090 Not available NTIS
National Bureau of Standards, Washington, DC.
Isotopic Analysis with the Laser Microprobe Mass Analyzer.
Final rept.,
D. S. Simons. Dec 83, 16p
Pub. in International Jnl. of Mass Spectrometry and Ion Processes 55, p15-30 Dec 83.

Keywords: *Isotopes, *Mass spectroscopy, Laboratory equipment, Performance evaluation, Sampling, Reprints, *Laser spectroscopy, *Laser microprobe mass analyzers, Osmium 187, Rhenium 187.

The capability of the laser microprobe mass analyzer (LAMMA) to perform isotopic ratio measurements has been investigated. The dynamic range is limited by the 8-bit resolution of the transient waveform recorder, but can be increased by using independent recording channels operated at different input sensitivities. An abundance sensitivity for uranium of 0.1% was measured on the low-mass side of the major peak. Measurement precision is limited by the finite number of ions in a pulse and by the dynamic bit resolution of the transient recorder. The major limitation for isotopic accuracy is a decrease in gain of the electron multiplier as the output pulse amplitude increases. This effect can be quantified using a calibration procedure. Isotopic ratio measurements were made on nanogram quantities of osmium with non-natural isotopic abundances. Relative accuracies better than 3% (1 sigma) were obtained for ratios larger than 0.2. These results give confidence that the LAMMA can be used to determine directly the radioactive decay constant of (187)Re by measuring the ingrowth of (187)Os.

401,290
PB84-222843 Not available NTIS
National Bureau of Standards, Washington, DC.
Oxygen Removal in Liquid Chromatography with a Zinc Oxygen-Scrubber Column.
Final rept.,
W. A. MacCrehan, and W. E. May. 1984, 4p
Pub. in Analytical Chemistry, v56 n4 p625-628 1984.

Keywords: *Aromatic polycyclic hydrocarbons, *Nitrogen organic compounds, *Chromatographic analysis, *Oxygen, Performance evaluation, Chemical analysis, Fluorescence, Electrical measurement, Reprints, *Zinc oxygen scrubber column, *Liquid chromatography.

A simple and effective method has been developed for oxygen removal from liquid chromatographic eluents, based on a zinc scrubber column. The mechanism of the oxygen reduction has been verified by differential pulse polarography. The scrubber column has been applied to remove the oxygen interference in two liquid chromatographic detection systems, reductive amperometry and molecular fluorescence, and its advantages are demonstrated in the detection of nitro-polynuclear aromatic hydrocarbons.

401,291
PB84-222900 Not available NTIS
National Bureau of Standards, Washington, DC.
X-ray Imaging of Extended Objects Using Nonoverlapping Redundant Array.
Final rept.,
L. I. Yin, J. I. Trombka, S. M. Seltzer, and M. J. Bielefeld. 15 Jul 83, 6p
Sponsored in part by National Aeronautics and Space Administration, Washington, DC.
Pub. in Applied Optics, v22 n14 p2155-2160, 15 Jul 83.

Keywords: Radiography, Crosstalk, X ray analysis, *X ray imagery, *Tomography, Computerized axial tomography, Image processing, Multiple pinhole arrays, Three dimensional.

A common problem associated with x-ray imaging using coded apertures is the reconstruction of low-intensity extended objects. In the decoding of such objects, the overlapping images from the multiple pinholes give rise to noise cross talk and, in many cases, also to signal cross talk. In this paper, the authors propose an alternate approach based on the principle used in earlier laboratory device for the real-time viewing of x-ray objects. It is shown that with this approach, the nonoverlapping redundant array, the sidelobes in the point spread function are not eliminated but merely displaced through a suitable choice of geometry. In

this manner, the sidelobes no longer contribute to the background in the vicinity of a reconstructed image, and both signal and noise cross talks are completely eliminated. It may now be possible to reconstruct extended x-ray objects in 3-D by simple optical correlation and tomographically by a computer.

401,292
PB84-223288 Not available NTIS
National Bureau of Standards, Washington, DC.
NBS (National Bureau of Standards) Standard Reference Materials for Quality Assurance of Food Analyses.
Final rept.,
R. Alvarez. 1983, 16p
Pub. in Proceedings of International Flavor Conference Instrumental Analysis of Foods, Corfu, Greece, July 27-30, 1983. Paper in Instrumental Analysis of Foods 1, p213-228.

Keywords: *Food analysis, *Chemical analysis, *Standards, *Measuring instruments, *Quality assurance, Concentration(Composition), Sampling, Toxicology, Nutrition, Beverages, Trace elements, Calibrating, Metabolism, *Standard reference materials.

The National Bureau of Standards is responsible under Federal statute for issuing Standard Reference Materials (SRM's) to assist investigators improve the accuracy of their laboratory tests. For the food science laboratory, these well-characterized, certified materials are available to serve as accuracy-control materials; to prepare primary standard solutions; and to evaluate and monitor the performance of instruments and devices, such as polarimeters and spectrophotometers. Of the approximately 900 different SRM's listed in the current catalog, the biological matrix materials are especially suitable for long-term quality assurance of food analyses. Examples of these are: Oyster Tissue (SRM 1566), Bovine Liver (SRM 1577a), Wheat Flour (SRM 1577), Rice Flour (SRM 1568), and a Non-Fat Milk Powder (Proposed SRM 1549), expected to be issued in late 1983. The Certificate of Analysis for these SRM's include certified concentrations of nutritionally and toxicologically important elements. Other SRM's for food and beverage analysis include a stabilized wine and compounds of certified high purity, such as cholesterol. Additional SRM's have been developed for metabolic studies, such as Human Serum (SRM 909).

401,293
PB84-223296 Not available NTIS
National Bureau of Standards, Washington, DC.
100 GHz Binary Counter Using SQUID Flip Flops.
Final rept.,
C. A. Hamilton. May 83, 2p
Pub. in IEEE Transactions on Magnetics MAG-19, n3 p1291-1292 May 83.

Keywords: *Counters, *Analog to digital converters, Flip flops, Binary digits, Superconductors, Reprints, SQUID devices, Flip flop circuits.

A binary counter using bistable dc SQUID's as flip flop circuits is reviewed. Its potential for frequency division in the THz range and for ultra high accuracy A/D conversion are discussed.

401,294
PB84-223361 Not available NTIS
National Bureau of Standards, Washington, DC.
Intercomparison of Different 'Absolute' Instruments for Measurement of Aerosol Number Concentration.
Final rept.,
B. Y. H. Liu, D. Y. H. Pui, R. L. McKenzie, J. K. Agarwal, and R. Jaenicke. 1982, 22p
Pub. in Jnl. of Aerosol Science 13, n5 p429-450 1982.

Keywords: *Measuring instruments, *Aerosols, Concentration(Composition), Comparison, Fines, Reprints.

During the 1979 workshop of the working group on ultrafine aerosols (WUFA) an intercomparison of different instruments for measurement of aerosol number concentration was performed. Each of these instruments (TSI-aerosol electrometer, TSI-condensation nuclei counter, Jaenicke-condensation nuclei counter, size analyzing nuclei counter SANC) can be regarded as 'absolute' because they do not depend on empirical calibration relative to external reference standards. Number concentrations were measured for monodispersed NaCl-aerosols with a mean particle diameter of 56nm generated by means of a collision atomizer and

an electrostatic aerosol classifier. The readings of TSI-aerosol electrometer and SANC are quite linearly related over the whole concentration range, the SANC being low by a factor of about 0.59. Thus different measuring techniques based on completely different principles yield comparable aerosol number concentrations and accordingly condensation nuclei counters are truly aerosol counters.

401,295
PB84-223809 Not available NTIS
National Bureau of Standards, Washington, DC.
Calibration of AC Susceptometer for Cylindrical Specimens.
Final rept.,
R. B. Goldfarb, and J. V. Minervini. May 84, 4p
Sponsored in part by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Review of Scientific Instruments, v55 n5 p761-764 May 84.

Keywords: *Magnetic measurement, *Calibrating, Magnetic permeability, Cylindrical bodies, Alternating current, Reprints, *Magnetic susceptibility, *Susceptometers.

The absolute magnetic susceptibility of cylindrical specimens is obtained with an ac susceptometer whose calibration is based on a calculation of mutual inductance.

401,296
PB84-223841 Not available NTIS
National Bureau of Standards, Washington, DC.
Performance Standards for Waveform Recorders.
Final rept.,
R. A. Lawton. Feb 83, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science NS-30, n1 p263-266 Feb 83.

Keywords: *Recording instruments, *Oscilloscopes, *Performance standards, *Standards, Transmission lines, Waveforms, Electric filters, Reprints.

A new technical committee for the Instrumentation and Measurement Society of the IEEE has been formed and is called Waveform Measurements and Analysis. The first task is to develop a performance standard for waveform recorders to satisfy a growing need for specifying the performance of the many new waveform recorders (transient digitizers, digital oscilloscopes, etc.) now coming on the market. The work of the committee to date will be described, together with the efforts of the Electromagnetic Waveform Metrology Group at the National Bureau of Standards in Waveform Standards Development.

401,297
PB84-223882 Not available NTIS
National Bureau of Standards, Washington, DC.
Effects of Viscosity, Temperature, and Rate of Rotation on Pressure Generated by a Controlled-Clearance Piston Gauge.
Final rept.,
J. K. N. Sharma, K. K. Jain, V. E. Bean, B. E. Welch, and R. J. Lazos. Apr 84, 7p
Pub. in Review of Scientific Instruments, v55 n4 p563-569 Apr 84.

Keywords: *Pistons, *Pressure measurement, *Pressure gages, *Viscosity, Standards, Fluid mechanics, Temperature, Reprints.

The calculation of the pressure generated by a controlled-clearance piston gauge depends upon the jacket pressure corresponding to zero clearance between the piston and cylinder, P(Z). The dependence of P(Z) on the viscosity of the pressure transmitting fluid, the temperature, and the rate of piston rotation have been measured. The results suggest that the best choice of fluid is the one having the lowest viscosity at pressure. Such a fluid can be selected on the basis of having the most nearly linear plot of P(Z) as a function of pressure of the candidate fluids. These results are also a clear indication that for the most accurate pressure measurements, a controlled-clearance piston gauge must be characterized using the same operational and environmental conditions with the same fluid as are used in normal operation.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,298
PB84-224005 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of In-Plane Residual Stress States in Plates Using Horizontally Polarized Shear Waves.
Final rept.,
R. B. King, and C. M. Fortunko. Jun 83, 9p
Sponsored in part by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in *Jnl. of Applied Physics*, v54 n6 p3027-3035 Jun 83.

Keywords: *Nondestructive tests, *Residual stress, Secondary waves, Elastic waves, Reprints.

In this paper a new approach for using acoustic measurements to evaluate residual stresses in the presence of unknown material property variation is presented. Procedures previously applied to the evaluation of stress with acoustic measurements are reviewed, and it is shown that these involve using measurements with bulk waves propagating along the normal to the surface of a plate and do not provide sufficient information to separate the influences of stress and material property variations. To overcome this fundamental limitation, an alternative theory is developed that governs the propagation of shear waves polarized horizontally with respect to the surface of a plate (SH waves), but propagating at oblique angles with respect to the surface normal. The question of separating the effects of residual stress and material properties on acoustic velocity is addressed in detail. A practical experimental procedure is developed that permits the evaluation of the in-plane components of the principal stresses in a plate exhibiting an unknown inhomogeneous initial anisotropy caused by material texture or microstructure. The procedure is then verified experimentally using an aluminum specimen with a known residual stress state, but unknown initial anisotropy.

401,299
PB84-224021 Not available NTIS
National Bureau of Standards, Washington, DC.
Impact of Atomic Physics on Fundamental Constants.
Final rept.,
R. D. Deslattes. 1983, 21p
Pub. in *Proceedings of Int. Conference Atomic Physics (8th)*, Goteborg, Sweden, August 2-6, 1982, *Atomic Physics 8*, p22-42 1983.

Keywords: *Fundamental constants, *Metrology, Atomic spectroscopy, Superconductivity, Hydrogen, Quantum electronics, *Atomic physics, Josephson effect.

Atomic physics determinations of numerical values involves the study of calculable spectra. In the case of hydrogen, inversion of the theoretical expressions for fine structure and hyperfine structure were used to obtain α , however their utility depends on the status of theory and experiment as well as on the availability of alternative approaches. Another group of measurements exploit the properties of macroscopic quantum mechanical systems. Among these on the electrical side, the Josephson frequency voltage relationship in superconductors has already a long and productive history. Other related effects such as flux quantization (as a route to the Compton wavelength) have yet to yield results commensurate with their promise. Finally, there remains a family of measurements which are both macroscopic and classical. These seem to be unavoidable thus far and continue to represent the least tractable problems encountered in this area of work.

401,300
PB84-225192 Not available NTIS
National Bureau of Standards, Washington, DC.
Thermal-Imaging System Performance Measures for Nondestructive Testing.
Final rept.,
J. Cohen. 1984, 5p
Pub. in *Society of Photo-Optical Instrumentation Engineers 446*, p176-180 1984.

Keywords: *Nondestructive tests, *Thermography, Performance, Reprints, *Infrared inspection.

Thermal images result from temperature differences and/or emissivity differences (apparent temperature differences) in a scene or target. It is the function of a thermal-imaging system to reproduce an acceptable visible image of the scene or target from its thermal

content. Thus, a thermal-imaging system is required to resolve spatial differences of temperature and emissivity. The performance of a thermal-imaging system may be specified by means of the fundamental performance measures, noise-equivalent temperature difference (NE(Δ T)), minimum-resolvable temperature difference (MRTD), and/or minimum detectable temperature difference (MDTD). The measurement and the significance of each of these performance measures is discussed.

401,301
PB84-225242 Not available NTIS
National Bureau of Standards, Washington, DC.
Cross-Bridge Test Structure for Evaluating the Linewidth Uniformity of an Integrated Circuit Lithography System.
Final rept.,
D. Yen, L. W. Linholm, and M. G. Buehler. Oct 82, 7p
Sponsored in part by Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH., Naval Air Systems Command, Washington, DC., and Army Electronics Technology and Devices Lab., Fort Monmouth, NJ.
Pub. in *Jnl. of the Electrochemical Society*, v129 n10 p2312-2318 Oct 82.

Keywords: *Integrated circuits, *Line width, *Lithography, Wafers, Microelectronics, Tests, Measurement, Reprints, Photomasks.

This paper describes an electrical measurement method using the cross-bridge test structure to evaluate linewidth variation associated with integrated circuit lithography. Arrays of cross-bridge test structures are used to measure the uniformity of linewidth across a wafer. Using this test structure array and high speed electrical test methods, sufficient quantities of data are obtained to make statistical comparisons and to evaluate a step-and-repeat system used to fabricate photomasks. In this study the variation in linewidth, which was systematic and repetitive from sample to sample, was several tenths of a micrometer across a wafer, and the linewidth measurement precision with the cross-bridge test structure was shown to be better than 0.03 micrometer.

401,302
PB84-225275 Not available NTIS
National Bureau of Standards, Washington, DC.
Calibration Facility for Static Pressure Transducers and Differential Pressure Transducers at High Base Pressure.
Final rept.,
C. F. Sindt, and J. F. LaBrecque. 1982, 3p
Sponsored in part by American Gas Association, Inc., Arlington, VA. and Gas Research Inst., Chicago, IL.
Pub. in *Proceedings of American Gas Association Operating Section Distribution Conference*, Washington, DC., May 3-5, 1982, pT-400-T-402.

Keywords: *Pressure sensors, *Calibrating, *Standards, *Manometers.

A facility has been developed to calibrate pressure transducers that are used in the NBS Gas Mass Flow Facility. Both static and differential pressure transducers can be calibrated. An air dead weight tester is the standard for static transducers in the range from 3.8 to 4.5 MPa. An air dead weight tester is also the standard for the differential pressure transducers in the range of 2.5 kPa to 50 kPa; a cistern manometer provides the transfer for the standard to a base operating pressure of 4.1 MPa.

401,303
PB84-225424 Not available NTIS
National Bureau of Standards, Washington, DC.
Beam Current Monitor for Intense Electron Beams.
Final rept.,
R. B. Fiorito, M. Raleigh, and S. M. Seltzer. Aug 83, 13p
Sponsored in part by Defense Advanced Research Projects Agency, Arlington, VA. and Office of Naval Research, Arlington, VA.
Pub. in *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science NS-30*, n4 p2210-2212 Aug 83.

Keywords: *Electron beams, *Electron accelerators, Monitors, Reprints, *Beam currents, Electrostatic shielding.

The use of interceptive probes for measuring the current density profile of electron beams is a common technique in accelerators producing low currents (1

<< 1 A). Severe requirements are imposed on interceptive devices when current densities of the order of kiloamperes per square centimeter are encountered. In this case, space charge effects, large secondary electron production, and probe heating are important considerations. This paper describes a simple, fast (τ (rise) about 0.4 ns) interceptive 'electric' probe which can be used in repetitively pulsed intense electron beam accelerators with high current densities. The device is sensitive only to beam charge present within the probe volume. To accomplish this, the probe uses a 'built in' electrostatic shield. By mechanically scanning the probe through the beam as a function of radius the beam current density can be determined.

401,304
PB84-225515 Not available NTIS
National Bureau of Standards, Washington, DC.
Millimeter Wave Standards at the National Bureau of Standards (NBS).
Final rept.,
R. A. Kamper, and C. A. Hoer. Nov 83, 3p
Pub. in *Proceedings of SPIE Int. Soc. Opt. Eng. Millimeter Wave Technology II*, San Diego, California, August 23-24, 1983, 423, p144-146 Nov 83.

Keywords: *Millimeter waves, *Standards, *Calibrating, Microwave frequencies, Measurement, Attenuation, Electrical impedance, Thermal noise.

This paper describes briefly the standards and measurement systems that are maintained at NBS to provide calibration service in the ranges 26 to 40 GHz, 55 to 60 GHz, and at 95 GHz. The measurement systems range in degree of automation from manually tuned reflectometer and attenuation measurement systems to semi-automated single and dual six-ports. Plans to complete the coverage in the range from 26 GHz to 75 GHz and to extend the range beyond 100 GHz are discussed.

401,305
PB84-225531 Not available NTIS
National Bureau of Standards, Washington, DC.
Evaluation of Residual Stress States Using Horizontally Polarized Shear Waves.
Final rept.,
R. B. King, and C. M. Fortunko. 1983, 12p
Sponsored in part by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in *Proceedings Review of Progress Quantitative Nondestructive Evaluation*, University of California, San Diego, California, 1-6 August 1982, n2B p1327-1338 1983.

Keywords: *Residual stress, *Acoustic measurement, *Nondestructive tests, Aluminum, Anisotropy, Elastic waves, Polarization, S waves.

A new approach for using acoustic measurements to evaluate residual stresses in the presence of unknown material property variations is presented. It is shown that measurements using shear waves propagating along the normal to the surface of a plate do not provide sufficient information to separate the influences of stress and materials property variations. To overcome this fundamental limitation, an alternative theory is developed that governs the propagation of shear waves polarized horizontally with respect to the surface normal. The question of separating the effects of residual stress and materials properties on acoustic velocity is addressed in detail. In addition, a practical experimental procedure is developed that permits the evaluation of the in-plane components of the principal stresses in a plate exhibiting an unknown inhomogeneous initial anisotropy caused by material texture or microstructure. The procedure is then verified experimentally using an aluminum specimen with a known residual stress state, but unknown initial anisotropy.

401,306
PB84-225549 Not available NTIS
 National Bureau of Standards, Washington, DC.
Inversion of Eddy Current Signals in a Nonuniform Probe Field.
 Final rept.,
 F. Muennemann, B. A. Auld, C. M. Fortunko, and S. A. Padgett. 1983, 26p
 Sponsored in part by Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.
 Pub. in Proceedings of Review of Progress Quantitative Nondestructive Evaluation, University of California, San Diego, California, 1-6 August 1982, n2B p1501-1526 1983.

Keywords: *Eddy current tests, Nondestructive tests, Born approximation.

The authors present a simple analytical method for predicting the eddy current signal produced by a surface flaw of known dimensions, when interrogated by a probe with spatially varying magnetic field. The model is easily parameterized, and we use it to construct inversion schemes which can extract overall flaw dimensions from multi-position, multifrequency measurements. The method is a type of Born approximation, in which the authors assume that the probe's magnetic field at the mouth of the flaw can be used as a boundary condition on the electromagnetic field solutions inside the flaw. To simplify the calculation the authors have chosen a 'rectangular' 3-dimensional flaw geometry for our model. The authors describe experimental measurements made with a new broadband probe on a variety of flaws. This probe operates in a frequency range of 200 kHz to 20 MHz and was designed to make the multifrequency measurements necessary for inversion purposes. Since inversion requires knowledge of the probe's magnetic field shape, the authors describe experimental methods which determine the interrogating field geometry for any eddy current probe.

401,307
PB84-225572 Not available NTIS
 National Bureau of Standards, Washington, DC.
NVLAP (National Voluntary Laboratory Accreditation Program) and NATA (National Association of Testing Authorities) Assessment Procedures.
 Final rept.,
 P. Postal, and P. Unger. Jun 83, 4p
 Sponsored in part by American Society for Testing and Materials, Philadelphia, PA.
 Pub. in American Society for Testing and Materials Standardization News p32-34, 37 Jun 83.

Keywords: *Laboratories, Tests, Comparison, Assessments, Reprints, *National voluntary laboratory accreditation program, *National association of testing authorities, Procedures.

The National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Bureau of Standards (NBS) and the National Association of Testing Authorities (NATA) of Australia use on-site assessment procedures of equivalent rigor to accredit laboratories in their respective jurisdictions. This and the fact that both systems use comparable accreditation criteria formed the basis for a bilateral agreement to provide mutual recognition of test results produced by each other's accredited laboratories. The paper compares and contrasts each system's assessment procedures. The authors, who are representatives from the two systems conclude that as both NVLAP and NATA learn from each other and from international efforts, their assessment procedures can be expected to converge.

401,308
PB84-226133 Not available NTIS
 National Bureau of Standards, Washington, DC.
Gas/Oil Interface and High Sensitivity Differential Pressure Indicator Used for the Comparison of Gas with Oil Piston Gauges.
 Final rept.,
 C. R. Tilford, and D. F. Martin. Jan 84, 4p
 Pub. in Review of Scientific Instruments, v55 n1 p95-98 Jan 84.

Keywords: *Pressure gages, *Pistons, *Measuring instruments, Comparison, Calibrating, Standards, Pressure measurement, Gas-liquid ratio, Reprints.

A free surface gas/oil pressure interface has been constructed to aid in the comparison of gas with oil piston gages. A coaxial three-terminal capacitor par-

tially immersed in the oil and partially in the gas permits the determination of hydrostatic heads and differential pressures between the piston gages. The interface has been used in the comparison of primary standard gas and oil piston gages with an average standard deviation about mean pressures of 4.5 Pa (0.00065 psi) over the range of 0.4 to 4 MPa (60 to 600 psi).

401,309
PB84-226174 Not available NTIS
 National Bureau of Standards, Washington, DC.
Simplified System for Calibration of Coupling Capacitor Voltage Transformers.
 Final rept.,
 D. L. Hillhouse, O. Petersons, and W. C. Sze. May 84, 7p
 Sponsored in part by Pennsylvania Power and Light Co., Allentown.
 Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems PAS-103, n5 p1092-1098 May 84.

Keywords: *Transformers, *Calibrating, Standards, Reprints, EHV AC systems.

Metering accuracy coupling capacitor voltage transformers (CCVTs) are installed permanently in 230-500 kV substations and must be calibrated in place. Several years ago, NBS developed a prototype field calibration system, with uncertainties of + or - 0.1% and + or - 0.3 milliradians (mrad). This paper describes a simpler system, consisting of a 15 kV standard transformer and its power supply, a capacitive transfer standard divider, and a voltage comparator. In field tests, this system agreed with the prototype to within + or - 0.03% and + or - 0.1 milliradians. The new system could be transported in a non-dedicated truck, and operated from the substation control house or a van.

401,310
PB84-226232 Not available NTIS
 National Bureau of Standards, Washington, DC.
Design of a Deep Borehole Tiltmeter.
 Final rept.,
 J. C. Harrison, J. Levine, and C. M. Meertens. 1983, 11p
 Sponsored in part by Air Force Geophysics Lab., Hanscom AFB, MA.
 Pub. in Proc. Ninth Int. Conf. Earth Tides, Stuttgart, West Germany, August 17-22 1981, p273-281 1983.

Keywords: *Boreholes, Design criteria, Performance evaluation, Tides, Deep depth, *Tiltmeters, *Earth tilt, Earth tides.

A deep borehole tiltmeter has been developed which can be operated below the near surface layers so as to reduce the influence of meteorological effects and which is relatively inexpensive to build and to install. A 15 cm diameter borehole is cased with steel irrigation pipe and has a stainless steel instrument compartment of 10 cm internal diameter at the bottom of the hole. The tiltmeter is contained in a 2 m stainless capsule held against the sides of the hole with flat springs. The tilt sensors are mounted on a platform which can be leveled by means of motors controlled from the surface, allowing for hole deviations of up to five degrees from the vertical. A number of different tilt sensors have been used on such platforms. Simple pendulums and horizontal pendulums have so far yielded the best results. A depth of 33 m is normally used although this is not a critical aspect of the design, as the electronics are inside the instrument capsule. The instruments are capable of operating unattended for long periods of time at tidal sensitivity; results of our tidal measurements will be presented in a companion paper at this symposium.

401,311
PB84-226240 Not available NTIS
 National Bureau of Standards, Washington, DC.
Precision Timekeeping Using a Small Passive Hydrogen Maser.
 Final rept.,
 F. L. Walls, and D. A. Howe. 1980, 18p
 Pub. in Proc. Twelfth Annu. Precise Time and Time Interval (PTTI), Goddard Space Flight Center, Greenbelt, Maryland, December 2-4 1980, p785-805.

Keywords: *Frequency standards, *Time standards, *Masers, Frequency stability, Cesium frequency standards, Comparison, *Hydrogen masers.

The time keeping ability of a prototype small passive hydrogen maser developed at NBS was recently compared to UTC(NBS) based on 10 cesium frequency

standards including a large primary standard, NBS-4. The frequency of the passive maser was monitored as a function of source pressure, cavity temperature, microwave power, modulation width, and magnetic field. Based on these measurements one would expect a frequency stability of better than 6×10^{-15} (10 to the -15th power) over many days, implying a time keeping ability of order 0.5 ns/day. Measurements vs. UTC(NBS) indicate a joint time keeping stability of order 1.2 ns/day.

401,312
PB84-226307 Not available NTIS
 National Bureau of Standards, Washington, DC.
Accuracy of Ellipsometric Thickness Determinations for Very Thin Films.
 Final rept.,
 D. Chandler-Horowitz, and G. A. Candela. Dec 83, 4p
 Pub. in Jnl. de Physique Colloque 10, n2 pC10-23-C10-26 Dec 83.

Keywords: *Thin films, *Thickness, *Polarimetry, Silicon dioxide, Silicon, Accuracy, Reprints, *Ellipsometry, Refractive index, Uncertainty.

The uncertainty in the ellipsometric determination of the thickness of a film on a substrate can be found quantitatively. The authors have used the solution of the differentials of film thickness and refractive index. Results of calculations for the air-SiO₂-Si system are presented. This theory has been used to calculate the uncertainty in the value of the thickness as a function of wavelength. The authors have also calculated this uncertainty for known uncertainty in the film's refractive index. They show which uncertainties contribute the most to the overall accuracy of a thickness measurement.

401,313
PB84-226331 Not available NTIS
 National Bureau of Standards, Washington, DC.
Impedance of a Coil in the Vicinity of a Crack.
 Final rept.,
 A. H. Kahn. 1984, 9p
 Pub. in Review of Progress in Quantitative Nondestructive Testing 3A, p579-587 1984.

Keywords: *Nondestructive tests, *Cracks, Defects(Materials), Electromagnetic fields, Electric coils, Electrical impedance, Reprints.

In the design of electromagnetic NDE systems for the detection and examination of cracks and other defects in conducting materials, it is desirable to have a quantitative description of the fields in the vicinity of the defect. In previous work by this author and co-workers, the fields in the vicinity of a crack were calculated for models based on excitation by a spatially uniform applied field, as in the interior of a solenoid. The present work reports on an improved model which includes non-uniformity of the field of the exciting coil and the effects of coil size and position relative to the crack.

401,314
PB84-226349 Not available NTIS
 National Bureau of Standards, Washington, DC.
Historical Development and Newer Means of Temperature Measurement in Biochemistry.
 Final rept.,
 R. L. Berger, T. Clem, V. A. Harden, and B. W. Mangum. 1984, 63p
 Pub. in Methods Biochem. Anal. 30, p269-331 1984.

Keywords: *Biochemistry, *Temperature, *Thermometry, Laboratory equipment, Reprints.

This chapter gives a brief review of the history of thermometry, of temperature scales, and of the various types of thermometers used in numerous applications. Specific techniques and applications of temperature measurements in biochemical studies are given. These include the new methods in thermometry in biochemistry.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,315
PB84-226422 Not available NTIS
National Bureau of Standards, Washington, DC.
Evaluation of Residual States of Stress and Material Texture Using Ultrasonic Velocity Measurements with Electromagnetic Acoustic Transducers.
Final rept.,
R. B. King, and C. M. Fortunko. 1982, 4p
Sponsored in part by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in Proceedings of 1982 Ultrasonics Symp., San Diego, California, 27-29 October 1982, IEEE CAT. No. 82CH1823-4, n2 p885-888.

Keywords: *Residual stress, *Acoustic measurement, *Nondestructive tests, Aluminum, Anisotropy, Elastic waves, Ultrasonic radiation.

A new approach for using acoustic measurements to evaluate residual stresses in the presence of unknown material property variation is presented. Procedures previously applied to the evaluation of stress with acoustic measurements are reviewed and it is shown that these involve using measurements with bulk waves propagating along the normal to the surface of a plate and do not provide sufficient information to separate the influences of stress and material property variations. To overcome this fundamental limitation, an alternative theory is developed that governs the propagation of shear waves polarized horizontally with respect to the surface of a plate (SH-waves), but propagating at oblique angles with respect to the surface normal. The question of separating the effects of residual stress and material properties on acoustic velocity is addressed in detail. A practical experimental procedure is developed that permits the evaluation of the in-plane components of the principal stresses in a plate exhibiting an unknown inhomogeneous initial anisotropy caused by material texture or microstructure.

401,316
PB84-226786 Not available NTIS
National Bureau of Standards, Washington, DC.
Microelectronic Ball-Bond Shear Test - A Critical Review and Comprehensive Guide to Its Use.
Final rept.,
G. G. Harman. Oct 83, 15p
Pub. in Proceedings of 1983 International Microelectronics Symposium, Philadelphia, Pennsylvania, October 31-November 2, 1983, International Jnl. of Hybrid Microelectronics 6, n1 p127-141.

Keywords: *Microelectronics, *Shear tests, *Bonding, Reliability(Electronics), Gold, Aluminum, Bonding strength, *Ball bond shear tests.

The microelectronic ball bond shear test was first developed in 1967. Since then, it has been used to study the effects of contamination on bondability, to characterize the reliability of gold-aluminum intermetallic formation, to control bonding machine parameters for device production, and to troubleshoot such production problems as poor metallization adherence and contamination. This paper critically reviews all of these uses and identifies ways that the shear test can be implemented to improve bond yield and assure long-term bond reliability. A manual shear probe is described that can be quickly made from the blade of a jeweler's screwdriver. This probe was instrumented with a strain gage and the shear test results compared within 10% of those obtained from a machine. The paper also presents data obtained from shearing both aluminum-ball and -wedge bonds and determines how the shear testing machine requirements for these differ from those required to test gold ball bonds.

401,317
PB84-226836 Not available NTIS
National Bureau of Standards, Washington, DC.
Experiments with Magnetic Spectrometers at Neal.
Final rept.,
J. W. Lightbody, Jr. 1983, 27p
Pub. in Proceedings of Spectrometer workshop, Williamsburg, Virginia, October 10-12, 1983, pXII-1-XII-27.

Keywords: Electron beams, Polarization(Spin alignment), Resolution, Focusing, Design, *Magnetic spectrometers, Electron spin polarization, Polarized beams.

The author outlines some of the important experiments that will be possible at NEAL, and discusses some of the details associated with their realization. The major points considered are (1) out-of-plane measurements, (2) polarization of the primary electron

beam, and (3) the effects of kinematic broadening on resolution requirements of spectrometers and their focussing properties.

401,318
PB84-227057 Not available NTIS
National Bureau of Standards, Washington, DC.
Reference Waveform Flat Pulse Generator.
Final rept.,
J. R. Andrews, B. A. Bell, N. S. Nahman, and E. E. Baldwin. Mar 83, 6p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-32, n1 p27-32 Mar 83.

Keywords: *Pulse generators, *Standards, *Waveform generators, *Calibrating, Waveforms, Measurement, Reprints.

The NBS Reference Flat Pulse Generator is used to transfer dc voltage and resistance standards to the nanosecond domain. It provides a step amplitude of 1.000 V (open circuit) from a source impedance of 50.0 ohms. The transition duration is 600 ps and all perturbations are damped out to less than + or - 10 mV volts within 5 ns. It can also be used as a time interval transfer standard.

401,319
PB84-227081 Not available NTIS
National Bureau of Standards, Washington, DC.
Experience in Standardizing Superconductor Measurements.
Final rept.,
A. F. Clark, L. F. Goodrich, and F. R. Fickett. Jan 84, 4p
Pub. in Jnl. de Physique Colloque C1, n1 pC1-379-C1-382 Jan 84.

Keywords: *Superconductors, Measurement, Standards, Reprints, *Critical current.

The research leading to standard measurement techniques for characterizing practical superconductors is described. Special attention is given to measuring critical current.

401,320
PB84-227248 Not available NTIS
National Bureau of Standards, Washington, DC.
Dual Six-Port Network Analyzer Using Diode Detectors.
Final rept.,
J. R. Juroshek, and C. A. Hoer. Jan 84, 5p
Sponsored in part by Aerospace Guidance and Metrology Center, Newark AFS, OH.
Pub. in IEEE Transactions on Microwave Theory and Techniques MTT-32, n1 p78-82 Jan 84.

Keywords: *Network analyzers, Attenuation, Microwave frequencies, Measurement, Performance, Electrical impedance, Diodes, Calibrating, Reprints.

The performance of a dual six-port network analyzer using diode detectors is described. The network analyzer operates over the 2-18 GHz band using commercially available, low-barrier, Schottky diodes. The paper describes the process for calibrating the diodes for deviation from square-law. Measurement results are presented showing the accuracy and precision of the six-port network analyzer when measuring 1-port and 2-port devices.

401,321
PB84-227321 Not available NTIS
National Bureau of Standards, Washington, DC.
Small Aperture Analysis of the Dual TEM Cell.
Final rept.,
P. F. Wilson. Apr 84, 5p
Pub. in Proceedings of IEEE Natl. Symp. Electromagnetic Compatibility, San Antonio, TX, Apr 24-26, 1984, IEEE Cat. No. 84CH2035-4, p365-369.

Keywords: Apertures, Analyzing, *TEM cells, Bethe's aperture theory.

This paper describes an analysis of dual TEM cell coupling based on Bethe's small aperture theory. This approach allows one to model a variety of possible aperture shapes (circular, elliptical, square etc.), including material loaded apertures of finite thickness. Measurements demonstrate that the theory accurately predicts coupling for an unloaded aperture.

401,322
PB84-227479 Not available NTIS
National Bureau of Standards, Washington, DC.
Experimental Method for Direct Evaluation of the J Contour Integral.
Final rept.,
D. T. Read. 1983, 15p
Sponsored in part by Naval Sea Systems Command, Washington, DC., and David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in American Society for Testing and Materials Special Technical Publication 791, pII-199-II-213 1983.

Keywords: *High strength steels, Numerical integration, Strains, Stresses, Cracks, Reprints, *J integral, Contour integration.

A method for direct experimental evaluation of the J contour integral has been developed and used to measure J as a function of strain in tensile panels of high strength steel ($\sigma_{sub y} = 900$ MPa) under elastic-plastic loading conditions. The principle of the present method is to measure the integrand terms of J at suitable intervals along an appropriate contour and then to evaluate the integral. Because the resulting J values are based directly on the definition of J no assumptions about the crack size of stress/strain fields in the vicinity of the crack tip are necessary.

401,323
PB84-229509 Not available NTIS
National Bureau of Standards, Washington, DC.
Lineshapes of Subdoppler Resonances Observable with FM Side-Band (Optical Heterodyne) Laser Techniques.
Final rept.,
J. L. Hall, H. G. Robinson, T. Baer, and L. Hollberg. 1983, 28p
Contract NOOO14-77-C-0656, Grant NSF-PHY79-04928
Pub. in Proceedings of NATO Advanced Science Institute (10th), San Miniato, Italy, July 26-August 7, 1981, p99-126 1983.

Keywords: Frequency modulation, Line width, *Laser spectroscopy, High resolution.

In this lecture the authors describe the 'new' technique of FM spectroscopy in which the modulation frequency is greater than the linewidths of interest. With this approach they may almost completely avoid the low frequency noise of a technical nature while recovering undistorted resonance profiles of a simple and characteristic shape with excellent signal/noise ratio. It is the theory of these profiles which forms the main subject for this lecture/paper.

401,324
PB84-233659 PC A07/MF A01
National Bureau of Standards, Washington, DC.
Experimentation and Measurement,
W. Y. Youden. Mar 84, 132p NBS/SP-672
Also available from Supt. of Docs as SN003-003-02575-5. Library of Congress catalog card no. 84-601011.

Keywords: *Measurement, *Measuring instruments, *Units of measurement, Laboratory equipment, Weight measurement.

This book is an elementary introduction to the laws of measurements. But the approach is not an abstract discussion of measurements, instead it depends upon getting you to make measurements and, by observing collections of measurements, to discover for yourself some of the properties of measurements. The idea is to learn something about measurement that will be useful-no matter what is being measured. Some hint is given of the devices that scientists and measurements specialists use to get more out of the available equipment. Understanding something about the laws of measurements, a person may be able to get the answers to your own research problems with half the usual amount of work. No young scientist can afford to pass up a topic that may double his scientific achievements.

401,325

PB84-235530 PC A07/MF A01
National Bureau of Standards, Washington, DC.
Journal of Research of the National Bureau of Standards. Volume 89, Number 1, January-February, 1984.
Feb 84, 149p
See also PB84-235548 through PB84-235605 and PB84-160605. Also available from Supt. of Docs. SN003-003-72085-2.

Keywords: *Materials tests, Surface roughness, Neutron scattering, Ceramics, Creep properties, Cracks, Ultrasonic tests, Acoustic emission testing.

Contents:

- Surface roughness studies with DALLAS-Detector array for laser light angular scattering;
- Microstructural characterization of ceramic materials by small angle neutron scattering techniques;
- Characterization of creep damage in metals using small angle neutron scattering;
- Impedance of a coil in the vicinity of a crack;
- Theory of acoustic emission from phase transformations;
- Reconstructing internal temperature distributions from ultrasonic time-of-flight tomography and dimensional resonance measurements;
- Acoustic emission--Establishing the fundamentals.

401,326

PB84-235548
(Order as PB84-235530, PC A07/MF A01)
National Bureau of Standards (NEL), Washington, DC. Center for Mfg. Engineering.
Surface Roughness Studies with DALLAS-Detector Array for Laser Light Angular Scattering, T. V. Vorburger, E. C. Teague, F. E. Scire, M. J. McLay, and D. E. Gilsinn. 14 Oct 83, 14p
Included in Jnl. of Research of the National Bureau of Standards, v89 n1 p3-16 Jan-Feb 84.

Keywords: *Surface roughness, Light scattering, Instruments, Fiber optics, Detectors, Laser applications.

An instrument has been developed to study surface roughness by measuring the angular distributions of scattered light. In our instrument, a beam from a He-Ne laser illuminates the surface at an angle of incidence which may be varied. The scattered light distribution is detected by an array of 87 fiber optic sensors positioned in a semicircular yoke which can be rotated about its axis so that the scattered radiation may be sampled over an entire hemisphere. The output from the detector array is digitized, stored, and analyzed in a laboratory computer. The initial experiments have concentrated on measurements of stainless steel surfaces which are highly two-dimensional and which yield scattering distributions that are localized in the plane of incidence. The results are analyzed by comparing the angular scattering data with theoretical angular scattering distributions computed from digitized roughness profiles measured by a stylus instrument. The theoretical distributions are calculated by substituting the roughness profiles into the operand of an integral equation for electromagnetic scattering developed by Beckmann and Spizzochino. This approach directly tests the accuracy of the basic optical theory.

401,327

PB84-235555
(Order as PB84-235530, PC A07/MF A01)
National Bureau of Standards, Washington, DC. Center for Materials Science.
Microstructural Characterization of Ceramic Materials by Small Angle Neutron Scattering Techniques, K. Hardman-Rhyne, N. F. Berk, and E. R. Fuller, Jr. 1 Dec 83, 18p
Included in Jnl. of Research of the National Bureau of Standards, v89 n1 p17-34 Jan Feb 84.

Keywords: *Ceramics, *Neutron scattering, Microstructure, Porosity, Materials tests.

The use of small angle neutron scattering (SANS) techniques for ceramic materials is discussed. Two areas are emphasized: (1) diffraction for microstructural phenomena of less than 100 nm, and (2) beam broadening for microstructural phenomena greater than 90 nm.

401,328

PB84-235571
(Order as PB84-235530, PC A07/MF A01)
National Bureau of Standards, Gaithersburg, MD. Metallurgy Div.
Impedance of a Coil in the Vicinity of a Crack, A. H. Kahn. 16 Nov 83, 8p
Included in Jnl. of Research of the National Bureau of Standards, v89 n1 p47-54 Jan-Feb 84.

Keywords: *Electromagnetic testing, Cracks, Nondestructive tests, Electric coils, Impedance.

Calculations are presented for the impedance of a coil as it is moved in the vicinity of a v-groove crack in the surface of a metallic slab. The coil is modeled as a pair of parallel wires, oriented parallel to the crack, carrying equal and opposite currents. The inhomogeneous electromagnetic fields in the air above the slab and in the metal are determined by the boundary integral equation (BIE) method. This approach leads to a pair of coupled integral equations for the tangential components of the electric and magnetic field vectors on the surface of the slab containing the crack. The solutions, which are obtained by standard methods of discretization, are valid for arbitrary ratio of crack or coil dimensions to skin depth. Illustrations are presented of the Poynting vector distribution over the surface of the metal, including the crack faces. A plot of the complex impedance is given in the form of a coil scan across the crack.

401,329

PB84-235605
(Order as PB84-235530, PC A07/MF A01)
National Bureau of Standards, Washington, DC.
Acoustic Emission: Establishing the Fundamentals, D. G. Eitzen, and H. N. G. Wadley. 23 Jan 84, 26p
Included in Jnl. of Research of the National Bureau of Standards, v89 n1 p75-100 Jan-Feb 84.

Keywords: Nondestructive tests, Monitoring, *Acoustic emissions, Signal processing.

In the mid-1970's a program of fundamental research was initiated at NBS to improve the scientific understanding of acoustic emission. Many individual results of this research have been reported in the literature and are beginning to be incorporated in a new generation of acoustic emission instrumentation, in improved test methodologies, and in the analysis of data. Here, we summarize the problems faced by acoustic emission midway through the last decade, review the accomplishments of the NBS program and related research programs, and outline the research that will be required in future years.

401,330

PB84-235704 PC A02/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
NBS (National Bureau of Standards) and WR62 and WR90 Reference Noise Standards
Final rept.,
C. K. S. Miller, and W. C. Daywitt. May 84, 25p
NBSIR-84/3005

Keywords: Standards, Waveguides, *Reference standards, *Thermal noise.

The basis for the National Bureau of Standards (NBS) WR90 and WR62 Waveguide Reference Noise Standards and the corresponding error analyses are described. The standards are heated (1270 K) thermal noise generators, and a derivation of their output noise temperature equations is also presented. Results of comparisons of the NBS WR90 standard with those of Sweden, England, Australia, and Japan are included. The text is extracted from course notes presented at NBS in 1970, and hence does not include descriptions of standards constructed at NBS since that time.

401,331

PB84-235894 PC A02/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
NBS (National Bureau of Standards) Switching Radiometers.
Final rept.,
C. K. S. Miller, and W. C. Daywitt. May 84, 24p
NBSIR-84/3004

Keywords: *Radiometers, Error analysis, Measurement, Reprints, Noise temperature.

An error analysis for the Dicke radiometers used by the National Bureau of Standards (NBS) in their WR90 waveguide noise calibration services for sources with noise temperatures above 1000 kelvin is discussed. A list of measurement frequencies currently available in the WR90 and WR62 bands is presented.

401,332

PB84-239870 Not available NTIS
National Bureau of Standards, Washington, DC.
Modification of Centrifugal Filtration Device for Elimination of Sorption Losses.
Final rept.,
W. A. MacCrehan. Apr 82, 2p
Pub. in Analytical Chemistry 54, n4 p838-839 Apr 82.

Keywords: *Centrifuges, *Filters, *Laboratory equipment, *Sorption, Liquids, Chemical analysis, Membranes, Performance evaluation, Reprints.

The preparation of many liquid samples for analysis frequently requires filtration to remove suspended solid matter. This is particularly true for samples prepared for liquid chromatography, where particles in the micrometer range can clog protective column frits. Several devices are commercially available for the filtration of liquid samples in the sub-milliliter range. Two approaches that we have used are syringe-membrane filters and centrifugation with withdrawal of the supernatant liquid. Although both approaches are effective for removing particles, each has disadvantages.

401,333

PB84-239979 Not available NTIS
National Bureau of Standards, Washington, DC.
Resonance Neutron Radiography.
Final rept.,
R. A. Schrack, J. W. Behrens, R. G. Johnson, and C. D. Bowman. 1983, 8p
Pub. in Proceedings of World Conference on Neutron Radiography (1st), San Diego, CA, Dec 7-10, 1981 p495-502 1983.

Keywords: *Neutron radiography, Proportional counters, Helium 3, *Resonance neutron radiography, Resonance neutrons, Multi-channel analyzers, Neutron detectors.

The production of images by the use of neutrons having energies in the resonance region is described. Two-dimensional position-sensitive neutron detectors are used to produce transmission images using neutron time-of-flight techniques at the National Bureau of Standards' electron linac facility. Two types of detectors are described. The first is a crossed-wire proportional counter using (3)He as the neutron-sensitive component. The second type uses a multichannel plate electron multiplier and a resistive anode readout. A lithium glass scintillator is the neutron-sensitive component in the latter detector. Resonance neutron radiography, using these detectors, has the capability of producing images with isotopic and chemical element discrimination in a complex matrix with a resolution of 1 mm or better.

401,334

PB84-239987 Not available NTIS
National Bureau of Standards, Washington, DC.
Frequency Measurement of Visible Light.
Final rept.,
K. M. Evenson, D. A. Jennings, and F. R. Petersen. Dec 81, 11p
Pub. in J. de Phys. Colloq. C8, 42, n12 pC8-473-C8-483 Dec 81.

Keywords: *Frequency measurement, *Light(Visible radiation), Reprints, MIM diodes.

A discussion of the extension of absolute frequency measurements to the visible is given along with some new measurements of visible frequency differences using the MIM diode. Future frequency measurements and the redefinition of the meter are discussed.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,335
PB84-244623 Not available NTIS
National Bureau of Standards, Washington, DC.
Three-Beam Phase Modulation Technique for Coherent Raman Spectroscopy.
Final rept.,
G. J. Rosasco, W. S. Hurst, and W. Lempert. Jan 84, 3p
Pub. in Optics Letters 9, p19-21 Jan 84.

Keywords: *Raman spectroscopy, *Gases, *Optical measuring instruments, Nitrogen oxides(NO), Nitrogen, Reprints, *Coherent Raman spectroscopy.

A new nonlinear optical technique is applied to coherent Raman spectroscopy of gases. Two orthogonal pump beams with relative phase modulation are generated in an electro-optic modulator and mixed with a linearly polarized probe. Shot noise limited detection and signals linear in either the real or imaginary parts of the third order susceptibility are demonstrated for NO and N₂.

401,336
PB84-244631 Not available NTIS
National Bureau of Standards, Washington, DC.
Nondestructive Measurement of Solar Cell Sheet Resistance Using a Laser Scanner.
Final rept.,
P. Kowalski, W. F. Lankford, and H. A. Schafft. May 84, 5p
Sponsored in part by Solar Energy Research Inst., Golden, CO.
Pub. in IEEE Transactions on Electron Devices ED-31, n5 p566-570 May 84.

Keywords: *Solar cells, *Optical scanners, Nondestructive tests, Measurement, Electrical resistance, Reprints, Laser applications.

Experimental data have shown that a laser scanner can be used as a probe to make nondestructive measurements of solar cell sheet resistance with an accuracy of several percent. The photovoltaic response from cells with controlled sheet resistance was measured using the scanner and compared with the theoretical predictions made by other workers. Several limitations in this technique are identified and a measurement methodology is suggested.

401,337
PB84-244672 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of Sputtering Yields by a New Procedure for Depth Profiling of Multilayered Structures.
Final rept.,
B. Navinsek, P. Panjan, A. Zabkar, and J. Fine. 1984, 4p
Pub. in Nuclear Instruments and Methods in Physics Research B2, p670-673 1984.

Keywords: *Sputtering, *Depth finding, *Laminates, *Thin films, *Thickness, Nickel, Chromium, Silver, Argon, Measurement, Ion irradiation, Surfaces, Reprints.

Sputtering yield data were obtained from a new procedure for determination of depth profiles of multilayered thin film structures. Depth profiling was performed with a mass analysed low energy ion beam and a quartz crystal oscillator microbalance. Yield data for 4-12 keV argon ions on Ni, Cr and Ag were measured as functions of ion dose (from 'zero' yield to 'equilibrium'), surface roughness and film thickness. In combination with AES, X-ray and RBS depth profiling, this method shows possibilities for obtaining higher depth resolution, and good prospects for the development of related standard reference materials for sputtering rate ('true depth scale') and depth profile calibration.

401,338
PB84-244813 Not available NTIS
National Bureau of Standards, Washington, DC.
Laser Techniques in NDE.
Final rept.,
G. Birnbaum, and G. White. 1984, 107p
Pub. in Nondestructive Testing 7 (Chapter 8), p259-365 1984.

Keywords: *Nondestructive tests, Light scattering, Reflection, Semiconductors, Interferometers, Reprints, *Laser applications, Photoacoustic effect, Acoustic waves.

Laser techniques in NDE are reviewed. These methods include optical reflection and scattering, laser-in-

duced thermal and acoustic waves, and laser induced electronic excitations in semiconductors. The theory of these methods, their experimental verification, and the NDE applications are discussed.

401,339
PB85-100121 Not available NTIS
National Bureau of Standards, Washington, DC.
AE (Acoustic Emission) Signal Analysis - Laboratory Experiments into the Physical Processes of Acoustic Emission.
Final rept.,
N. N. Hsu, and D. G. Eitzen. 1980, 12p
Sponsored in part by Japan Society for Non-Destructive Inspection, Tokyo, Atomic Energy Society of Japan, Tokyo, High Pressure Inst. of Japan, Tokyo, and Japan Society of Civil Engineers, Tokyo.
Pub. in Proceedings of International Acoustic Emission Symposium (5th) Held at Tokyo, Japan on November 18-20, 1980, p67-78.

Keywords: *Transfer functions, Signal processing, *Acoustic emission testing, Acoustic emissions.

A goal of acoustic emission (AE) signal analysis is to reliably assess and monitor the integrity of structures. In order to achieve this goal, we feel that it is necessary to quantitatively determine the source mechanisms by transforming the detected signals into a precise measurement of the source function. Only through this determination will the reliability of AE technology be sufficiently assured. To pursue this goal, we have studied the details of the physical processes of an AE from the generation of the stress waves at the source to the wave propagation in the structure, to the conversion into electrical voltage signals through a combination of analysis, design and conduct of controlled experiments.

401,340
PB85-100253 Not available NTIS
National Bureau of Standards, Washington, DC.
Objective Measurement and Characterization of Scratch Standards.
Final rept.,
M. Young. 1982, 7p
Sponsored in part by Army Armament Research and Development Command, Dover, NJ.
Pub. in Society of Photo-Optical Instrumentation Engineers 362, p86-92 1982.

Keywords: *Light scattering, *Diffraction, *Scratches, *Standards, Measurement, Surfaces, Reprints.

The manufacture of scratch standards for use with MIL-0-13830A has been hampered by the lack of an objective measurement technique. The U.S. National Bureau of Standards has therefore undertaken a comprehensive program to provide quantitative measurements of the light scattered by the scratches and to correlate them with assessments made by trained observers. In this paper, the author applies scalar diffraction theory to developing design criteria for a polar scanning apparatus, describes the apparatus, and shows scans from one full set of secondary standards. Comparing these scans with the visual assessments is not straightforward.

401,341
PB85-100295 Not available NTIS
National Bureau of Standards, Washington, DC.
Design Considerations for Broadband Magnetic-Field Sensors.
Final rept.,
M. Kanda, F. X. Ries, L. D. Driver, and R. D. Orr. 1982, 3p
Pub. in Proceedings of Conference on Precision Electromagnetic Measurements, 28 June-1 July, 1982, p11-13.

Keywords: *Magnetic measurement, *Magnetic detection, Magnetic fields, Loop antennas, Broadband, Sensitivity, Design.

Basic design considerations required to produce broadband magnetic-field sensors are discussed. Three different configurations are discussed. The advantages and disadvantages of each configuration are presented in terms of its sensitivity and bandwidth. A physical discussion is given for the operation of a shielded loop.

401,342
PB85-100337 Not available NTIS
National Bureau of Standards, Washington, DC.
Frequency Measurements of Optical Radiation.
Final rept.,
K. M. Baird. Jan 83, 6p
Pub. in Physics Today 36, n1 p52-57 Jan 83.

Keywords: *Frequency measurement, *Frequency standards, *Time standards, Microwave frequencies, Infrared radiation, Light(Visible radiation), Reprints.

This paper presents an overview of recently developed techniques that have made it possible to relate directly the frequencies of microwave and optical radiations by the use of very high speed non-linear devices. The significance of the techniques, which will allow the use of a single spectroscopic transition to define the standards of both time and length, is discussed.

401,343
PB85-100444 PC A02/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Electronics and Electrical Engineering.
High-Current Measurement Techniques,
J. D. Ramboz, and D. R. Flach. May 84, 23p NBSIR-84/2881
Sponsored in part by Sandia National Labs., Albuquerque, NM.

Keywords: *Electrical measurement, *Electric current, Electric coils, Bypasses, Circuits, Alternating current, Rogowski coils.

The measurement of very high ac currents presents special problems in the selection of current sensors, instrumentation, and techniques. This report discusses initial test results for Rogowski coils and high-capacity current shunts often used to measure large ac currents.

401,344
PB85-100451 PC A05/MF A01
National Bureau of Standards (NEL), Washington, DC.
Building Equipment Div.
National Bureau of Standards Passive Solar Test Facility - Instrumentation and Site Handbook,
B. M. Mahajan. Aug 84, 89p NBSIR-84/2911
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Test facilities, *Solar energy, Detectors, Passive systems.

This handbook provides a complete description of the test building, thermophysical properties of the building material, location of the sensors installed at the test facility, and data acquisition system and procedures.

401,345
PB85-102721 Not available NTIS
National Bureau of Standards, Washington, DC.
Broadband, Isotropic, Real-Time, Electric-Field Sensor (BIRES) Using Resistively Loaded Dipoles.
Final rept.,
M. Kanda. 1981, 11p
See also PB80-117732.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electromagnetic Compatibility 23, n3 p122-132 1981.

Keywords: *Detectors, Electric fields, Broadband, Electromagnetic interference, Measurement, Reprints.

A broadband, isotropic, real-time, electric-field sensor (BIRES) developed by the National Bureau of Standards (NBS) consists of three resistively loaded dipoles mounted orthogonally to each other. It has the capability of measuring a complete description of frequency, polarization, magnitude, and phase information of the incident electromagnetic (EM) field. The typical tangential sensitivity of the BIRES is 13 to 16 $\mu\text{V}/\text{m}$ with a usable dynamic range of 125 to 144 db for various bandwidths in the frequency range of 10 MHz to 1 GHz. The isotropic response, isotropy, of the BIRES is obtained by calculating the Hermitian magnitude of the incident electric field, and its variation is found to be less than plus or minus 1 dB.

401,346

PB85-102796 Not available NTIS
National Bureau of Standards, Washington, DC.
Determination of the Fine-Structure Constant Using GaAs-Al(x)Ga(1-x)As Heterostructures.

Final rept.,
B. F. Field, M. E. Cage, R. F. Dziuba, D. C. Tsui, and A. C. Gossard. 1982, 4p
Prepared in cooperation with Bell Labs., Murray Hill, NJ. Sponsored in part by Office of Naval Research, Arlington, VA.
Pub. in Physical Review Letters 48, n1 p3-6 1982.

Keywords: *Fundamental constants, Hall effect, Gallium arsenides, Electron gas, Reprints, *Fine structure constant, Aluminum gallium arsenides, Heterostructures.

The fine-structure constant alpha has been determined from precision measurements of quantized Hall resistances (R sub H) of three different GaAs-Al(x)Ga(1-x)As heterostructure samples. The result, $1/\alpha = 137.035\ 968(23)$ (0.17 ppm), is in excellent agreement with the 0.11 ppm value obtained from the gyromagnetic ratio of the proton, gamma prime sub p, and $2e/h$ via the Josephson effect. Our (R sub H) value can be combined with gamma prime sub p and $2e/h$ to yield a more accurate value of $1/\alpha$ independent of the ohm: $1/\alpha = 137.035\ 965(12)$ (0.089 ppm).

401,347

PB85-104727 Not available NTIS
National Bureau of Standards, Washington, DC.
Determining Stress and Strain and Texture Using Ultrasonic Velocity Measurements.

Final rept.,
D. E. MacDonald. 1980, 2p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Sonics and Ultrasonics 27, n3 p172-173 1980.

Keywords: *Nondestructive testing, *Stress analysis, *Strain tests, *Ultrasonic radiation, *Anisotropy, Texture, Comparison, Reprints.

The application of ultrasonics to the nondestructive evaluation of residual stresses has been hindered by the question of whether the wave velocity is actually stress or strain dependent and by the difficulty of separating the stress/strain related anisotropy from that due to texture. The ultrasonic wave velocity is shown to depend directly on the stress as well as on the strain dependent second-order coefficients. This separate dependence on stress and strain is demonstrated with the aid of a mathematical model used to find the effect of finite strain on the wave velocities. A comparison of wave speeds for materials with isotropic, transversely isotropic, cubic and tetragonal symmetry and these same materials under uni-axial strain is presented which indicates how to separate the effects of stress and texture.

401,348

PB85-104735 Not available NTIS
National Bureau of Standards, Washington, DC.

Piezoelectric-Crystal Mercury Monitor.
Final rept.,
E. P. Scheide, and R. B. J. Warnar. 1978, 5p
Pub. in American Industrial Hygiene Association Jnl. 39, n9 p745-749 Sep 78.

Keywords: *Piezoelectric crystals, *Portable instruments, *Mercury(Metal), *Dosimeters, *Industrial hygiene, Air pollution, Exposure, Reprints, *Air pollution detection, *Occupational safety and health, *Indoor air pollution.

A hand calculator sized instrument with digital readout for measuring the mercury vapor concentration in air and/or personal exposure to mercury vapor has been developed and evaluated. This instrument is applicable to many industrial hygiene applications.

401,349

PB85-104743 Not available NTIS
National Bureau of Standards, Washington, DC.
Calibration System for Producing Known Concentrations of Mercury Vapor in Air.

Final rept.,
E. P. Scheide, E. E. Hughes, and J. K. Taylor. 1979, 7p
Pub. in American Industrial Hygiene Association Jnl. 40, n3 p180-186 Mar 79.

Keywords: *Monitors, *Mercury(Metal), *Calibrating, Industrial hygiene, Performance evaluation, Design cri-

teria, Concentration(Composition), Air pollution, Reprints, Occupational safety and health.

This paper describes the construction and evaluation of a system capable of producing well-defined test mixtures of mercury in air, or other diluent gas, at mercury concentrations between zero and 16 mg/cu M. The various parameters that affect the generation system and their interactions are discussed and data is given for the calibration of several different mercury monitors.

401,350

PB85-104842 Not available NTIS
National Bureau of Standards, Washington, DC.
Comment on Millman Effect in Cesium Beam Atomic Frequency Standards.

Final rept.,
D. J. Wineland, and H. Hellwig. 1977, 2p
Pub. in Metrologia 13, n4 p173-174 1977.

Keywords: *Cesium frequency standards, *Frequency shift, Magnetic fields, Reprints, Millman effect.

Data on frequency shifts in cesium beam tubes resulting from magnetic field reversals are discussed. An explanation of this effect is given, based on the mixing of m-states in the region between state selector magnet and interrogation region in conjunction with the distributed cavity phase shift.

401,351

PB85-108561 Not available NTIS
National Bureau of Standards, Washington, DC.
Separation Between Deterministic Response and Random Fluctuations by Means of the Cross-Power Spectrum in the Study of Electrochemical Noise.

Final rept.,
U. Bertocci. 1981, 4p
Pub. in Jnl. of Electrochemical Society 128, n3 p520-523 Mar 81.

Keywords: *Electrochemistry, *Random noise, *Spectrochemical analysis, Laboratories, Reprints, Numerical solution.

It is shown that by calculating the cross-power spectrum between the input (the electrode potential) and the output (the cell current) of an electrochemical system under potentiostatic conditions, it is possible to identify which part of the cell current is the response to the input voltage and which part is caused by random fluctuations of the parameters characterizing the electrode. The noise introduced by the amplifiers can be measured separately and then subtracted from the signal. As an example, the current noise of an aluminum electrode below and at the pitting potential is examined. Both electrode impedance and spectral power density of the random fluctuations are obtained. It is shown that below the pitting potential, random fluctuations are below the minimum detectable value of 10 to the -23th power sq A/cm sup 4 Hz.

401,352

PB85-110104 Not available NTIS
National Bureau of Standards, Washington, DC.

NBS (National Bureau of Standards) Personal Ambient Aerosol Sampler: Capabilities and Testing.

Final rept.,
R. A. Fletcher, and D. S. Bright. 1981, 9p
Pub. in Proceedings of the Tech. Program International Powder and Bulk Solids Handling and Processing, Rosemont, IL., May 12-14, 1981, p323-331.

Keywords: *Samplers, *Portable equipment, *Aerosols, Particles, Filtration, Wind tunnels, Performance evaluation, Dosimeters, Air pollution, Exposure, Concentration(Composition), Dry cells, Calibrating, Industrial hygiene, *Indoor air pollution.

A portable, light weight, battery powered aerosol sampler has been developed at NBS. The sampler can be used to measure human exposure to ambient aerosol concentrations. Ambient aerosols are size separated by the sampler into two fractions, 1.5-2.5 micrometers diameter and below 2.5 micrometers diameter by series stack filtration. The first filtration stage, a 8 micrometers pore Nuclepore filter, size cuts at approximately 2.5 micrometers diameter. The back up filter collects the remaining particles <2.5 micrometers diameter. The miniature pump, which is powered by dry cell batteries, gives the sampler a 6 L/min flow rate capability. Both filtration stages are weighable to a + or - 10 micrograms uncertainty and can be subsequently used for chemical analysis of the aerosol

sample. An impactor type inlet removes particles > 15 micrometers diameter and has been designed to minimize the effects of wind on sampling. Results of wind tunnel testing of the inlet will be discussed.

401,353

PB85-110203 Not available NTIS
National Bureau of Standards, Washington, DC.
Effects of Resistive Loading of TEM (Transverse Electromagnetic) Horns.

Final rept.,
M. Kanda. 1982, 11p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electromagnetic Compatibility 24, n2 p245-255 May 82.

Keywords: *Horn antennas, Transfer functions, Pulse analyzers, Reprints, Loading(Electronics), Fast fourier transforms, Picoseconds, Transverse electromagnetic waves.

For directional reception or transmission of picosecond pulses with minimal distortion, a short transverse electromagnetic (TEM) horn with continuously tapered resistive loading was developed, and found to be broadband and nondispersive with a low VSWR. The receiving transient response of the resistively loaded 'TEM' horn indicates that the shape of 70 ps impulse is well preserved. The theoretical analyses using the method of moments and the fast Fourier transform (FFT) technique were performed and agreed well with time domain measurements.

401,354

PB85-110393 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Mfg. Engineering.

Evaluation of Chain Saw Simulated Kickback Modes,

D. Robinson. Sep 83, 37p NBSIR-84/2823
Sponsored in part by Consumer Product Safety Commission, Bethesda, MD.

Keywords: *Saws, Hazards, Test equipment, Performance tests, Performance evaluation, Simulation, Safety, Tests.

For the past several years, the National Bureau of Standards (NBS) has supported the Consumer Product Safety Commission (CPSC) in the development of a performance standard to address the kickback hazard for chain saws. This process included participation of the Chain Saw Manufacturers Association (CSMA), CPSC, and NBS in the development of kickback testing equipment and procedures and the study of operator/saw interactions during simulated kickback trials. The present report describes an evaluation of the CSMA and CPSC procedures for simulating 'Classical' or rotational kickback motion based primarily on analyses of high-speed films of kickback trials, the development of test procedures for simulating 'pinch' or linear kickback motion, and the simulation of kickbacks for the actuation of chain brake systems for chain saws. Included in the report is a discussion of important kickback test parameters such as mechanical energy, saw inertia, handle spacing and the interrelationships among the various parameters.

401,355

PB85-110427 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.
Building Equipment Div.

Test Methods for the Direct Measurement of Stack Energy Loss during the Off-Period of Space Heating Equipment,

E. Kweller, and R. A. Wise. Sep 84, 66p NBSIR-84/2869
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Space heating, Gas heating, Tests, Energy dissipation, Flues, Thermal measurements, Thermal efficiency, Heat loss, Simulation.

Evaluations have been made of a possible alternative to the tracer gas test method now being used to measure off-period energy loss of space heating equipment with vent dampers. This alternative method offers the potential of a direct measurement method without the need for expensive tracer gas type instrumentation. The method uses a controlled flow of gas to a small gas fueled burner to simulate normal flue or stack temperatures previously measured during a cool-down test. Energy metered through the gas burner during the simulation gives a direct measurement of the thermal

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energy losses out of the stack. Results in comparison with the tracer gas method of test were lower for off-period energy loss measurements. A trend to better agreement between the two methods was noticeable for test furnaces with greater fuel input rates. Further development testing and evaluation will be required before the simulation can be considered as an acceptable alternative test method.

401,356
PB85-111847 Not available NTIS
National Bureau of Standards, Washington, DC.
NBS (National Bureau of Standards) 45 Deg/
Normal Reflectometer for Absolute Reflectance
Factors.
Final rept.,
J. J. Hsia, and V. R. Weidner. 1981, 6p
Pub. in Metrologia 17, n3 p97-102 Oct 81.

Keywords: *Reflectometers, *Reflectance, *Calibrating, Spectrophotometers, Measurement, Reprints, Polarized light.

A 45 deg/normal reflectometer has been constructed and tested for calibrating the absolute reflectance factor of diffuse samples over the 380-770 nm spectral range using polarized radiation. The measurement equations have been derived for the method used. The method using a step-down technique and view factor calls for the measurements of the ratio of two fluxes and, in addition, some linear dimensions. The uniformity of the receiver system is achieved by means of a double-sphere signal averager. Uncertainties of the absolute-reflectance-factor measurements obtained with this system are estimated to be \pm or $-$ 0.3% of the measured value. For all the samples that have been tested, the 45 deg/normal reflectance factor was found to be higher than the 6 deg/hemispherical reflectance factor. The higher reflectance values for 45 deg/normal geometry were confirmed by additional gonireflectometer measurements.

401,357
PB85-111862 Not available NTIS
National Bureau of Standards, Washington, DC.
Quantitative Sub-Micrometer Linewidth Determination using Electron Microscopy.
Final rept.,
S. Jensen, G. Hembree, J. Marchiando, and D. Swyt. 1981, 9p
Pub. in SPIE International Society of Optical Engineers 275, p100-108 1981.

Keywords: *Line width, *Semiconductor devices, Electron microscopy, Monte Carlo method, Automation, Minicomputers, Measurement, Reprints, *Photomasks, Scanning electron microscopy, Computer applications, Laser interferometry.

Quantitative determination of sub-micrometer linewidths in semiconductor devices and masks is demonstrated using an approach employing complementary experimental measurements and theoretical modeling. Experimental measurements are performed using the Microlength Calibrating Electron Probe (MCEP), a new facility at the National Bureau of Standards consisting of a scanning electron microscope modified to incorporate a scanning stage and laser-interferometer position measurement system. Automated data acquisition and analysis for the MCEP are achieved through interfacing to a laboratory minicomputer. Theoretical modeling based on Monte Carlo calculations provides a basis for selection of the threshold level in the experimentally measured backscatter electron intensity profile which corresponds to the actual material line edge. A measurement on a photomask is shown which illustrates the utility of the MCEP facility and the Monte Carlo modeling calculations for accurate measurement of sub-micrometer linewidths.

401,358
PB85-112985 PC A04/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Metrology for Electromagnetic Technology: A Bibliography of NBS (National Bureau of Standards) Publications,
R. A. Kamper, and K. E. Kline. Jul 84, 66p NBSIR-84/3014
See also PB83-111658.

Keywords: *Metrology, *Bibliographies, Microwaves, Fiber optics, Lasers, Electromagnetic radiation, Superconductors, Waveforms, Superconductivity, Cryogenics, Magnetic materials, Josephson junctions, Time domain, National Bureau of Standards.

This bibliography lists the publications of the personnel of the Electromagnetic Technology Division of NBS in the period from January 1970 through December 1983. A few earlier references that are directly related to the present work of the Division are included.

401,359
PB85-114932
(Order as PB85-114700, PC E07/MF E01)
Standard Telecommunication Labs. Ltd., Harlow (England).
Accurate Determination of Optical Fibre Length from Measurements in the Frequency Domain,
D. L. Walters. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p103-106 1984.

Keywords: *Fiber optics, *Dimensional measurement, *Strains, Length, *Optical fibers.

The precise measurement of the length of an optical fiber at various stages of processing, cabling, handling and installation yields important information which can be used to help to predict the long-term mechanical and optical performance of the finished cable. The large-scale routine manufacturing of a wide variety of optical cables which is not taking place made desirable the development of equipment which could be used regularly to evaluate fiber strain in factory and laboratory environments, and in the field. This paper describes the operation and application of such a measurement system.

401,360
PB85-114940
(Order as PB85-114700, PC E07/MF E01)
Helsinki Univ. of Technology, Espoo (Finland).
Elimination of the Influence of Q-Switched-Mode-Locked Laser Jitter in Sampled Time-Domain Measurements,
E. J. R. Hubach, A. B. Sharma, and S. J. Halme. Oct 84, 4p
Prepared in cooperation with Tampere Univ. of Technology (Finland). Lab. of Electronics.
Included in Technical Digest - Symposium on Optical Fiber Measurements, p107-110 1984.

Keywords: *Fiber optics, Crystal oscillators, Vibration, *Optical fibers, Mode locked lasers, YAG lasers.

In this paper, the authors draw attention to the influence of the sub-harmonic content of crystal oscillators upon the jitter performance of an important source for fiber measurements. It is shown that the effect is predominantly systematic and can be easily eliminated by judicious choice of the division ratio between mode-lock and Q-switch frequencies. The validity of the arguments is apparent from the jitter value of 5 ps RMS in their system, in contrast to their previous effective value of 100 ps.

401,361
PB85-115004
(Order as PB85-114700, PC E07/MF E01)
Valtec, West Boylston, MA.
Field Dispersion Measurements - A Swept Frequency Technique,
R. Rao. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p135-138 1984.

Keywords: *Fiber optics, *Optical dispersion, *Field tests, Near infrared radiation, Optical measurement, Optical communication, *Fiber optics transmission lines, *Optical fibers.

As transmission rates increase and WDM systems become operational, it is likely that the dispersion characteristics of long spans of single mode cable will have to be checked after installation. This will require dispersion measurement equipment capable of making field measurements. Dispersion in single mode fibers is caused by the material and waveguide properties of the fiber. For long lengths of fiber, it can be determined from measuring the relative group delay through the fiber as a function of wavelength. Present laboratory techniques for doing this measurement are unsuitable for field use due to their complexity and equipment size. In this paper a swept frequency measurement system is described where group delay is determined from frequency domain data. This system has been developed specifically for field use and uses typical multimode frequency domain bandwidth test equipment.

401,362
PB85-115442
(Order as PB85-115426, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Iterative Calibration Curve Procedure,
C. H. Spiegelman. 13 Mar 84, 6p
Also available from Supt. of Docs as SN003-003-72086-1.
Included in Jnl. of Research of the National Bureau of Standards, v89 n2 p187-192 Mar-Apr 84.

Keywords: *Calibrating, Curve fitting, Iteration, Measurement.

Calibration curves are an important part of many measurement processes. The user of a fitted calibrating curve must know its precision and accuracy. These are determined in a timely fashion using the data iteratively. This paper gives a method that divides the data into training and test groups. The test group is iteratively checked to see that a prechosen nominal confidence interval probability of coverage is met. If on the basis of this check the calibration experiment is completed, the nominal probability level is shown to still be valid.

401,363
PB85-115459
(Order as PB85-115426, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Determination of the Viscoelastic Shear Modulus Using Forced Torsional Vibrations,
E. B. Magrab. 12 Dec 83, 15p
Also available from Supt. of Docs as SN003-003-72086-1.
Included in Jnl. of Research of the National Bureau of Standards, v89 n2 p193-207 Mar-Apr 84.

Keywords: *Shear modulus, Vibration, Viscoelasticity, Torsion.

A forced torsional vibration system has been developed to measure the shear storage and loss moduli on right circular cylindrical specimens whose diameter can vary from 2 to 9 cm and whose length can vary from 2 to 15 cm. The method and apparatus are usable over a frequency range of 80 to 550 Hz and a temperature range of 20C to 80C.

401,364
PB85-115467
(Order as PB85-115426, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Ultrasonic Absolute Power Transfer Standard,
S. E. Fick, F. R. Breckenridge, C. E. Tschiegg, and D. G. Eitzen. 6 Jan 84, 4p
Also available from Supt. of Docs as SN003-003-72086-1.
Included in Jnl. of Research of the National Bureau of Standards, v89 n2 p209-312 Mar-Apr 84.

Keywords: *Standards, Power, Transferring, Ultrasonic radiation, Transducers.

In response to increased interest in the use of calibrated sources of ultrasonic energy, we have developed a system comprising components grouped to facilitate the accurate transfer of calibration. Electronic circuitry supplied with and built into each ultrasonic transducer obviates both the use of not-readily-available radio-frequency equipment and the measurement of anything more exotic than dc voltage. Prototype transducers have shown good output at frequencies up to 78 MHz. Units now available to the public can be calibrated at output powers ranging from 5 mW to 500 mW at frequencies between 1 and 20 MHz.

401,365
PB85-115673 Not available NTIS
National Bureau of Standards, Washington, DC.
Inverse-Fourth Apparatus for Photometric Calibrations.
Final rept.,
D. A. Swyt, and J. G. LaRock. 1978, 7p
Pub. in Review of Scientific Instruments 49, n8 p1083-1089 Aug 78.

Keywords: *Photometry, *Calibrating, Photometers, Performance, Optical measurement, Light transmission, Reprints.

A new photometric device is described which can perform direct, as opposed to comparison, measurements of optical transmittance, without bootstrapping, over a

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range of nearly six orders of magnitude. Operated with a 1000 W tungsten-halogen lamp as a source, a photomultiplier as a detector, and either an integrating sphere or opal glass for diffuse collection at the detection plane, the system is designed to attain an overall accuracy of + or - 0.5% for ANSI PH2.19 diffuse transmission densities up to 6.0 density units, corresponding to + or - 0.1% for transmittances above 0.5000 transmittance units and to + or - 3% for transmittances between 0.00001 and 0.0001 transmittance units.

401,366
PB85-115681 Not available NTIS
National Bureau of Standards, Washington, DC.
Dimensional Metrology at the National Bureau of Standards.

Final rept.,
R. J. Hocken, and P. Nanzetta. 1983, 8p
Pub. in *Physics Teacher*, v21 n8 p506-513 1983.

Keywords: *Dimensional measurement, *Metrology, Liquefied natural gas, Ships, Tanks(Containers), Polarimetry, Sugars, Reprints, Three dimensional.

This paper describes three current projects of The Dimensional Metrology Group at NBS in a simplified manner suitable for students of Physics and Engineering. Projects in LNG tank measurements on ships, 3-Dimensional Metrology, and polarimetry are described.

401,367
PB85-115764 Not available NTIS
National Bureau of Standards, Washington, DC.
Relief-Exposure Characteristics of Radiographs-In-Relief.

Final rept.,
S. Mardix, M. Keene, D. A. Swyt, and E. C. Teague.
1978, 3p
Pub. in *Jnl. of Applied Physics*, v49 n2 p498-500 Feb 78.

Keywords: *Radiography, Radiographic film, Exposure, Images, Reprints.

Highly exposed radiographs are utilized in microradiography in order to increase the signal to noise ratio. Relief radiography enables the evaluation of these microradiographs. Relief-exposure characteristics are shown to follow relationship of the type $R = R_{sub m}(1 - \exp(-E/E_{sub m}))$ where R is the relief height, E the exposure, $R_{sub m}$ and $E_{sub m}$ are constants. The density of developed silver in Ilford L-4 nuclear emulsion if found from the value of $R_{sub m}$ to be 2.86. The constant $E_{sub m}$ is shown to give the exposure for maximum contrast. The experimental results are discussed and compared to those found in the literature.

401,368
PB85-118370 Not available NTIS
National Bureau of Standards, Washington, DC.
Fabrication, Testing, and Evaluation of Prototype Fluidic Capillary Pyrometer Systems.

Final rept.,
T. Negas, H. S. Parker, R. M. Phillippi, T. M. Drzewiecki, and L. P. Domingues. 1981, 9p
Pub. in *Jnl. of Dynamic Systems, Measurement, and Control Transactions ASME* 103, n4 p308-316, 4 Dec 81.

Keywords: *Temperature measuring instruments, Sensor characteristics, Detectors, Probes, High temperature tests, Design, Evaluation, Fabrication, Field tests, Refractory materials, Reprints, *Pyrometers.

Prototype fluidic capillary pyrometers (FCP) were designed and fabricated to measure elevated temperatures for several field applications. The device utilizes a viscosity and, hence, temperature-sensitive fluid resistor or capillary tube as the sensing probe combined with a simple fluid resistor bridge. Small pressure changes due to temperature are then amplified to a usable level with fluidic laminar amplifier circuitry. Monolithic FCP sensors for low thermal stress applications were constructed from several refractory oxides. Other sensors, for high thermal shock duty, were constructed from molybdenum protected with ceramic oxide coatings. This demonstrated that fabrication is feasible and permitted the evaluation of performance at elevated temperature. Two monolithic sensors were installed at the Scranton Army Ammo Plant and have, to date, successfully operated for over 5,000 hours. A coated molybdenum sensor was tested in various environments which included rapid immersion in an inductively heated molten gray iron bath. This sensor accumulated over 48 hours at temperatures up to 1550C and

made measurements for six hours in the molten iron. Materials and design options for high temperature probes are outlined and pertinent fluidic circuitry is detailed.

401,369
PB85-119345 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Thermal Performance Testing of Passive Solar Components in the NBS (National Bureau of Standards) Calorimeter.
M. E. McCabe, C. E. Hancock, and M. Van Migom.
Aug 84, 71p NBSIR-84/2920
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Calorimeters, *Thermal measurements, Tests, Components, Performance, Windows, Solar energy, Test facilities, Walls, Passive solar heating systems, Passive solar cooling systems, Solar collectors, Shutters.

Studies of the thermal performance of passive solar buildings have indicated a need for precise measurement of solar heat gain and thermal heat loss or gain for modular passive/hybrid solar components in the outdoor environment. A description of the design, calibration, and initial operational results for a new calorimetric test facility designed to perform these measurements is presented in this report. The test facility is located at the National Bureau of Standards in Gaithersburg, MD, and it is anticipated that it will provide a substantial improvement in the measuring techniques for passive and hybrid solar components over the field test cells currently in use. Thermal performance data were taken for four passive solar test articles during the winter of 1982-1983, including two windows and two collector storage walls. Test results are correlated as U-values and Shading Coefficients for the two windows.

401,370
PB85-120590 Not available NTIS
National Bureau of Standards, Washington, DC.
Metrology.
Final rept.,
J. A. Simpson. 1981, 2p
Pub. in *Encycl. Phys.*, p596-597 1981.

Keywords: *Metrology, Quality control, Measurement, Weight(Mass), Standards, Reprints, Weights and measures.

Metrology is defined as the science of measurement and thus would cover the bulk of experimental physics. The term is usually used in a more restricted sense as that portion of measurement science used in the service of dissemination of the SI units, to provide support for the legal system of weights and measures enforcement, or as an adjunct to quality control in manufacturing.

401,371
PB85-120608 Not available NTIS
National Bureau of Standards, Washington, DC.
Calibration of an EDXRF Spectrometer.
Final rept.,
A. R. Stiles, T. G. Dzubay, R. M. Baum, R. L. Walter, and R. D. Willis. 1976, 14p
Pub. in *Advances in X-Ray Analysis* 19, p473-486 1976.

Keywords: *Calibrating, *Standards, *Spectrometers, Laboratory equipment, X ray analysis, Mass spectroscopy, Performance evaluation, Chemical analysis, Reprints, Isotope dilution techniques, Proton induced x ray emission analysis.

The purpose of this work was to develop accurate calibration standards which were fully characterized in terms of uniformity and concentration using fundamental measuring methods. Three similar sets of vacuum deposits were commercially made, each set containing the deposits (Cu)S, KCl, Ca(F2), Cr, Fe, Cu, Rb(NO3), Sr(F2), Mo(O3), Ba(F2), and Pb. Thickness variations in each deposit were measured with PIXEA (proton induced x-ray excitation analysis) measurements taken at 6 to 8 positions along the foil diameters. Relative elemental concentrations on corresponding foils from each set were measured using multiple XRF intercomparisons. One set of deposits was destructively analyzed at the National Bureau of Standards with thermal ionization isotope dilution mass spectrometry. Elements of interest heavier than sulfur were linked to the twelve calibrated elements

using solution deposited ratio standards. Attenuation corrections for the light elements and a smooth calibration curve were calculated. Error estimates were obtained for the calibrated spectrometer based on system error determinations and uncertainties in the calibration standards and procedures.

401,372
PB85-120855 Not available NTIS
National Bureau of Standards, Washington, DC.
Realization of the Ampere at NBS (National Bureau of Standards).
Final rept.,
P. T. Olsen, M. E. Cage, W. D. Phillips, and E. R. Williams. 1980, 4p
Pub. in *Jnl. of IEEE Transactions on Instrumentation and Measurement* 29, n4 p234-237 Dec 80.

Keywords: *Electric current, *Electrical measurement, Dynamometers, Reprints, *Ampere, Superconducting coils, Balances, Laser interferometry.

The authors present a method for the realization of the ampere, based on Faraday's induction law and using a modification of the classic Pellat balance. A preliminary apparatus has been constructed, and initial measurements have been obtained. This balance is also compared with a balance similar to one proposed earlier.

401,373
PB85-121192 PC A04/MF A01
National Bureau of Standards, Gaithersburg, MD.
National Bureau of Standards.
Jul 84, 53p NBS/SP-679
Also available from Supt. of Docs as SN003-003-02618-2. Library of Congress catalog card no. 84-601089.

Keywords: *Research projects, *Laboratories, *Test facilities, Chemistry, Tests, Laboratory equipment, Standards, National government, Industries, Physics, *National Bureau of Standards.

When the Bureau was established more than 80 years ago, it was given the specific mission of aiding manufacturing, commerce, government, and academia. Today, NBS remains the only federal laboratory with the explicit goal of serving U.S. industry and science. This mission takes on special significance now as the country responds to serious challenges to its industry and manufacturing--challenges which call for industry, universities, and government to pool their resources in research and development. The U.S. Department of Commerce has made industrial competitiveness a cornerstone of its programs. As a Commerce Department agency, NBS provides the measurement foundation that our changing industrial economy needs, and thus is well-positioned to help the nation meet these challenges. This brochure describes some of the cooperative programs the Bureau has underway as well as other work it is doing to improve the nation's measurement capabilities.

401,374
PB85-121200 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
Facilities of the National Bureau of Standards.
Sep 84, 33p NBS/SP-682
Also available from Supt. of Docs as SN003-003-02617-4. Library of Congress catalog card no. 84-601093.

Keywords: *Research projects, *Laboratories, *Test facilities, Chemistry, Tests, Laboratory equipment, Standards, National government, Industries, Physics, *National Bureau of Standards.

Every laboratory in this country is a valuable national resource. Along with the people who work in these facilities, U.S. laboratories constitute the basic foundation of this country's scientific and industrial strength. As the nation's foremost science and engineering measurement laboratory, the National Bureau of Standards has some of the premier research and testing facilities in the United States, and several of our laboratories are unequaled anywhere in the world. This brochure highlights only a small number of the special facilities available at NBS and provides information about their availability for collaborative or independent research and testing. Individuals or organizations wishing to use a facility should contact the facility manager listed in each write-up. NBS has designed its system for reviewing such requests to be as efficient and responsive as possible, to encourage maximum use and

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minimal paperwork on the part of both NBS and the prospective user.

401,375
PB85-121424 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Primer for Mass Metrology.

Final rept.,
K. B. Jaeger, and R. S. Davis. Nov 84, 90p NBS/SP-700-1

Also available from Supt. of Docs as SNOO3-003-02621-2. Library of Congress catalog card no. 84-601090. Prepared in cooperation with Lockheed Missiles and Space Co., Inc., Sunnyvale, CA.

Keywords: *Metrology, *Mass, *Calibrating, Buoyancy, Air, Correction.

This paper attempts to fill the need for a coherent guide to the many publications which document the NBS program in mass metrology. The topics the authors emphasize are generally those which experience has shown to present the greatest difficulties for metrologists new to the field of mass measurements. Thus the authors have included many worked examples and have retained steps often omitted in more scholarly treatments of the same subjects. A full bibliography is included so that the reader may also consult the primary sources of this work.

401,376
PB85-123370 Not available NTIS
National Bureau of Standards, Washington, DC.

Ultrasonic Reflectivity Tomography: Reconstruction with Circular Transducer Arrays.

Final rept.,
S. J. Norton, and M. Linzer. 1979, 31p
Pub. in Ultrason. Imag. 1, n2 p154-184 1979.

Keywords: *Ultrasonic tests, Scattering, Reflectivity, Reprints, *Tomography, Image processing, Computer applications.

An analysis is presented of backprojection methods for reconstructing cross-sectional images of ultrasonic reflectivity from scattering measurements. A circular array of transducer elements is considered, using three basic modes of data acquisition and image reconstruction: (1) the same element serves as transmitter and receiver and data is backprojected along circular paths centered at the element; (2) distinct transmitter and receiver with fixed separation and backprojection along elliptical paths with the elements at the foci; and (3) distinct transmitter and receiver with varying separations and backprojection along corresponding elliptical paths.

401,377
PB85-124238 Not available NTIS
National Bureau of Standards, Washington, DC.

Analysis of Ultracentrifugation Interference Patterns with Image Digitizer: Application to Molecular Weight Determination of SRM 1478 Polystyrene.

Final rept.,
F. W. Wang, and F. L. McCrackin. Dec 83, 6p
Pub. in Polymer 24, p1541-1546 Dec 83.

Keywords: *Molecular weight, *Polystyrene, *Analog to digital converters, Standards, Reprints, *Standard reference materials, *Ultracentrifugation.

A new method for the analysis of ultracentrifugation interference patterns with the use of a commercial image digitizer is given. The application of the method to the sedimentation equilibrium data for SRM 1478 Polystyrene leads to a weight-average molecular weight of 37,400 g/mol having a sample standard deviation of 0.7% and an expected systematic error limit of 2%.

401,378
PB85-124246 Not available NTIS
National Bureau of Standards, Washington, DC.

Method to Determine the Pressure Dependent Distortion of a Simple Piston Gage Based on Dimensional Metrology.

Final rept.,
B. E. Welch, and V. E. Bean. 1984, 4p
Pub. in Proceedings of AIRAPT Interactive High Pressure Conference (9th), Albany, NY., July 24-29, 1984, pt 2, p261-264.

Keywords: Pressure gages, Pressure measurement, Distortion, *Piston gages.

Elastic distortion of the piston and cylinder is the leading cause of inaccuracy in piston gages at higher pressures. The distortion depends upon pressure profile between the piston and the cylinder. One possible method of determining the pressure profile is demonstrated.

401,379
PB85-124279 Not available NTIS
National Bureau of Standards, Washington, DC.
Pressure Dependence of Viscosity of Pressure Transmitting Fluids.

Final rept.,
V. E. Bean, S. D. Wood, and R. J. Lazos. 1984, 4p
Pub. in Proceedings of AIRAPT Interactive High Pressure Conference (9th), July 24-29, 1983, pt. 2, p289-292 1984.

Keywords: *Viscosity, *High pressure tests, *Transmission fluids, *Viscometers.

A rolling-ball viscometer has been constructed and the viscosities of 19 candidate pressure transmitting fluids have been measured as a function of pressure up to 700 MPa at room temperature.

401,380
PB85-124303 Not available NTIS
National Bureau of Standards, Washington, DC.
Effects of Viscosity, Temperature, and Rate of Rotation on the Operation of a Controlled-Clearance Piston Gauge.

Final rept.,
J. K. N. Sharma, K. K. Jain, V. E. Bean, B. E. Welch, and R. J. Lazos. 1984, 4p
Pub. in Proceedings of AIRAPT Interactive High Pressure Conference (9th), Albany, NY., July 24-29, 1983, pt. 2, p265-268 1984.

Keywords: Pressure gages, Pressure measurement, Viscosity, *Piston gages.

The calculation of the pressure generated by a controlled-clearance piston gauge depends upon the jacket pressure corresponding to zero clearance between the piston and cylinder, $P_{sub z}$. The dependence of $P_{sub z}$ on the viscosity of the pressure transmitting fluid, the temperature, and the rate of piston rotation have been measured. The value of $P_{sub z}$ is nearly independent of viscosity below 60 cp. Above 60 cp, $P_{sub z}$ depends strongly upon viscosity. Variations of $P_{sub z}$ with temperature and rate of rotation are more severe at higher viscosities. These results are a clear indication, that for the most accurate pressure measurements, a controlled-clearance piston gauge must be characterized using the same operational and environmental conditions with the same fluid as are used in normal operation.

401,381
PB85-124402 Not available NTIS
National Bureau of Standards, Washington, DC.

Certified Reference Materials for Thermophysical Properties.

Final rept.,
R. K. Kirby. 1984, 5p
Pub. in Compendium on Thermophysical Properties Measurement Methods (Chapter 20), p771-775 1984.

Keywords: *Thermophysical properties, *Laboratory equipment, *Standards, Calibrating, Thermal conductivity, Electrical resistivity, Specific heat, Melting points, Freezing, Thermal expansion, Reprints, *Certified reference materials.

Reference materials for use in calibrating either the temperature scale of equipment or a physical property measured by the equipment as a function of temperature are available from certifying agencies in at least 5 countries. These reference materials are certified for properties that include thermal conductivity, electrical resistivity, heat capacity, thermal expansion, and freezing and melting points.

401,382
PB85-127421 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.

Public Information Div.
NBS (National Bureau of Standards) Research Reports.

Special pub.
Oct 84, 32p NBS/SP-680/1
Library of Congress catalog card no. 84-601124.

Keywords: *Research projects, Communications, Automation, Computers, Industries, Mapping, *National Bureau of Standards.

Contents:

Focus on cooperation and communication:
an introduction;
Research update;
Standard interfaces key to factory automation;
Standard data formats:
transferring part designs between systems;
How to secure your computer systems;
Cold circuits next step in electronics revolution;
New particles for measuring pigments, flour, blood cells;
Measurement methods for a new industry:
industrial radiation;
Compositional mapping:
NBS researchers take a glimpse into the atomic world;
Tools of the NBS compositional mapping program;
New publications;
Conference calendar.

401,383
PB85-127827 PC A02/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Magnetic Measurements, Calibrations, and Standards: Report on a Survey,
F. R. Fickett. Oct 84, 25p NBSIR-84/3018

Keywords: *Standards, *Calibration, *Industries, *Magnetic measurement, Surveys, *Standard reference materials.

The report summarizes the analysis of responses to a survey of industrial needs for magnetic services and research.

401,384
PB85-128122 PC A04/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Generalized Method for the Calibration of Four-Terminal-Pair Type Digital Impedance Meters.

Rept. for 19 Apr-30 Sep 83,
R. M. Judish, and R. N. Jones. Aug 84, 60p NBSIR-84/3016
Sponsored in part by Sandia National Labs., Albuquerque, NM.

Keywords: *Electrical impedance meters, *Calibrating, Digital systems, Measurement.

The paper describes a calibration procedure having such a background and illustrates its use. The calibration is accomplished through the use of impedance standards which relate instrument readings to the values of the standards through a known functional relationship. The calibration procedure described estimates the parameters associated with the functional relationship and requires the use of a computer. Calibration is accomplished at the reference plane of the impedance standards and any adapter required to connect the standards to the instrument is assumed to be an integral part of the impedance meter.

401,385
PB85-128841 Not available NTIS
National Bureau of Standards, Washington, DC.

Interlaboratory Comparisons of Quantitative Analyses of Individual Compounds in Simple and Complex Mixtures.

Final rept.,
W. E. May, J. M. Brown-Thomas, S. N. Chesler, F. R. Guenther, and L. R. Hilpert. 1983, 21p
Pub. in Advanced Techniques in Synthetic Fuels Analysis, p381-401 1983.

Keywords: *Chemical analysis, *Laboratories, *Trace elements, Aromatic polycyclic hydrocarbons, Phenols, Nitrogen heterocyclic compounds, Fuels, Comparison, Organic compounds, Assessments, Standards, Amines, Reprints, *Alternate fuels, *Standard reference materials, State of the art.

In recent years, the Organic Analytical Research Division of the National Bureau of Standards (NBS) has been involved in a number of interlaboratory collaborative studies whose purpose was to assess the accuracy of data obtained from trace organic analytical methodologies. The first of these studies revealed the existence of large biases among laboratories involved in the measurement of polynuclear aromatic hydrocarbons (PAH), phenols, amino PAH, and N-heterocyclic compounds in environmental samples. In this paper we summarize the data obtained from a number of col-

laborative analytical studies conducted between 1975 and 1980, discuss the development and certification of a trace organic SRM, and reveal through reference to several recent publications, advances in the state of the art for trace organic analysis that can be at least in part attributed to the NBS/DOE analytical characterization program.

401,386

PB85-128924 Not available NTIS
National Bureau of Standards, Washington, DC.
Second Joint Test of an U.S. Electrode System in the U.S.S.R. U-02 Facility.
Final rept.,
G. Rudins, S. J. Schneider, T. Negas, B. R. Rossing, and J. L. Bates. 1977, 13p
Pub. in Proceedings of a Symposium on Engineering Aspects of Magnetohydrodyn (16th), Pittsburgh, PA, May 16-18, 1977, pIV.1-IV.1.12.

Keywords: *Electrodes, *Materials tests, Tests, Magnetohydrodynamics, Cesium oxides, Zirconium oxides, Thermal analysis, Chemical reactions, Phase changes, Lanthanum chromates.

The second (Phase II) joint U.S.-U.S.S.R. test of U.S. electrode materials was carried out in Moscow between September 21 and September 27, 1976 in the Soviet U-02 MHD Facility. The test procedure followed closely a predetermined work plan designed to test five different electrode materials, different lead-out and attachments, and the cathode and anode electrode walls under MHD operation conditions. Extensive pre- and post-test materials characterizations were made to determine the effect of the MHD environment on the electrodes and insulators. Measurements included: thermal diffusivity, thermal expansion, chemical composition, microstructure, electrical conductivity, phase composition, closed and open porosity, pore size distribution and radiography. Results indicated that there was extensive attack by the seed on the cathode wall resulting in chemical reactions and phase changes of the electrode materials.

401,387

PB85-129286 Not available NTIS
National Bureau of Standards, Washington, DC.
Liquid Nitrogen Cooled Microwave Noise Standard.
Final rept.,
C. L. Trembath, W. J. Foote, and D. F. Wait. 1971, 2p
Pub. in Review of Scientific Instruments 42, n8 p1261-1262 Aug 71.

Keywords: *Microwaves, *Standards, Cryogenics, Reports, *Noise standards.

A liquid-nitrogen-cooled reference noise standard in WR-51 waveguide size is described. At 20 GHz, the output noise temperature available at the useable waveguide flange is 4.1 kelvins above the boiling point of liquid nitrogen and is known to be plus or minus 0.4 kelvins. The VSWR over the frequency range 17-22 GHz is less than 1:05:1.

401,388

PB85-129617
(Order as PB85-129591, PC A03/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Stability of Small Industrial Platinum Resistance Thermometers,
B. W. Mangum. 10 Apr 84, 12p
Included in Jnl. of Research of the National Bureau of Standards, v89 n4 p305-316 Jul-Aug 84.

Keywords: *Resistance thermometers, Platinum, Stability.

The paper reports the results of an investigation of the stability of a selection of small industrial platinum resistance thermometers (IPRTs) upon heat treatment and handling. Ninety-four IPRTs, of several models, obtained from five manufacturers were studied. Most of the IPRTs exhibited calibration drifts and also effects due to the presence of moisture or strain. There was no apparent improvement in the stability if the resistance ratio, $R(t)/R_0 = W(t)$, instead of resistance were used as the criterion. Comparisons are made of the relative stability of the products of the five companies.

401,389

PB85-130078 PC A99/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
Precision Measurement and Fundamental Constants II,
B. N. Taylor, and W. D. Phillips. 1984, 651p NBS/SP-617, LCCCN-84-601083
See also PB85-130086 through PB85-131381. Library of Congress catalog card no. 84-601083. Proceedings of International Conference (2nd) held at the National Bureau of Standards, Gaithersburg, MD., June 8-12, 1981.

Keywords: *Fundamental constants, *Meetings, Standards, Relativity, Frequency standards, Atomic clocks, Quantum electrodynamics, Electric potential, Electrical resistance, Electric current, Magnetic measurement, Gravitational constant, Light speed, Fine structure constant, Ampere, Ohm, Volt, Quantum Hall effect.

No abstract available.

401,390

PB85-130094
(Order as PB85-130078, PC A99/MF A01)
Frequency and Time Systems, Inc., Beverly, MA.
Frequency, Wavelength, and Stored Ions: Frequency Standards Based on Magnetic Hyperfine Structure Resonances,
H. Hellwig. 1984, 9p
Included in Precision Measurement and Fundamental Constants II, p11-19 1984.

Keywords: *Atomic clocks, *Frequency standards, *Hyperfine structure, Cesium frequency standards, Rubidium frequency standards, Hydrogen masers.

Practical frequency standards and clocks use magnetic hyperfine transitions in cesium, rubidium, and hydrogen, and the unit of time is defined--as well as practically realized--via the cesium resonance. This paper explores the basis for this phenomenon which is a result of a combination of mature electronics and physics technologies with proven principles of experimental physics such as beam spectroscopy and optical pumping. This paper will also address the limitations of these 'traditional' or 'microwave' frequency standards as well as opportunities still open for further improvements. These limitations and opportunities center around the desirability to achieve a spectrally narrow line; i.e., a high line-Q within the microwave region. Options to realize improved Q-values will be discussed.

401,391

PB85-130102
(Order as PB85-130078, PC A99/MF A01)
National Research Council of Canada, Ottawa (Ontario). Div. of Physics.
Performance of the Three NRC (National Research Council) 1-Meter CsVI Primary Clocks,
A. G. Mungall, H. Daams, and J. S. Boulanger. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p21-23 1984.

Keywords: *Atomic clocks, *Cesium frequency standards, *Frequency standards, Frequency stability, Performance, Impurities, Correction.

The performance of the three 1-m interaction length NRC primary cesium clocks, CsVIA, CsVIB, and CsVIC, is outlined for their initial year and a half of operation as primary clocks, which commenced in December, 1979. The potential long-term frequency stability appears to be a few parts in (10 to the 15th power).

401,392

PB85-130110
(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards, Boulder, CO. Time and Frequency Div.
Prospects for Cesium Primary Standards at the National Bureau of Standards,
L. L. Lewis, F. L. Walls, and D. A. Howe. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p25-27 1984.

Keywords: *Cesium frequency standards, *Atomic clocks, *Frequency standards, Optical pumping, Frequency stability, Accuracy.

An application of optical pumping, in conjunction with a number of design improvements, may permit the de-

velopment of a cesium primary standard with an accuracy an order of magnitude better than that of our present primary frequency standards, NBS-4 and NBS-6. Limitations to short-term stability, as well as possible errors in accuracy, are discussed.

401,393

PB85-130128
(Order as PB85-130078, PC A99/MF A01)
Paris-11 Univ., Orsay (France). Inst. d'Electronique Fondamentale.
Cesium Beam Atomic Clock with Laser Optical Pumping, as a Potential Frequency Standard,
M. Arditi. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p29-34 1984.

Keywords: *Atomic clocks, *Cesium frequency standards, *Frequency standards, Gallium arsenide lasers, Optical pumping, Atomic beams.

A passive microwave cesium beam resonator using optical pumping and optical detection, with a cw tunable GaAs diode laser, has been realized. The '0-0 clock transition' is detected through a change in the intensity of the fluorescence of the cesium beam. Experimental recordings of the Ramsey pattern agree with a Maxwellian distribution of atomic velocities. Results of preliminary tests, to an accuracy of a few parts in 10 to the 11th power, show good potential for a frequency standard of higher accuracy.

401,394

PB85-130136
(Order as PB85-130078, PC A99/MF A01)
National Research Council of Canada, Ottawa (Ontario).
Frequency Measurement of Optical Radiation,
K. M. Baird. 1984, 7p
Included in Precision Measurement and Fundamental Constants II, p35-41 1984.

Keywords: *Frequency measurement, Frequency standards, Microwave frequencies, Phase locked systems, Standards, Length, Feasibility, *Visible radiation, Laser radiation.

The feasibility of directly relating the frequency of visible radiation to microwave standards has been demonstrated and a number of frequency comparison systems linking infrared frequencies to the cesium primary standard have already been operated. These have yielded sufficient accuracy that together with wavelength measurement based on the (86)Kr line used to define the Meter, the standard of length can now be based without fear of a significant discontinuity, on a conventional value for the speed of light and the Cs standard for time. This paper reviews present and proposed frequency comparison chains and discusses their possibilities. Limitations for the general use of frequency comparison methods in the optical region are described.

401,395

PB85-130144
(Order as PB85-130078, PC A99/MF A01)
Joint Inst. for Lab. Astrophysics, Boulder, CO.
Optical Frequency Standards: Progress and Applications,
J. L. Hall. 1984, 2p
Included in Precision Measurement and Fundamental Constants II, p43-44 1984.

Keywords: *Frequency standards, Reviews, *Visible radiation, Tunable lasers, Color center lasers, Dye lasers, Laser applications.

To reach spectral transitions of particular physical interest (e.g., H) or of special promise as standards (e.g., Ca at 657 nm) in general will require use of a broadly tuneable laser, typically using color center crystals or a flowing dye solution as the active medium. Comparable stabilization results with such tuneable lasers--especially dye lasers--is vastly more difficult than with gas lasers, although kilohertz linewidth dye lasers have just been reported. A technique suggested by Dréver recently allowed achievement of sub-100 Hz dye laser linewidth.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,396

PB85-130185

(Order as PB85-130078, PC A99/MF A01)
National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
Laser Wavelength Measurements and Standards for the Determination of Length,
W. R. C. Rowley. 1984, 8p
Included in Precision Measurement and Fundamental Constants II, p57-64 1984.

Keywords: *Wavelengths, *Length, *Standards, Optical interferometers, Laser radiation.

The light emitted by portable stabilized lasers used as wavelength standards for length and spectroscopic measurements is reproducible to at least three parts in 10 to the 11th power, and different wavelengths can be intercompared to this level of uncertainty by interferometry. Their absolute wavelength accuracy, limited at present to four parts in 10 to the 9th power by the (86)Kr standard of the meter, will be improved at least tenfold by a redefinition of the meter, based on the fixed value 299 792 458 m/s for the speed of light. Length measurements, however, are seldom more accurate than one part in 10 to the 7th power, except in lunar and interplanetary ranging; although changes in length can be measured to better than one part in 10 to the 14th power.

401,397

PB85-130243

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards, Boulder, CO. Time and Frequency Div.
Spectroscopy of Stored Ions,
D. J. Wineland. 1984, 10p
Included in Precision Measurement and Fundamental Constants II, p83-92 1984.

Keywords: *Atomic spectroscopy, *Fundamental constants, Mass spectroscopy, *Ion traps, *Atomic ions, G factor.

The benign environment and long confinement times obtained with ion storage techniques have led to some unique experiments in the area of precision measurements and fundamental constants. This is perhaps epitomized by the single electron g factor measurements at the University of Washington in which a precision of 4 parts in 10 to the 11th power has been attained. Now, use of lasers to cool stored ions has allowed the experimentalist to approach the goal of unperturbed atomic ions nearly at rest; most recently, spectroscopy has been performed on single 'cold' trapped ions. Stored ion experiments in the area of precision measurements and fundamental constants will be briefly reviewed. These include experiments on $e(-)/e(+)$ g factors, mass spectroscopy, lifetimes, and atomic spectroscopy. The intent is to emphasize the unique environment provided by ion storage techniques for these measurements.

401,398

PB85-130250

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards, Boulder, CO. Time and Frequency Div.
Progress Toward a Stored Ion Frequency Standard at the National Bureau of Standards,
W. M. Itano, D. J. Wineland, J. C. Bergquist, and F. L. Walls. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p93-97 1984.

Keywords: *Frequency standards, Microwave frequencies, Hyperfine structure, Optical pumping, *Ion traps, Visible radiation, Magnesium 25, Mercury 201, Mercury 199, Double resonance methods.

Two fundamental problems with the development of a primary frequency standard based on stored ions have long been apparent—the second-order Doppler shift and the low signal-to-noise ratio. Both problems have been addressed in experiments at the National Bureau of Standards (NBS)—the first by the development of the laser cooling technique and the second by the development of laser-optical-pumping techniques with high detection efficiency. Also, a hyperfine transition in (26)Mg(+1) has been observed by rf-optical double resonance with a linewidth of 0.012 Hz and a Q of 2.4 X 10 to the 10th power. A possible microwave frequency and time standard based on a two-photon transition in (199)Hg(+1) or (201)Hg(+1) are described.

401,399

PB85-130284

(Order as PB85-130078, PC A99/MF A01)
Moscow State Univ. (USSR). Dept. of Physics.
Quantum Limits in the Measurements of e.m. Fields and Frequency,
V. B. Braginsky. 1984, 2p
Included in Precision Measurement and Fundamental Constants II, p109-110 1984.

Keywords: *Frequency measurement, *Quantum theory, Electromagnetic fields, Frequency stability, Limits.

No abstract available.

401,400

PB85-130649

(Order as PB85-130078, PC A99/MF A01)
National Science Foundation, Washington, DC. Div. of Physics.
Applications of X-ray Interferometry,
R. D. Deslattes. 1984, 9p
Included in Precision Measurement and Fundamental Constants II, p303-311 1984.

Keywords: *Fundamental constants, Optical interferometers, Density(Mass/volume), Gamma rays, Standards, Silicon, Crystal lattices, Reviews, *X ray interferometry, Avogadro constant, Uses.

This review begins by summarizing work at the PTB and NBS on optical interferometry of (220) repeat distances in samples of monocrystalline Si. Distribution of such an initial calibration to other samples and other species is briefly mentioned. The main emphasis is on subsequent applications of these crystals toward determination of fundamental constants, especially N(A) and extension of the congruent electromagnetic scale to gamma-rays as has so far been carried out at NBS. In the last mentioned case, applications emerge which include tests of QED in muonic atoms, determination of mass values for the pion and the kaon, and tests of relativistic self-consistent field calculations for inner vacancy states in atoms.

401,401

PB85-130789

(Order as PB85-130078, PC A99/MF A01)
Bureau International des Poids et Mesures, Sevres (France).
Assignment of Uncertainties to the Results of Experimental Measurements,
J. W. Mueller. 1984, 7p
Included in Precision Measurement and Fundamental Constants II, p375-381 1984.

Keywords: *Measurements, Experimental data, Variance(Statistics), Probability theory, Covariance, Errors, *Uncertainty.

After a brief review of some of the current ways of indicating in a quantitative manner the uncertainties which are associated with an experimental measurement, the main shortcomings of some of the usual practices are indicated. The present situation is unsatisfactory and results in frequent misinterpretations, rendering, for instance, a critical data evaluation a cumbersome task. BIPM recently organized a meeting of experts, chosen by the national standardizing laboratories, for discussion of the relevant problems. This resulted in the establishment of five recommendations concerning the statement of uncertainties which are included in an appendix.

401,402

PB85-130805

(Order as PB85-130078, PC A99/MF A01)
National Research Council of Canada, Ottawa (Ontario).
Measurement Assurance,
A. F. Dunn. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p385-389 1984.

Keywords: *Measurement, Standard deviation, Probability theory, Accuracy, *Uncertainty.

Measurement assurance involves combining intrinsic uncertainties of instruments and standards used in a measurement procedure with uncertainties associated with actual use of the instruments, in order to provide a meaningful statement of a total effective uncertainty of the measurement procedure.

401,403

PB85-130813

(Order as PB85-130078, PC A99/MF A01)
Rockwell International, Thousand Oaks, CA. Science Center.
Extended-Least-Squares Treatment of Discrepant Data,
E. R. Cohen. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p391-395 1984.

Keywords: *Measurement, *Least squares method, Experimental data, Variance(Statistics), Estimates.

In the usual least squares analysis, the weighting of the data is proportional to the inverse of the assigned variance. As this variance is itself the result of measurement, its value is uncertain. The observed residuals in the least squares adjustment provide a posteriori estimates of the variance. Linear, unbiased, minimum-variance estimators (LUMVE) are derived which provide a means for assigning weights to the experimental data. Using this estimator, data treatment algorithms can be formulated which are a significant improvement on the 'traditional' Birge-ratio procedures.

401,404

PB85-130870

(Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
Mass Unit 'Kilogram', Precision Measurement of Mass, Attainable Uncertainties, and Possibilities of a New Definition,
M. Kochsiek. 1984, 9p
Included in Precision Measurement and Fundamental Constants II, p427-435 1984.

Keywords: *Mass, Weight indicators, Standards, Reviews, Balances, Uncertainty, Kilograms.

In this review, the present state of the dissemination of the unit of mass scale (hierarchy of mass standards, multiples and submultiples), requirements for mass standards, important designs of weighing machines, and the predominant influencing parameters such as air density, in mass determination are discussed. Lately it has become possible to determine air density with smaller uncertainty by way of calculation and experiment. Possibilities are shown for a new definition on the basis of fundamental constants.

401,405

PB85-130888

(Order as PB85-130078, PC A99/MF A01)
Commonwealth Scientific and Industrial Research Organization, Lindfield (Australia). Div. of Applied Physics.
Measurement of Air Density for High Accuracy Mass Determination,
D. B. Prowse. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p437-439 1984.

Keywords: *Mass, *Atmospheric density, *Air, *Density(Mass/volume), Buoyancy, Measurement, Balances.

A description is given of the air density balance developed for the fundamental determination of the density of air. The method consists of measuring the apparent mass difference between a sphere and a ring of similar mass and large known difference in volume. The two-arm balance used has been modified to give a continuous electrical readout of the air density. The uncertainty (3 standard deviations) in air density given by the method is 3.5 X 10 to the -5th power km/mu cubed. Preliminary results indicate that the air density balance agrees with the values obtained by the equations developed to calculate air density to 2 parts in 10,000. Rapid fluctuations up to 1 in 10,000 of the air density are observed in an air-conditioned laboratory.

401,406
PB85-130896

(Order as PB85-130078, PC A99/MF A01)
National Research Lab. of Metrology, Sakura (Japan).
More Precise Correction for Buoyancy and Gas Adsorption in Mass Measurement,
Y. Kobayashi. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p441-443 1984.

Keywords: *Mass, *Buoyancy, *Standards, *Adsorption, Precision, Correction, Gases, Atmospheric density, Density(Mass/volume), Air, Kilogram.

Using Pt-Ir Kilogram Prototypes, mass standards made of other materials, for example stainless steel, are usually calibrated in the atmosphere. In this case, the precision is limited by various conditions of the measuring environment. In this study, the increased precision of the correction for buoyancy and the introduction of a correction for water vapor adsorption made it possible to decrease, by one order of magnitude, the errors caused by the measuring environment.

401,407
PB85-130904

(Order as PB85-130078, PC A99/MF A01)
Commonwealth Scientific and Industrial Research Organization, Lindfield (Australia). Div. of Applied Physics.
Density Standards - The Density and Thermal Dilatation of Water,
G. A. Bell, and J. B. Patterson. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p445-447 1984.

Keywords: *Density(Mass/volume), *Water, *Standards, Weight measurement, Mass, Spheres, Stretching, Dilatation.

A hydrostatic weighing experiment has been done to measure the density of water samples of differing isotopic composition from which values have been derived for the density of SMOW (standard mean ocean water). Measurements are also being made of the dilatation of water in the temperature range 0 to 40 degrees C.

401,408
PB85-130912

(Order as PB85-130078, PC A99/MF A01)
Istituto di Metrologia Gustavo Colonnetti, Turin (Italy).
Precision Measurements on Solid Artifacts for a Redetermination of the Density of Water,
A. Peuto, A. Sacconi, R. Panciera, W. Pasin, and M. Rasetti. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p449-452 1984.

Keywords: *Density(Mass/volume), *Water, *Standards, *Mass, *Volume, Weight measurement, Spheres, Optical interferometers, Helium neon lasers, Hydrostatics, Iodine 127.

Mass and volume of four spheres made of low thermal expansion glass-ceramic were determined. Mass was measured against stainless steel standards, with + or - 2 X 10 to the -7th power relative uncertainty. The volume of two of the spheres was obtained through correlation of measured diameters and roundness data. Diameters were measured with a two-step interferometric method. Roundness data were taken on nine sections 20 degrees apart. Estimated uncertainty of volume values is + or - 1 X 10 to the -6th power. The volume of all four spheres, at 20 degrees C, was also measured by hydrostatic weighing in water with + or - 3 X 10 to the -6th power relative uncertainty. The comparison between volumes determined through both methods yields results in agreement within 1.5 X 10 to the -6th power. Volume ratios agree within 4 X 10 to the -7th power.

401,409
PB85-130920

(Order as PB85-130078, PC A99/MF A01)
Bureau International des Poids et Mesures, Sevres (France).
Influence of Dissolved Air on the Density of Water,
G. Girard, and M. J. Coarasa. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p453-456 1984.

Keywords: *Density(Mass/volume), *Water, *Dissolved gases, *Air, Compressibility, Weight measurement, Hydrostatics, Thermal expansion, Isotope ratio.

A knowledge of the density of water to an accuracy of 0.0001 kg/cu m (1 part in one million) has been of metrological importance for a long time. The basic work on the density of water dates from the beginning of the century and at the time included the absolute value itself together with the variations of density as a function of temperature and of amount of dissolved air. In recent years a number of laboratories, BIPM among them, have once again taken up this work. At BIPM, studies have been undertaken of the influence of variations in isotopic composition on the density. A relation has been derived which is valid for all samples of water likely to be encountered in any of the various national metrological laboratories. Recent work at BIPM has been devoted to the question of the effect of dissolved air on the density. The density of samples having different levels of saturation of dissolved air has been measured at various temperatures between 4 and 22 degrees C. The levels of saturation of dissolved oxygen were within the range 0.1 to 0.95.

401,410

PB85-130995

(Order as PB85-130078, PC A99/MF A01)
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Metrologii, Leningrad (USSR).
Work Done at the Mendeleyev Research Institute of Metrology (VNIIM) to Improve the Values of the Fundamental Constants,
Y. V. Tarbeyev. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p483-488 1984.

Keywords: *Fundamental constants, Measurement, Protons, Avogadro constant, Rydberg constant, Gyromagnetic ratio.

The work on fundamental constants carried out at VNIIM is a part of the overall effort in metrology aimed at improving measurement standards and systems. The results of work on the Avogadro constant, the gyromagnetic ratio of the proton, the Rydberg constant, and in associated research fields are reported. Improvements in the techniques for adjusting the values of fundamental constants as well as nuclear spectroscopy reference lines are discussed.

401,411

PB85-131001

(Order as PB85-130078, PC A99/MF A01)
Electrotechnical Lab., Sakura (Japan).
Realization of a Josephson Potentiometer,
M. Koyanagi, T. Endo, and A. Nakamura. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p489-492 1984.

Keywords: *Potentiometers(Instruments), *Electric potential, *Standards, Josephson junctions, Alternating current, Microwaves, *Voltage standards, Josephson effect, Voltage, Uncertainty.

Preliminary experiments have been done on a new Josephson potentiometer. The emf of a standard cell is determined with an uncertainty at the 10 to the -8th power level by using a Josephson voltage of 100 mV which is generated by multiple Josephson junctions.

401,412

PB85-131019

(Order as PB85-130078, PC A99/MF A01)
Helsinki Univ. of Technology, Espoo (Finland).
Transportable Josephson Voltage Standard,
K. Lahdenperae, H. Seppae, and P. Wallin. 1984, 3p
Prepared in cooperation with Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).
Included in Precision Measurement and Fundamental Constants II, p493-495 1984.

Keywords: *Electric potential, *Standards, Portable equipment, Josephson junctions, Superconductivity, Alternating current, Cryogenics, *Voltage standards.

A transportable cryogenic Josephson effect emf standard has been developed in which all precise measurements are carried out in a helium bath (4.2 K). This standard uses a superconducting current comparator and 0.1 Hz measurement current for the calibration of a resistive potential divider. The cryogenic emf standard has a measurement uncertainty of 2 X 10 to the 8th power (one standard deviation).

401,413

PB85-131035

(Order as PB85-130078, PC A99/MF A01)
Beijing Univ. (China).
Development of Precision Measurement and Fundamental Constants in China,
Z. X. Wang. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p505-508 1984.

Keywords: *Fundamental constants, *Frequency standards, Cesium frequency standards, Helium neon lasers, Gravity, Electrical resistance, Measurement, Iodine, Methane, Stabilization, Protons, China, Gyromagnetic ratio, Hydrogen masers, Ohm.

In China there is some experimental work on precision measurement and fundamental constants, such as cesium and hydrogen frequency standards, iodine and methane stabilized lasers, the determination of the proton gyromagnetic ratio (gamma prime, sub p) and the gravitational acceleration g, the realization of the SI electrical resistance unit, and so on.

401,414

PB85-132322

(Order as PB85-130078, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Advanced Thin Film Thermocouples,
K. G. Kreider, S. Semancik, and C. Olson. Oct 84, 85p
NBSIR-84/2949
Contract NASA-C-54715

Keywords: *Thermocouples, Thin films, Platinum, Rhodium, Temperature measuring instruments, Gas turbines, Detectors.

The fabrication, materials characterization, and performance of thin film platinum-platinum rhodium thermocouples on gas turbine engine alloys has been investigated. The materials chosen for the study were the turbine blade alloy systems MAR M200 + Hf with NiCoCrAlY and FeCrAlY coatings; and vane alloy systems MAR M509 with FeCrAlY. Research was focused on making improvements in the problem areas of coating-substrate stability, adhesion, and insulation reliability and durability. Diffusion profiles between the substrate and coating with and without barrier coatings of Al2O3 are reported. The relationships between fabrication parameters of thermal oxidation and sputtering of the insulator and its characterization and performance are described. The best thin film thermocouples were fabricated with the NiCoCrAlY coatings which were thermally oxidized and sputter coated with Al2O3.

401,415

PB85-134047

(Order as PB85-130078, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
AVS (American Vacuum Society) in 1981: The State of the Society and the Challenges of Growth.
Final rept.,
T. E. Madey. 1982, 5p
Pub. in Jnl. of Vacuum Science and Technology 20, n3
p265-270 1982.

Keywords: *Vacuum, History, Utilization, Reprints, *American Vacuum Society, Uses.

This paper is the text of an address given by the outgoing President of the Society at the 28th National Symposium of the AVS in Anaheim. To commemorate the 50th Anniversary of the American Institute of Physics, of which the AVS is the fastest growing member society, a brief historical overview of the origin of the AVS is provided. The unique role played by the AVS as the most industrially-based AIP society is discussed, and the challenges of rapid growth being experienced by the AVS are explored. The expanding influence of the AVS in the national and international technical community is examined.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,416
PB85-135408 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Power Factor Standard Using Digital Waveform Generation.

Final rept.,
N. M. Oldham, and R. S. Turgel. 1981, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems 100, n11 p4435-4438 Nov 81.

Keywords: *Power factor, *Standards, Waveform generators, Digital techniques, Wattmeters, Phase angle, Reprints.

A measurement technique is described which uses the adjustable linear phase relationship between two digitally generated waveforms to establish power factor with an uncertainty of less than 50 ppm. Results of comparisons with thermal, electrodynamic and electronic wattmeters are summarized.

401,417
PB85-135952
(Order as PB85-135929, PC A04/MF A01)
Maxwell Labs., Inc., San Diego, CA.
Absolute Electric Current Probe Based on the Faraday Effect.

W. Caton, and J. Katzenstein. 24 Apr 84, 8p
Included in Jnl. of Research of the National Bureau of Standards, v89 n3 p265-272 May-Jun 84.

Keywords: *Electric current meters, *Faraday effect, Measurement, Polarized light, Verdet constants.

This paper describes the design, construction, and testing of a probe for the measurement of electric current in a circuit. This measurement is performed by using Faraday rotation produced in a beam of polarized light that encircles the current-carrying conductor. Such a probe is an absolute instrument whose calibration only depends upon the Verdet constant of the rotative medium and is independent of the dimensions or positions of the light path relative to the current. The time resolution of the probe is the optical transit time about the closed path and can in practice be reduced to a few nanoseconds.

401,418
PB85-136786 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Development of the Cone Calorimeter - A Bench-Scale Heat Release Rate Apparatus Based on Oxygen Consumption.

Final rept.,
V. Babrauskas. 1984, 15p
See also PB83-151266.
Pub. in Fire and Materials 8, n2 p81-95 1984.

Keywords: *Calorimeters, *Plastics, *Combustion, *Fire tests, *Oxygen consumption, Design criteria, Performance evaluation, Ignition, Reprints.

A new bench-scale rate of heat release calorimeter utilizing the oxygen consumption principle has been developed for use in fire testing and research. Specimens may be of uniform or composite construction and may be tested in a horizontal, face-up orientation, or, for those which do not melt, in a vertical orientation. An external irradiance of zero to over 100 kW/sq m may be imposed by means of a temperature-controlled radiant heater. The rate of heat release is determined by measuring combustion product gas flow and oxygen depletion, while the mass loss is also recorded simultaneously. The instrument has been designed to be capable of higher accuracy than existing instruments and yet to be simple to operate and moderate in construction cost. The instrument is termed a 'cone calorimeter' because of the geometric arrangement of the electric heater.

401,419
PB85-136810 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Wind Tunnels Applied to Wind Engineering in Japan.

Final rept.,
R. D. Marshall. Jun 84, 19p
Pub. in Jnl. of Structural Engineers 110, n6 p1203-1221 Jun 84.

Keywords: *Wind tunnels, Aerodynamics, Boundary layer, Research management, Test facilities, Engineering, Dimensions, Performance evaluation, Reprints.

Many large boundary layer wind tunnels have been commissioned in Japan over the past 10 years, giving Japan a commanding lead in this area of technology. Some reasons for this extensive building program include the recent concentration of government research institutes at Tsukuba, the increased emphasis on structural and bridge engineering by the heavy industry companies, and the emphasis placed on research by Japanese construction corporations. In general, Japanese universities have not been able to keep pace with the government and private sectors in providing their engineering laboratories with modern and expensive research facilities. Nevertheless, much of the new and exciting work in wind engineering is being done by the universities. The very substantial investment made in boundary layer wind tunnels over the past two years suggests that Japanese heavy industries and construction corporations see a bright future for wind engineering. It is concluded that a significant penetration of the U.S. market for specialized engineering services is likely to occur within the next few years. The paper presents basic dimensions and performance characteristics for several wind tunnels and four new boundary layer wind tunnels are described in detail.

401,420
PB85-137651 PC A04/MF A01
National Bureau of Standards, Gaithersburg, MD.
State Measurement Laboratories: Program Description (Part 1). Directory (Part 2).

Final rept.
H. V. Oppermann. Nov 84, 73p NBS/SP-686
Library of Congress catalog card no. 84-601142.

Keywords: *Laboratories, *Calibrating, *Measurement, *Directories, *States(United States), Tolerances(Mechanics), *Weights and measures, State agencies.

The National Bureau of Standards receives repeated requests from industry and Federal agencies (e.g., Department of Defense, Nuclear Regulatory Commission) for information about the capabilities of and services provided by State measurement laboratories. This directory is a compilation of such information by State, including a description of the services available and fees charged. The directory will be updated annually in January of each year to coincide with the issuance of annual certification of these laboratories.

401,421
PB85-139996 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Effect of Surface Roughness on Ultrasonic Echo Amplitude in Steel.

Final rept.,
G. V. Blessing, P. P. Bagley, and J. E. James. Oct 84, 4p
Pub. in Materials Evaluation 42, n11 p1389-1392, 1400 Oct 84.

Keywords: *Ultrasonic tests, *Steels, Surface roughness, Nondestructive tests, Attenuation, Reprints.

The effect of surface roughness on the amplitude of ultrasonic echos has been studied for longitudinal waves in steel over a frequency range of 1 to 20 MHz. A set of five steel sample disks possessed (one-side) front surface roughnesses of a periodic nature ranging from 1 to 23 micrometers rms in height. Successive back-surface echo amplitudes were measured for the water-immersed samples using a multi-cycle tone burst technique. In addition, front surface echos were monitored as a function of roughness at 10 MHz in water, and at 2.3 MHz in air. The effects of several competing factors on echo amplitude were observed: scattering at the front (rough) surface, diffraction within the sample, and material attenuation. While at the lower frequencies, the surface roughnesses studied had little effect on echo amplitude, at 10 MHz and above the amplitude was observed to monotonically decrease with increasing roughness. For a given roughness value, diffraction effects dominated at the lower frequencies, while scattering and attenuation dominated at the higher frequencies.

401,422
PB85-140283 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Imaging Strategy in the Scanning Electron Microscope.

Final rept.,
D. E. Newbury. 1981, 8p
Pub. in Scanning Electron Microscopy, n1 p71-78 1981.

Keywords: *Electron microscopes, Backscattering, Resolution, Contrast, Reprints, *Scanning electron microscopy, *Optical images, *Imaging techniques.

A strategy for choosing the operating parameters for optimal imaging with the scanning electron microscope is described. This procedure consists of: (1) calculating the contrast produced by the specimen as a result of electron-solid interactions; (2) calculation of the modification of that contrast by the detector response characteristics; (3) calculation of the threshold beam current required to observe the contrast; (4) selection of suitable signal processing to properly display the contrast information on the final image or photograph; and (5) calculation of the spatial resolution limitations due to the gun brightness. Specific calculations for the case of atomic number contrast between pure element couples show that the limiting spatial resolution increases rapidly as the difference in atomic number decreases. For rapid visual searching of image fields at 1 second frame rates, beam currents as high as 500 nA and beam diameters of 1 micrometer or more are necessary to detect contrast levels below 1 percent.

401,423
PB85-140325 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
25-Gram-Capacity Oxygen Bomb Calorimeter.

Final rept.,
D. R. Kirklin, and E. S. Domalski. 1983, 11p
Pub. in Resource Conservation 10, n3 p177-187 1983.

Keywords: *Calorimeters, *Oxygen, Samples, Design criteria, Performance evaluation, Reprints, Refuse derived fuels, Solid wastes.

A 25 gram-capacity oxygen bomb calorimeter has been designed, constructed and tested at the National Bureau of Standards. The calorimeter should produce more representative calorific values for heterogeneous materials because the samples are an order of magnitude larger in mass than those used in conventional-size bomb calorimeters. The calorific values for processed and unprocessed samples were equivalent. The 25 gram-capacity bomb calorimeter yields more representative calorific values and requires less sample processing.

401,424
PB85-140473 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Linewidth Measurement Spotlight.

Final rept.,
D. Nyysonen. 1980, 18p
Pub. in Semiconductors and Insulators 3, n3 p39-56 Mar 80.

Keywords: *Line width, *Measurement, Integrated circuits, Metrology, Reprints.

In order to meet VLSI and VHSIC design requirements for tolerances of 10 percent or less on 1- and 2-m line geometries, more accurate and precise linewidth measurement techniques than those prevalent in the IC industry are needed. This paper reviews state-of-the-art optical linewidth measurement techniques, discusses sources of poor accuracy and precision and shows what improvement can be expected from linewidth calibration as opposed to line scale calibration.

401,425
PB85-140697 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Air Buoyancy Correction in High-Accuracy Weighing on Analytical Balances.

Final rept.,
R. M. Schoonover, and F. E. Jones. 1981, 3p
Pub. in Analytical Chemistry 53, n6 p900-902 1981.

Keywords: *Weight indicators, *Buoyancy, Calibrating, Chemical analysis, Laboratories, Performance evaluation, Reprints.

Laboratories, Test Facilities, and Test Equipment—Group 14B

In the context of the calculation and application of air buoyancy corrections in weighing, the calibration of single-pan direct-reading analytical balances is treated in detail. The resulting equations are applied to the calibration of syringes and to the weighing of granular or powdered materials or liquids in weighing bottles.

401,426
PB85-140705 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurement of the Optical Properties of Solar Energy Materials.
Final rept.,
J. C. Richmond. 1980, 12p
Sponsored by Solar Energy Research Inst., Golden, CO.
Pub. in High Temperature-High Pressures 12, n4 p465-476 1980.

Keywords: *Optical properties, Measurement, Solar energy, Absorptivity, Reflectance, Irradiance, Transmittance, Reprints.

The optical properties of interest for solar energy applications are the solar absorptance of receivers, the solar reflectance of concentrating mirrors and the solar transmittance of cover plates and refracting concentrators. These properties are normally evaluated by measuring the spectral property and then computing the weighted average, with the terrestrial solar spectral irradiance as the weighting function. Differences in values reported by different laboratories for the same materials are due to errors in measurement, differences in the terrestrial solar irradiance used, and the methods of computations.

401,427
PB85-140713 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurements of Small Dimensions of Products and By-Products.
Final rept.,
D. A. Swyt, and S. W. Jensen. 1980, 8p
Pub. in Proceedings of Society of Photo-Optical Instrumentation Engineers 220, p28-35, 6 Feb 80.

Keywords: *Dimensional measurement, Electron microscopy, Length, Optical microscopes, Particle size, Line width, Displacement, Reprints, Scanning electron microscopy, Transmission electron microscopy, Photomasking.

Mainstays for providing definitive, calibration-quality measurements of small dimensions for industrial and clinical applications are direct-imaging and plane-projection instruments. Light-optical and electron-optical techniques spans six orders of magnitude of sizes measured, from 1000 micrometers to 0.001 micrometer. In the application of each of these techniques, a common assumption is that, above the resolution limit of the device, accurate dimensional measurements of extended objects can be made based on the geometrical optical relation of image size to object size: $X(i) = MX(o)$, where $X(i)$ is the dimension of the image, $X(o)$ is the dimension of the object, and M is the scalar magnification of the device. However, the relationship strictly applies only to distance between points and in the measurements of dimensions such as lengths, widths or diameters of extended objects, the geometric optical relationship fails long before the resolution limit of the device is approached. Evidence of such failure in the form of substantial systematic errors in dimensional measurements appears in industrial applications from particle sizing to photomask metrology. The causes of such difficulties and calibration techniques to overcome them are discussed in the context of work at NBS on the development of SEM and optical techniques for accurate measurements in the range 0.1 to 100 micrometers.

401,428
PB85-140747 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
AC Magnetic Fields in the Vicinity of a Crack Calculated by Analytic and Numerical Methods.
Final rept.,
A. H. Kahn, and R. Spal. 1982, 4p
Sponsored by Advanced Research Projects Agency, Arlington, VA.
Pub. in Proceedings of the DARPA/AFML Review of Progress in Quantitative Nondestructive Eval., La Jolla, CA, July 8-13, 1979, Air Force rept. no. AFWAL-TR-30-4078, p65-68 1980.

Keywords: *Eddy current tests, *Cracks, Nondestructive tests.

Calculations are reported of the impedance of a long solenoid which surrounds a cylinder of conducting material containing a radial surface crack. The calculation is accomplished by two independent methods. The first method expresses the field in the interior of the 'cracked' cylinder as an infinite series of cylindrical Bessel function. The coefficients in the series are determined in principle by boundary conditions; the most significant terms are calculated by solving the finite set of equations obtained by truncation of the series. The second method, applicable to any uniform geometrical cross-section, obtains the impedance from the normal derivative of the field on the boundary of the conductor. This normal derivative satisfies a (boundary) Fredholm integral equation of the first kind; a solution is obtained by discretizing and solving the resulting linear system of algebraic equations. The impedance is calculated for a wide range of values of the ratios of crack depth-to-radius and radius-to-skin depth. The results are displayed in graphical form giving the fractional charges of the real and imaginary parts of the complex impedance induced by the presence of the crack.

401,429
PB85-140796 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Electron Microscope Based System for Accurate Microdimensional Measurements.
Final rept.,
D. A. Swyt, and S. W. Jensen. 1981, 5p
Pub. in Prec. Eng. 3, n1 p11-15 1981.

Keywords: *Dimensional measurement, *Calibrating, Electron microscopes, Length, Accuracy, Metrology, Reprints, Computerized control systems, Scanning electron microscopy.

A new facility at the U.S. National Bureau of Standards provides calibration measurements of linear dimensions in the range 0.1 to 100 micrometers by means of a high-resolution, electron microscope-scanning specimen stage system. Computer-controlled, with a stationary electron beam and interferometric measurement of stage position, the system can provide point-to-point measurements accurate to 0.01 micrometer. It also forms the basis for development and certification of calibrated standards for planar objects, particles, and other microscopic objects and features.

401,430
PB85-140812 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Harmonic Optimization of a Periodic Flow Wind Tunnel.
Final rept.,
J. P. Retelle, J. M. McMichael, and D. A. Kennedy. 1981, 6p
Sponsored by Air Force Academy, CO., and Colorado Univ. at Boulder.
Pub. in Jnl. of Aircraft 18, n8 p618-623 1981.

Keywords: *Wind tunnels, Unsteady flow, Revisions, Velocity, Harmonics, Performance, Vanes, Optimization, Design, Reprints.

This work describes a wind tunnel modification designed to superpose on the mean velocity sinusoidal longitudinal velocity fluctuations with minimal harmonic content. The technique is presented in light of a theoretical analysis of the low-frequency performance illustrating how harmonic suppression can be achieved with this particular design. Velocity fluctuations are produced by a system of primary rotating vanes and a bypass containing a secondary set of rotating vanes. Experimental data on tunnel performance are also presented.

401,431
PB85-140978 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Programmable Precision Voltage-Step Generator for Testing Waveform Recorders.
Final rept.,
H. K. Schoenwetter. Sep 84, 5p
Pub. in IEEE Transactions on Instrumentation and Measurement IM-33, n3 p196-200 Sep 84.

Keywords: *Pulse generators, Test equipment, Waveforms, Reprints.

A pulse generator for testing the approximate step-response of waveform recorders is described. The initial and final levels of voltage steps are each programmable within the range of plus or minus 1 V for 50 ohm termination and within plus or minus 5 V for a high impedance load. Voltage steps within these ranges settle

to within plus or minus 0.02% of full-scale range (FSR) in less than 30 ns and 40 ns, respectively, for a load capacitance $<$ or $=$ 30 pF. The corresponding 10-90 percent transition durations are approximately 7 ns and 12 ns.

401,432
PB85-141463 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Review of Ultrahigh Resolution Sizing of Single Droplets by Resonance Light Scattering.
Final rept.,
T. R. Lettieri, and W. D. Jenkins. 1984, 11p
Pub. in American Society for Testing and Materials, Special Technical Publication 848, p98-108 1984.

Keywords: *Aerosols, *Dimensional measurement, *Light scattering, *Particle size, *Drops(Liquids), *Size determination, Resolution, Reprints, Resonance scattering.

Resonance light scattering as a means for ultrahigh resolution sizing of liquid droplets in the 5 to 50 micrometer diameter range is reviewed. So far, the technique has been used to make relative size measurements with resolutions of 30 ppm on individual, non-evaporating droplets and 300 ppm on individual, evaporating droplets. The calculated existence of resonances sharper than those observed thus far offers the possibility of size resolutions approaching 0.1 ppm on highly transparent spherical droplets. The paper also reviews the relatively small amount of reported work on resonance light scattering from aerosols and from individual aspheres.

401,433
PB85-141489 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Gas Orifice Meter Discharge Coefficients as Determined by Mass Flow Measurements.
Final rept.,
D. B. Mann, J. A. Brennan, C. F. Sindt, J. F. LaBrecque, and S. E. McManus. 1984, 20p
Contract GRI-5080-353-0422
Pub. in Proceedings of the International Conference on the Metering of Natural Gas and Liquefied Hydrocarbon Gases, London, England, Feb 1-2, 1984, p1-20.

Keywords: *Orifice meters, *Gas meters, Gas flow, Performance, Data, Flow rate, Natural gas, Gas industry, Measurement, *Discharge coefficient.

A summary of orifice meter performance data and system descriptions are provided. A U.S. gas industry supported program has generated gas orifice meter performance data for four nominal orifice meter run sizes from 2 to 6 inches with up to six beta ratio of from 0.2 to 0.75. Two meter runs for each of the four nominal line sizes and two sets of orifice plates were interchanged in order to develop full meter performance characteristics. The data have been developed using nitrogen gas as the process fluid and a unique NBS gas flow reference facility capable of directly measuring the mass of gas metered by the orifice meter.

401,434
PB85-141539 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Essential Features of a Laboratory Quality Assurance Program.
Final rept.,
J. K. Taylor. 1984, 8p
Pub. in American Society for Testing and Materials, Special Technical Publication 845, p66-73 1984.

Keywords: *Laboratories, *Quality assurance, *Quality control, *Chemical analysis, Reprints.

Progress in the environmental sciences is vitally dependent on reliable data resulting from complex measurement processes. Because of this complexity, the measurement process must be well designed and operate in a state of statistical control. A quality assurance program, including quality control and quality assessment procedures, denotes those features that lead to the production of data under this condition. The rudimentary features are described together with the expected benefits. Parallelisms are drawn with a well designed manufacturing process.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,435

PB85-141893 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Small Obstacle Loading in a TEM (Transverse Electromagnetic) Cell.
Final rept.,
P. F. Wilson, and M. T. Ma. 1984, 6p
Pub. in Proceedings of the International Symposium on Electromagnetic Compatibility, Tokyo, Japan, Oct 16-18, 1984, p30-35.

Keywords: Measurement, Scattering, *TEM cells, Loading(Electronics).

A typical transverse electromagnetic (TEM) cell measurement procedure involves calibrating an empty cell and introducing a test object. The loading effect due to the test object presence is normally assumed to be negligible. This paper examines the effect of the test object and the validity of the 'non-perturbing' assumption. The analysis utilizes the small aperture theory, as applied to the dual problem of small obstacle scattering. The result is an equivalent T-network representation of the test loading which allows the overall transmission line circuit to be studied. In addition, evaluating the scattered modes gives the field perturbation due to the test object.

401,436

PB85-142057 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Instrumental Aspects of Supercritical Fluid Chromatography.
Final rept.,
T. J. Bruno. 1984, 8p
Pub. in Proceedings of Symposium on Energy Engineering Sciences, Research on Instrumentation, Testing and Evaluation (2nd), Argonne, IL., April 10-11, 1984, Conf-8404123, p78-85.

Keywords: *High pressure tests, *Laboratory equipment, Chemical analysis, Physicochemical process, *Supercritical fluid chromatography, High pressure liquid chromatography.

Supercritical fluid chromatography (SFC) offers many unique advantages as a tool for analytical and physicochemical studies. It logically is an intermediary between gas (GC) and liquid chromatography (LC). In this short review, the instrumental aspects of SFC will be discussed, after a short discussion on GC and LC to set the stage.

401,437

PB85-142081 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Development of a High Temperature (600 K), High Pressure (100 MPa) Viscometer.
Final rept.,
D. E. Diller. 1984, 5p
Pub. in Proceedings of Symposium on Energy Engineering Sciences, Research on Instrumentation, Testing and Evaluation (2nd), Argonne, IL., April 10-11, 1984, Conf-8404123, p49-53.

Keywords: *Viscometers, *High temperature tests, *High pressure tests, *Piezoelectric crystals, Fuels, Chemical industry, Design criteria, Performance evaluation, Density(Mass/volume), Gases, Liquids, Calibrating.

A high temperature (600 K), high pressure (100 MPa) torsional, piezoelectric crystal viscometer is being developed for accurate, wide-range shear viscosity measurements on compressed gaseous and liquid mixtures of interest to the fuel and chemical industries. The method is absolute in the sense that the apparatus does not require calibration with a fluid of known viscosity. The upper temperature limit is chosen to exceed the critical temperatures of a considerable number of industrially important fluids. The upper pressure limit is chosen to permit separating the dependence of the viscosity coefficient on density (at fixed temperature) from the dependence on temperature (at fixed density). Four, nearly identical, cylindrical quartz crystals, about 4.3 cm long by 0.5 cm diameter, have been fabricated from specially prepared ('swept', electrolyzed), high quality cultured quartz.

401,438

PB85-142115 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Apparatus for Moderate Temperature VLE Measurements of CO₂-Isobutane Systems.
Final rept.,
L. A. Weber. 1984, 7p
Sponsored by Department of Energy, Washington, DC, and Argonne National Lab., IL. Components Technology Div.
Pub. in Proceedings of Symposium on Energy Engineering Sciences, Research on Instrumentation, Testing and Evaluation (2nd), Argonne, IL., April 10-11, 1984, Conf-8404123, p10-16.

Keywords: *Laboratory equipment, *Butanes, *Carbon dioxide, *Binary systems(Materials), Separations, Temperature, Design criteria, Cryogenics, *Phase equilibrium, *Vapor liquid equilibrium.

This paper describes a new apparatus designed for making VLE measurements on light hydrocarbon containing systems in the range 300-400 K and pressures of 2-150 bar. Features of the new apparatus, systems to be studied, and treatment of the data are discussed. Some data from a similar previous (cryogenic) apparatus are shown to illustrate expected results.

401,439

PB85-142131 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Recent Improvement in the Atomic Time Scales of the National Bureau of Standards.
Final rept.,
D. W. Allan, D. J. Glaze, F. E. Gray, R. H. Jones, and J. Levine. 1983, 12p
Pub. in Proceedings of Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting, Washington, DC., December 6-8, 1983, p29-40.

Keywords: *Frequency standards, *Time standards, Frequency stability, Synchronism, Calibrating, US NBS.

Coincident with the installation of a new measurement system, the National Bureau of Standards has also developed a new philosophy for the generation of both UTC(NBS) and TA(NBS). Several benefits have resulted from this new direction. These are discussed.

401,440

PB85-142164 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Clock Characterization Tutorial.
Final rept.,
D. W. Allan. 1983, 17p
Pub. in Proceedings of Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting, Washington, DC., December 6-8, 1983, p459-475.

Keywords: *Frequency standards, *Time standards, Frequency stability, Performance, Reviews.

Managers are often required to make key program decisions based on the performance of some elements of a large system. This paper is intended to assist the manager in this important task insofar as it relates to the proper use of precise and accurate clocks. An intuitive approach will be used to show how a clock's stability is measured, why it is measured the way it is, and why it is described the way it is. An intuitive explanation of the meaning of time domain and frequency domain measures as well as why they are used will also be given. Explanations of when an 'Allan variance' plot should be used and when it should not be used will also be given. A more efficient way to measure clock frequency drift will be explained. The relationship of the rms time error of a clock to a $(\sigma_{\text{sub } y})$ (τ) diagram will also be given. The environmental sensitivities of a clock are often the most important effects determining its performance. Typical environmental parameters of concern and nominal sensitivity values for commonly used clocks will be reviewed.

401,441

PB85-142214 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Reference Materials and Environmental Analysis.
Final rept.,
S. D. Rasberry, and W. P. Reed. 1984, 4p
Pub. in Environment International, v10 p87-90 1984.

Keywords: *Environmental surveys, *Standards, Chemical properties, Physical properties, Calibrating, Laboratory equipment, Quality control, Reprints, *Standard reference materials.

Accurate measurements are an important consideration in environmental analysis. The National Bureau of Standards (NBS) provides several types of services to aid analysts in obtaining accurate measurements and in validating the accuracy of measurement methods and measurement systems. The most well known of these services is Standard Reference Materials (SRMs). In general, SRMs are well-characterized homogeneous materials or simple artifacts with specific chemical or physical properties certified by NBS. This paper discusses various possible roles for the use of SRMs, together with a description of currently available SRMs. In addition, a brief discussion of the technology of certification has been included as well as some discussion of future activities.

401,442

PB85-142248 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Can You Describe Optical Surface Quality with One or Two Numbers.
Final rept.,
M. Young. 1984, 11p
Pub. in SPIE (Society of Photo-Optical Instrumentation Engineers) 406, p12-22 1984.

Keywords: *Surface roughness, *Optical measurement, *Standards, Light scattering, Reprints, Total integrated scatter standard, Scratch and dig standard.

This talk discusses two optical surface quality standards, total integrated scatter (TIS) and the scratch and dig standard (ML-0-13830A). The author begins by using Fourier optics to show that the well known expression, $(I_{\text{sub } t})/I(0) = 4(k_{\text{sub } \text{squared}})(\sigma_{\text{sub } \text{squared}})$, which relates scattered power to rms roughness σ , is truly valid only for certain classes of surfaces. Vector scattering theory applied to a more general case shows that in fact optics can measure only a bandwidth limited roughness that can be related to scattered power only if the surface statistics are known. For this reason, the standard should perhaps be regarded as a scattered light standard and not as a surface roughness standard. The author concludes by describing efforts to develop an objective measurement technique to aid in the manufacture of the artifacts used to implement the scratch standard.

401,443

PB85-142255 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Quality Assurance for a Measurement Program.
Final rept.,
J. K. Taylor. 1984, 4p
Pub. in ACS (American Chemical Society) Symposium Series 267, p105-108 1984.

Keywords: *Quality assurance, *Laboratories, *Chemical analysis, Reprints, Reference materials.

The quality assurance practices for use in monitoring programs are discussed. Effective programs require the exclusive use of participating laboratories with their own sound quality assurance programs that will certify the quality of their data outputs, based on statistical evidence. The role of reference laboratories in monitoring programs is discussed.

401,444

PB85-142487 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Photoconductive Switches Used for Waveform Generation at the National Bureau of Standards.
Final rept.,
R. A. Lawton. 1983, 7p
Pub. in SPIE 439, p88-94 1983.

Keywords: *Waveform generators, *Standards, Photoconductors, Switches, Reprints.

The characterization of waveform measurement systems and the development of reference waveforms is now underway at the National Bureau of Standards (NBS). Efforts to upgrade the state of the art of fast waveform measurements at NBS has resulted in the development of the first photoconductive switch using GaAs in addition to a patent on the sampling of electrical signals with optical signals and vice versa. These photoconductive switches are now being applied to the development of reference waveform generators in the form of a Maxwell-Wagner two-layer capacitor in silicon stripline to complement the liquid-filled coaxial line filters developed previously.

401,445

PB85-142503 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Advanced Methods for Noncontact Inspection of Welds Using Electromagnetic-Acoustic Transducers.

Final rept.,
R. E. Schramm, C. M. Fortunko, and J. C. Moulder.
1984, 8p

Sponsored by Ames Lab., Iowa.

Pub. in Review of Progress in Quantitative Nondestructive Evaluation 3B, p1425-1432 1984.

Keywords: *Ultrasonic tests, *Weld defects, Nondestructive tests, Butt welds, Transducers, Reprints, Electromagnetic-acoustic transducers.

Electromagnetic-acoustic transducers (EMATs) offer several distinct advantages over more conventional means of acoustically interrogating large welded structures. They require no acoustic couplant and can operate without contact. They can also generate long wavelength shear horizontal waves. Proper design of transducers and electronics, supplemented with signal processing, results in a good signal-to-noise ratio. In this paper, the authors describe an improved EMAT configuration for use in an automated inspection system for butt weldments. A minicomputer controls transducer positioning, data acquisition, and digital signal processing to improve flaw detection, sizing, and localization. In particular, good detectability is possible with a synthetic aperture method that combines ultrasonic data from several transducer locations to produce a focusing effect and increase the signal-to-noise ratio.

401,446

PB85-142602 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Portable Organic Vapor Detectors.

Final rept.,
J. E. Brown, and P. H. Krupenie. Jun 84, 9p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in National Inst. of Justice Standard-0606.00, 9p Jun 84.

Keywords: *Portable equipment, *Gas detectors, *Vapors, *Fire investigation, *Standards, Performance evaluation, Organic compounds, Reprints, Arsons.

The purpose of this standard is to establish the minimum performance criteria for portable organic vapor detectors, instruments which may be used by arson investigators to locate fire debris that may contain residues of a liquid accelerant. Reliable identification of a specific class of accelerants is possible only in a laboratory using more sophisticated equipment, and is not included in the performance criteria. The standard does present methods by which a detector's sensitivity to selected organic vapors may be determined. It also includes methods to compare the instrument's responses to fire debris with and without residues of a liquid accelerant.

401,447

PB85-142628 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Volume Uncertainty of a Large Tank Calibrated by Photogrammetry.

Final rept.,
J. D. Siegwarth, J. F. LaBrecque, and C. L. Carroll.
Aug 84, 8p
Sponsored by Maritime Administration, Washington, DC.
Pub. in Photogrammetric Engineering and Remote Sensing 50, n8 p1127-1134 Aug 84.

Keywords: *Liquefied natural gas, *Photogrammetry, *Storage tanks, *Volume, Calibrating, Standards, Reprints.

The volume calibration uncertainty of large (30,000 cu m) liquefied natural gas tanks calibrated by photogrammetry has been independently estimated by the National Bureau of Standards. The independent estimates were obtained using surveying tapes.

401,448

PB85-142834 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Application of a Microwave-Induced Helium Plasma Detector at Atmospheric Pressure for Gas Chromatographic Capillary Columns.

Final rept.,
S. P. Wasik, and F. P. Schwarz. 1980, 4p
Pub. in Jnl. of Chromatographic Science 18, n12 p660-663 1980.

Keywords: *Gas chromatography, *Chemical analysis, Performance evaluation, Comparison, Design criteria, Laboratory equipment, Mercury(Metal), Reprints, *Microwave induced plasma detectors, Flame ionization detectors.

The analytical performance of a modified version of Beenakker's cavity was evaluated as a microwave-induced plasma detector (MPD) for gas chromatographic capillary columns. The MPD compared favorably with the flame ionization detector (FID), with respect to peak resolution and ease of operation. The FID performance was superior in detection limits and linear range for compounds containing carbon. For compounds containing mercury, the MPD and the FID had the same sensitivity.

401,449

PB85-142917 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Laser Enhanced Ionization Flame Velocimeter.

Final rept.,
P. K. Schenck, J. C. Travis, G. C. Turk, and T. C. O'Haver. 1982, 4p
Pub. in Applied Spectroscopy 36, n2 p168-171 Mar/Apr 82.

Keywords: *Speed indicators, Performance evaluation, Atoms, Reprints, *Laser enhanced ionization.

The temporal and spatial evolution of the depleted neutral atom density following laser enhanced ionization in laminar flow flames has been used to characterize the flow velocity of the flame gases. This technique utilizes a low power CW dye laser and a low sodium seed density (10 to the 11th power-10 to the 12th power atoms/cc). The flow velocity can be measured to better than 2 percent in standard analytical burners.

401,450

PB85-142941 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Development of the NBS (National Bureau of Standards) Isotropic Magnetic-Field Meter (MFM-10), 300 kHz to 100 MHz.

Final rept.,
L. D. Driver, and J. E. Cruz. 1982, 8p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) International Symposium on Electromagnetic Compatibility, San Jose, CA., September 8-10, 1982, IEEE Cat. No. 82-CH1718-6, p460-467.

Keywords: *Measuring instruments, *Field strength, Magnetic fields, Antennas, Electromagnetic fields.

An isotropic magnetic-field meter is described which provides accurate near-zone measurements of H-fields over the range of 0.01 sq A/sq m to 250 sq A/sq m from 300 kHz to 100 MHz. This instrument's many advanced features include (1) wide frequency coverage, (2) large dynamic range, (3) flat frequency response, (4) high overload capacity, and (5) the capability of measuring each of the three orthogonal H-vectors, as well as their Hermitian magnitude.

401,451

PB85-142958 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Biomagnetism: An Interdisciplinary Approach. Chapter 2. Magnetic Quantities, Units, Materials and Measurements. Chapter 3. Cryogenics.

Final rept.,
J. E. Zimmerman. Dec 83, 51p
See also AD-A134 314.
Pub. in Biomagnetism: An Interdisciplinary Approach, Chapters 2 and 3, p17-67 1983.

Keywords: *Magnetic measurement, Units of measurement, Magnetostatics, Magnetic materials, Magnetometers, Detectors, Thermal noise, Cryogenics, Reprints, *Biomagnetism, SQUID devices, Magnetism, Ohm law, Dewars, Cryogenic refrigerators, Nyquist noise.

This publication consists of two chapters for a book entitled Biomagnetism: an Interdisciplinary Approach, to be published by the NATO Advanced Study Institute, written to be intelligible to both physical and medical scientists. Chapter 2 covers the terminology of magnetism, simple theory of magnetostatics, Ohm's Law, electric and magnetic SI units, magnetic materials, magnetic sensors, and magnetic measurements. Chapter 3 covers Nyquist noise and construction of dewars and refrigerators for SQUID magnetometers.

401,452

PB85-143006 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Sensitivity of Commercial Ion Gage Tubes.

Final rept.,
C. R. Tilford. 1981, 1p
Sponsored by Department of Energy, Washington, DC., Illinois Univ. at Urbana-Champaign, Argonne National Lab., IL., and Institute of Electrical and Electronics Engineers, Inc., New York.
Pub. in Proceedings of Symposium on Engineering Problems of Fusion Research (9th), Chicago, IL., October 26-29, 1981, p1924+, IEEE Catalog No. 81CH1715-2 NPS, p1924+ 1981.

Keywords: *Ionization gages, Measuring instruments, Vacuum gages, Performance, Sensitivity, Accuracy, Linearity, Variability.

Fusion science and engineering requires an increasing number of accurate vacuum measurements. In order to determine what level of a performance can be expected from different ion gages a gage characterization program has been initiated. This program determines the uniformity, accuracy, and linearity for different gage tubes, and for the more promising candidates further characterizes the sensitivity for different gases and the effects of changing bias voltages and emission currents. Results to date show the best performance from conventional triode and tubulated Bayard/Alpert gages with tungsten filaments. Significantly poorer results are obtained from nude Bayard/Alpert gages and gages with thoriated iridium filaments.

401,453

PB85-143303 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Ellipsometry of Rough Surfaces.

Final rept.,
T. V. Vorburger, and K. C. Ludema. 1980, 13p
Pub. in Applied Optics 19, n4 p561-573, 15 Feb 80.

Keywords: *Surface roughness, *Polarimetry, Optical measurement, Diffraction, Surfaces, Texture, Reprints, *Ellipsometry, Profilometers, Kirchhoff approximation.

The authors have done ellipsometry measurements on several different kinds of rough surfaces and compared them with stylus measurements of the surface texture. For steeply-sloped, periodic surfaces, the authors observe rapid variations in the ellipsometric angles, delta and psi, versus the angle of incidence for certain angles. This effect is ascribed to interference between the singly and doubly scattered light waves. For a set of Ni replicas of machined surfaces, the surface composition was varied between sets of measurements by evaporating first Al, then Au on them. The systematic effects due to surface roughness are in disagreement both with theory and with previous experiments. The possible reasons for this are discussed, along with the prospects for using ellipsometry as a tool for measuring surface roughness.

401,454

PB85-143451 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Simultaneous Electric and Magnetic Field Sensor for Near-Field Electromagnetic Field Measurements.

Final rept.,
M. Kanda, F. X. Ries, L. D. Driver, and R. D. Orr.
1983, 4p
Pub. in Proceedings of Symposium and Technical Exhibition on Electromagnetic Compatibility (5th), Zurich, Switzerland, March 8-10, 1983, p263-266.

Keywords: *Detectors, Electric fields, Magnetic fields, Field strength, Measurement, Electromagnetic fields, Antennas, Electromagnetic interference, Load impedance, Near field.

This paper describes a concept for a single sensor to perform simultaneous near-field electric and magnetic field measurements. The theory indicates that it is possible

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

sible to obtain the loop-mode and dipole-mode currents using a loop terminated with identical loads at diametrically opposite points. The theory also indicates that it is possible to adjust the load impedance, and thus obtain an ideal load impedance for achieving equal electric and magnetic field responses of the loop. Preliminary experiments have been performed using plane waves to verify these results.

401,455
PB85-143469 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Time Domain Sensors for Radiated Impulsive EMI (Electromagnetic Interference) Measurements.
Final rept.,
M. Kanda. 1983, 7p
Pub. in IEEE Transactions on Antennas and Propagation AP-31, n3 p438-444 May 83.

Keywords: *Detectors, *Electromagnetic interference, Measurement, Field strength, Antennas, Transfer functions, Reprints, Time domain, Reciprocity theorem.

Discussion of various sensors and radiators commonly used for time domain antenna measurements is presented. The sensors and radiators discussed here are passive and analog devices which convert the electromagnetic quantity of interest to a voltage or current at their terminal ports. Moreover they are primary standards in the sense that their transfer functions can be calculated from their geometries and are flat (constant) across a wide frequency range. One of the major requirements for these sensors and radiators is that the electromagnetic far field, transmitted or received, is a replica or high fidelity derivative of the original pulse.

401,456
PB85-144376 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Simple Vacuum Pump Exhaust Filter.
Final rept.,
R. A. Forman, and H. D. Krantz. Sep 84, 1p
Pub. in Review of Scientific Instruments 55, n9 p1503 Sep 84.

Keywords: *Filters, Vacuum pumps, Laboratory equipment, Reprints.

A simple high throughput, exhaust filter for oil-filled mechanical vacuum pumps is described. The design allows easy connection to external systems. Inexpensive filter elements, available anywhere, are a further feature of the system.

401,457
PB85-144475 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Position-Sensitive X-ray Detector.
Final rept.,
B. P. Duval, J. Barth, R. D. Deslattes, A. Henins, and G. G. Luther. 1984, 5p
Pub. in Nuclear Instruments and Methods in Physics Research 222, p274-278 1984.

Keywords: Transfer functions, Methane, Xenon, Reprints, *X-ray detection, *X-ray detectors.

The authors have constructed a single anode wire position sensitive gas proportional detector with a fwhm of 80 micrometers for a highly collimated monochromatic beam of 8 keV photons over a useful range of 38 mm, operated with 600 Torr Xe/CH₄. The transfer function of the detector has been measured and explained by the theoretical charge distribution induced on the cathode.

401,458
PB85-144491 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Absolute, Prompt Gamma-Ray Spectroscopy and the Determination of Fundamental Constants.
Final rept.,
R. D. Deslattes, G. L. Greene, and E. G. Kessler. Mar 84, 6p
Pub. in Jnl. de Physique C3, n45 pC3-41-C3-46 Mar 84.

Keywords: *Fundamental constants, *Gamma ray spectroscopy, Diffractometers, Wavelengths, Optical interferometers, X rays, Single crystals, Reprints, MeV range 01-100.

There currently exists a highly accurate absolute wavelength scale for electromagnetic radiation which extends from microwaves to gamma-rays having ener-

gies less than about 1 MeV. This scale begins with the cesium atomic beam clock (and thus the SI meter) and continues through the iodine stabilized HeNe laser. Such a laser is then used to determine the lattice spacing of a single crystal of Si using x-ray/optical interferometry. Accurately calibrated crystals are then used in a flat diffractometer to determine absolute gamma-ray wavelengths. The authors propose to extend this scale to the region of about 1-10 MeV. This requires the use of in-pile sources for the examination of prompt gamma-rays from n-gamma reactions.

401,459
PB85-144509 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Photon Energy Analysis by Reflectivity Modulation.
Final rept.,
P. L. Cowan. 15 May 84, 5p
Pub. in Nuclear Instruments and Methods in Physics Research 222, n1-2 p46-50, 15 May 84.

Keywords: *X rays, *Mirrors, Synchrotron radiation, Reflectivity, Modulation, X ray spectroscopy, Reprints.

X-ray mirror reflectivity versus energy is approximately a step function. By dithering the orientation of an X-ray mirror and phase detecting the reflected photons, one obtains a response function which is the derivative of this step function. A photon response function with a narrow energy resolution is thus produced. This photon energy analysis by reflectivity modulation is analogous to a modulated retarding grid electron energy analyzer. The energy resolution and the peak efficiency of the response function are determined by the optical constants of the mirror, the amplitude of the dither and the collimation of the photons, so the signal can be increased at the expense of energy resolution by altering the dither amplitude. Although the resolving power is low compared with what can be achieved with crystals, reflectivity modulation has several advantages over crystal based monochromators and spectrometers. Reflectivity modulation can be used over a very large energy range, including soft X-rays. For focused applications, the surface of an X-ray mirror is more easily figured than the diffracting planes of a crystal. The response function of a mirror is harmonic free and most importantly, the signal amplitude can be much higher than from crystals.

401,460
PB85-144517 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Calibration Methods and the Reference Materials in ESR Spectroscopy.
Final rept.,
T. T. Chang. May 84, 60p
Pub. in Magnetic Resonance Review 9, n1-3 p65-124 May 84.

Keywords: *Electron parametric resonance, *Calibrating, Frequency measurement, Magnetic measurement, Magnetic fields, Reprints, *Electron spin resonance, Reference materials.

This paper reviews the calibration methods and the reference materials that have been recommended or have been in use in EPR spectroscopy. The methods for the measurement of microwave frequencies and magnetic fields are briefly mentioned. The methods to measure the Q-factor of a microwave cavity are described. The calculation and the measurement of the microwave magnetic field in an EPR resonance cavity are described in detail. Methods for the determination of the concentration of the paramagnetic centers in a sample are described after a discussion of the theoretical background. Precautions and factors that affect the accuracy of this determination are discussed. Reference materials, in 16 groups, are listed. Recipes for preparation of some of these standard samples are also given.

401,461
PB85-144855 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Wideband Sampling Wattmeter.
Final rept.,
G. N. Stenbakken. Oct 84, 8p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems PAS-103, n10 p2919-2926 Oct 84.

Keywords: *Wattmeters, Broadband, Sampling, Calibrating, Reprints, Microprocessors.

The design and operation of a wideband sampling wattmeter capable of measuring distorted power sig-

nals with fundamental frequencies from 1 Hz to 10 kHz and harmonics up to 100 kHz is described. The microprocessor controlled wattmeter uses asynchronous sampling of the voltage and current signals. The errors associated with this type of operation are described as are various methods of correcting for some of these errors. The wattmeter uses a both a hardware multiplier-accumulator and a direct-memory-access unit to capture the data. Differential time delays in the input channels can be compensated by programmable time delay circuits. Performance checks show that measurement uncertainties of less than plus or minus .1 percent of full-scale range (FSR) are obtainable.

401,462
PB85-144913 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurement of High Current and Voltage Pulses.
Final rept.,
R. E. Hebner. 1984, 45p
Grant AFOSR-78-3675
Sponsored by Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH., and Air Force Weapons Lab., Kirtland AFB, NM.
Pub. in Air Force Pulsed Power Lecture Series, Lecture No. 25, 45p 1984.

Keywords: *Electrical measurement, High voltage, Waveforms, High current, *Pulse measurement.

The note introduces some of the fundamental approaches to the measurement of voltage or current pulses. The evaluation of the measurement process and the properties of selected devices -- resistive and capacitive probes, shunts, and transformers -- are highlighted. Electro-optical measurement of voltage and magneto-optical measurement of current are also discussed.

401,463
PB85-144962 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Capacitive Sensors for Voltage Measurements in Pulse Power Systems.
Final rept.,
R. H. McKnight, and H. K. Schoenwetter. 1984, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Cat. No. CH84-2056-0, p284-287 1984.

Keywords: *Electrical measurement, High voltage, Surges, Transmission lines, Waveforms, Reprints, Capacitive sensors.

Capacitive E-Field sensors are frequently used in pulse power systems to measure voltage waveforms. Even though these sensors, often called 'E-dot' sensors, are intrinsically simple in design and application, accepted techniques to evaluate their performance are not generally available. A laboratory test line has been constructed to facilitate detailed examination of the electrical characteristics of the sensors and to allow investigation of methods of calibrating such devices. Both discrete frequency and step-like signals can be placed on the line and the response of the sensor determined. Two different probe geometries have been studied with each showing the characteristic behavior of the capacitive sensor, including nano-second rise time. The use of active electronic techniques has also been explored to extend the low frequency bandwidth of the measuring system. Sensors with a wide bandwidth are required for measurements of disconnect transients in gas-insulated power frequency equipment.

401,464
PB85-144988 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Use of Drill-Up for On-Line Determination of Drill Wear.
Final rept.,
K. W. Yee. 1984, 12p
Pub. in Society of Manufacturing Engineers Technical Paper MS84-914, p1-12 1984.

Keywords: *Drills, Wear, Instruments, Detectors, Failure, Drilling, Reprints.

Drill-Up is an instrument for determining drill wear and predicting drill breakage by applying time-domain analysis to a signal from an accelerometer coupled to the workpiece. The potential of Drill-Up as a drill wear-out sensor for automated drilling machines has been demonstrated for a limited range of drill sizes and materials. Worn-out drills in moderately hard steel can be readily detected. In softer low-carbon steel, detection

is possible if the techniques suggested are used to overcome practical problems.

401,465

PB85-145142 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Quantitative Particle Analysis in Electron Beam Instruments.

Final rept.,
J. A. Small. 1981, 15p
Pub. in Scanning Electron Microscopy, n1 p447-461 1981.

Keywords: *Electron microscopy, *Electron probes, *Microanalysis, Particles, Reprints, Electron probe microanalysis.

Various methods which have been developed for the quantitative analysis of particles in electron beam instruments are reviewed. This review includes two procedures, relative sensitivity-factor and local mass methods, which apply to the analysis of particles fitting the thin film criterion. These particles are generally less than a few tenths of a micrometer in diameter and are best analyzed with the analytical electron microscope at beam energies of 100 keV or more. Six additional methods are described including normalization of ZAF results, methods requiring particle standards, normalization of beam raster area modified P-factors, geometric modeling of particle shape, and peak-to-background normalization. These methods are best suited for the SEM/EDS analysis of particles with diameters larger than a few tenths of a micrometer. Included in the discussion of the various methods is the error histogram for 200 particle analyses run with the normalized ZAF method. The various particle effects like mass, absorption, and secondary fluorescence which make quantitative particle analysis difficult are also discussed. Finally, the experimental requirements which are unique to each analysis method are reviewed.

401,466

PB85-145159 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Daguerreotypes: A Study of the Plates and the Process.

Final rept.,
A. Swan, C. E. Fiori, and K. F. J. Heinrich. 1979, 13p
Pub. in Scanning Electron Microscopy, n1 p411-423 Apr 79.

Keywords: *Photographic emulsions, *Chemical analysis, X ray analysis, Photographic plates, Substrates, Reprints, *Daguerreotypes, Scanning electron microscopy.

Daguerreotypy was the first widely used photographic process. The pictures consist of silver mercury amalgam particles on a silver substrate. It was necessary to develop a description and explanation of the process, since this was not available in the literature. The results of a detailed electron microprobe analysis of both pristine and deteriorated daguerreotypes are presented. The studies have shown that multiple interdependent deterioration processes are present involving not only the plate surface but also the copper support, the cover glass and the microclimate in the case.

401,467

PB85-145357 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Performance Characteristics of a Broad Range Ionization Gage Tube.

Final rept.,
C. R. Tilford, K. E. McCulloh, and H. S. Woong. 1982, 4p
Pub. in Jnl. of Vacuum Science and Technology 20, n4 p1140-1143 1982.

Keywords: *Ionization gages, Performance evaluation, Calibrating, High pressure tests.

Seven commercial 'broad range' Bayard-Alpert ionization gage tubes were calibrated for nitrogen, argon, hydrogen, deuterium, and helium. The data showed an inexplicable grouping of the gage tubes into two distinct groups, one with small voltage coefficient typical of Bayard-Alpert gages, the other with much larger coefficients, such as expected from conventional triode gages.

401,468

PB85-145498 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Apparatus for the Measurement of Gas Fluxes through Immobilized Liquid Membranes.

Final rept.,
B. R. Bateman, J. D. Way, and K. M. Larson. 1984, 12p
Pub. in Separations Science and Technology 19, n1 p21-32 1984.

Keywords: *Membranes, *Laboratory equipment, *Gases, Transport properties, Design criteria, Performance evaluation, Reprints.

An automated apparatus to measure gas fluxes through immobilized liquid membranes is described. Specific design features permit safe operation for experimentation with CO, NO, and H₂S. Nitric oxide fluxes through immobilized Fe(II) solutions have been measured and are presented as a typical equipment application. Facilitation factors (ratio of total flux to flux without carrier) greater than 5 were observed.

401,469

PB85-145522 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Pulse Calorimetry.

Final rept.,
A. Cezairliyan. 1984, 26p
Pub. in Compendium of Thermophysical Property Measurement Methods Chapter 16, 1, p643-668 1984.

Keywords: *Specific heat, *Heat measurement, Reprints, *Calorimetry, High temperature, High speed.

Developments of pulse calorimetric techniques for the measurement of specific heat of electrically conducting substances are presented. Emphasis is placed on millisecond and microsecond resolution calorimetry as applied to measurements at temperatures above about 1000 K. Experimental difficulties related to the dynamic measurements of experimental quantities, such as power and temperature, are discussed, and sources and magnitudes of errors are given.

401,470

PB85-145639 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Laser Magnetic Resonance of the O₂ Molecule at 699 micrometers.

Final rept.,
M. Mizushima, K. M. Evenson, J. A. Mucha, D. A. Jennings, and J. M. Brown. 1983, 12p
Contract NASA-W-15047
Pub. in Jnl. of Molecular Spectroscopy 100, p303-315 1983.

Keywords: *Oxygen, *Microwave spectroscopy, *Hyperfine structure, Molecular energy levels, Design criteria, Performance evaluation, Reprints, *Laser magnetic resonance spectroscopy, Laser spectroscopy.

A new highly sensitive far infrared optically pumped laser magnetic resonance (LMR) spectrometer has facilitated the observation of 21 transitions in O₂ at 699 micrometers (428.6285 GHz). From the intensity of the observed lines the sensitivity limit of this LMR spectrometer is found to be about 10 to the -9th power/cm at this frequency with a 1-sec time constant.

401,471

PB85-147890 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

National Bureau of Standards (NBS) Temperature Scale in the Range 15 to 200 mK.

Final rept.,
J. H. Colwell, W. E. Fogle, and R. J. Soulen. 1984, 2p
Pub. in Proceedings of International Conference on Low Temperature Physics (17th), Karlsruhe, Germany, August 15-22, 1984, p395-396.

Keywords: *Temperature measurement, Josephson junctions, Superconductors, Reproducibility, Cryogenics, *Ultralow temperature.

The authors have studied the reproducibility upon thermal cycling of several types of thermometers. A Josephson junction noise thermometer, a CMN thermometer, and an SRM 768 superconductive fixed-point device were very consistent, while a germanium and a carbon resistance thermometer showed significant irreproducibility.

401,472

PB85-147940 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Characteristics of Ion Gages.

Final rept.,
C. R. Tilford. 1984, 10p
Pub. in Proceedings of International Symposium on Vacuum Technology and Nuclear Applications, Bombay, India, December 6-9, 1983, p139-148 1984.

Keywords: *Ionization gages, Performance evaluation, Sampling, Stability, Design criteria.

The operation of ionization vacuum gages is affected by a number of factors that make it very difficult to theoretically predict or characterize their performance. This has led to efforts in recent years to experimentally characterize the properties of commercially available gages. Factors affecting the performance of ion gages are discussed and results are presented from a National Bureau of Standards program that has determined nitrogen sensitivities, relative sensitivities for several common gages, dependences on operating parameter, and limited long-term stability tests for samples of several gage types. The results favor tungsten filament gages, particularly of the conventional triode type. However, one design of a dual tungsten filament Bayard-Alpert gage came close to the conventional triode in many criteria and performed significantly better on a limited long-term stability test.

401,473

PB85-148500 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Densimetry in Compressed Fluids by Combining Hydrostatic Weighing and Magnetic Levitation.

Final rept.,
R. Masui, W. M. Haynes, R. F. Chang, H. A. Davis, and J. M. H. L. Sengers. Jul 84, 11p
Contract DOE-EA-77-A-01-6010
Sponsored by Science and Technology Agency, Tokyo (Japan).
Pub. in Review of Scientific Instruments 55, n7 p1132-1142 Jul 84.

Keywords: *Density(Mass/volume), *Densitometers, *Liquids, Design criteria, Performance evaluation, Compressibility, Magnetic fields, Reprints.

A magnetic densimeter is described that has been built for measuring the density of compressed liquids at pressures up to 15 MPa in the temperature range 20-200C with a desired accuracy of 0.1%. The densimeter combines the principle of magnetic levitation of a buoy with that of liquid density determination by hydrostatic weighing. To this effect, the support coil is suspended from an electronic balance, and the balance readings are recorded (1) with the buoy at rest, and (2) with the buoy in magnetic suspension. Details are given of the construction of the cell, coil, buoy and thermostat. The procedure is described by which cell and buoy are aligned so that the suspended buoy does not touch the cell wall. Test data on the densities of seven different liquids were obtained at room temperature. They agree with reliable literature values to within 0.1%. In a separate experiment, the thermal expansion coefficient of the buoy material was determined. This experiment and its results are also given here.

401,474

PB85-151579 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Approach to Realism in Field Ion Microscopy via Zone Electropolishing.

Final rept.,
A. J. Melmed, and J. J. Carroll. 1984, 2p
Pub. in Jnl. of Vacuum Science and Technology A2, n3 p1388-1389 Jul/Sep 84.

Keywords: *Electropolishing, Preparation, Microanalysis, Reprints, *Field ion microscopy, *Atom probe field ion microscopy.

A method of specimen preparation for field ion microscopy and atom probe analysis is presented which allows the preparation of specimens from a wide variety of initial morphologies.

Field 14—METHODS AND EQUIPMENT

Group 14B—Laboratories, Test Facilities, and Test Equipment

401,475

PB85-151637 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Investigations in Array Sizing. Part 1. Accuracy of the Sizing Process.
Final rept.,
A. W. Hartman. 1984, 10p
Pub. in Powder Technology 39, p49-59 1984.

Keywords: *Optical microscopes, *Size determination, *Arrays, *Particle size, Calibrating, Performance evaluation, Light scattering, Reprints.

The technique of two-dimensional array sizing by optical microscopy is investigated for use in the determination of the average diameter of 0.9 micrometers polystyrene latex spheres. Error sources for the diameter measurement are discussed, including the effects of microcracks, anisotropy, and dissolved impurities. The technique has been used in a particle calibration program at NBS. The average diameter found was 0.897 ± 0.016 micrometers, while techniques based on light scattering from a single particle and from a suspension yielded 0.900 ± 0.011 and 0.895 ± 0.008 micrometers, respectively.

401,476

PB85-157550 PC A13/MF A01
National Bureau of Standards, Gaithersburg, MD.
Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices as Adopted by the 69th National Conference on Weights and Measures, 1984 (1985 Edition).
Final rept.,
O. K. Warnlof. Nov 84, 297p NBS/HB-44/1985
Supersedes PB84-125764. Also available from Supt. of Docs as SN003-003-02625-5.

Keywords: *Weight indicators, *Measuring instruments, *Handbooks, Specifications, Tolerances(Mechanics), Requirements, Standards.

The specifications, tolerances, and other technical requirements published herein comprise, in their latest form, all of the current codes as adopted by the National Conference on Weights and Measures. The National Conference is sponsored by the National Bureau of Standards (NBS), which organization provides its secretariat and publishes its documents. The NBS also develops technical publications for use by weights and measures agencies; these publications may subsequently be endorsed or adopted by the NCWM. The purpose of these technical requirements is to eliminate from use weights and measures and weighing and measuring devices that are false, that are of such construction that they are faulty (that is, that are not reasonably permanent in their adjustment or will not repeat their indications correctly), or that facilitate the perpetration of fraud but, without prejudice to apparatus that conforms as closely as practicable to the official standards.

401,477

PB85-159952 PC A04/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Small Aperture Analysis of the Dual TEM (Transverse Electromagnetic) Cell and an Investigation of Test Object Scattering in a Single TEM Cell.
P. F. Wilson, and M. T. Ma. Oct 84, 63p NBS/TN-1076
Also available from Supt. of Docs.

Keywords: Test equipment, Transverse waves, Electromagnetic shielding, Electromagnetic scattering, *TEM cells, Small aperture theory.

Small aperture theory is used to investigate the dual TEM cell. Analyzing coupling through an empty versus a loaded aperture leads to a model of dual TEM cell shielding effectiveness measurements. Small obstacle scattering yields results for both the field perturbation and the change in a cell's transmission line characteristics due to the presence of a test object in a TEM cell. In each case, theoretical values are compared to experimental data.

401,478

PB85-160695 PC A08/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Calorimeter for Measuring High-Energy Optical Pulses,
P. A. Simpson, E. G. Johnson, and S. M. Etzel. Oct 84, 169p NBSIR-84/3008
Sponsored by Aerospace Guidance and Metrology Center, Newark AFS, OH.

Keywords: *Calorimeters, *Optical equipment, Calibrating, Design criteria, Performance evaluation, Laser applications, Computer applications.

Two similar calorimeters for measuring laser pulses in the range 1 kJ to 15 kJ are described. The calorimeters, which are electrically calibrated, can be operated anywhere from the ultraviolet to infrared by selecting the proper materials for the volume absorber and deflecting mirror. Operation of each calorimeter is controlled by a dedicated desk-top computer. The theoretical basis for the calorimeters is given as are the constructional and operational details. The computer programs that are used are included in the appendices.

401,479

PB85-161271 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 89, Number 5, September-October 1984.
Oct 84, 87p
See also PB85-161289 through PB85-161313 and PB85-129591. Also available from Supt. of Docs as SN003-003-72089-5. Library of Congress catalog card no. 63-37059.

Keywords: *Research projects, Resistance thermometers, Temperature measuring instruments, High temperature tests, Propane, pH, Standards, Coal deposits, PVT properties.

Contents:

- Evaluation of Some high-temperature platinum resistance thermometers;
- Automated High-temperature PVT apparatus with data for propane;
- Radio Propagation in a coal seam and the inverse problem;
- A report on the National Bureau of Standards pH Standards.

401,480

PB85-161289
(Order as PB85-161271, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Evaluation of Some High-Temperature Platinum Resistance Thermometers,
J. P. Evans. 17 Jul 84, 25p
Included in Jnl. of Research of the National Bureau of Standards, v89n5 p349-373 Sep-Oct 84.

Keywords: *Resistance thermometers, *Temperature measuring instruments, Standards, Platinum, Performance, Stability, Tests, Tables(Data), High temperature, Temperature scales.

Two sets of high-temperature platinum resistance thermometers of different design have been tested in the temperature range 0 to 1100 degrees C. One set was constructed at the National Institute of Metrology, in the People's Republic of China, and the other at the National Bureau of Standards. The results of the tests provide information on long- and short-time thermometer stability, and on other characteristics such as temperature coefficient, immersion, self-heating effect, electrical leakage, and durability. The results also show that the behavior of the two sets is similar enough to allow them to be considered as a single set of thermometers, and that the sets perform as well as, or better than, other sets of thermometers tested earlier. It is expected that this information will aid in the evaluation of the high-temperature platinum resistance thermometer as an interpolating instrument for a practical temperature scale up to the gold point.

401,481

PB85-161297
(Order as PB85-161271, PC A05/MF A01)
National Bureau of Standards, Boulder, CO.
Automated High-Temperature PVT Apparatus with Data for Propane,
G. C. Straty, and A. M. F. Palavra. 20 Jun 84, 9p
Prepared in cooperation with Instituto Superior Tecnico, Lisbon (Portugal).
Included in Jnl. of Research of the National Bureau of Standards, v89 n5 p375-383 Sep-Oct 84.

Keywords: *Propane, *Laboratory equipment, *Compressibility, Fluids, Design criteria, Performance evaluation, Supercritical flow, *PVT properties, Burnett method.

An apparatus is described which can be used for PVT and compressibility measurements on supercritical fluids from near room temperature to 600 degrees C and pressures to 35 MPa. Two separate experimental techniques are employed to obtain PVT data over a broad range of the state surface. Burnett expansions are performed to generate compressibility factor (or equivalently density) data along a well-behaved supercritical isotherm. A series of isochoric measurements is then made to extend the temperature range. Densities assigned to the isochores are determined from their intersection with the previously measured Burnett isotherm or gravimetrically. A computer is used for experimental control and for data logging. Isochoric measurements lasting several days can be performed routinely and without operator attention. The apparatus has been tested on propane to a temperature of 325 degrees C. The density data, estimated to ± 0.1 percent, are in excellent agreement with other existing data.

14D. Reliability

401,482

PB85-108587 Not available NTIS
National Bureau of Standards, Washington, DC.
Renewal-Process Approach to Continuous Sampling Plans.
Final rept.,
G. L. Yang. Feb 83, 9p
Pub. in Technometrics 25, n1 p59-67 Feb 83.

Keywords: *Quality control, *Sampling, Approximation, Inspection, Production, Reprints, Renewal theory.

A class of continuous sampling plans (CSP's) that switch between full and partial inspection of items in a production line is formulated in terms of discrete renewal processes. The renewal-theory framework facilitates studying both the long-run average outgoing quality (AOQ) and the average outgoing quality in a short production run of length t , $AOQ(t)$. Renewal theory also leads to a computable approximation, $AOQ^*(t)$, to $AOQ(t)$. By simulation it is found that AOQ greatly overestimates $AOQ(t)$, for short runs, while the approximation $AOQ^*(t)$ is found to be sufficiently accurate in situations corresponding to actual practice. Formulas are derived enabling one to compute AOQ and $AOQ^*(t)$ for the Dodge sampling plans CSP-1 through CSP-5. Numerical illustrations for selected CSP's are presented.

14E. Reprography

401,483

PB84-162809 PC A04
National Bureau of Standards, Washington, DC. National Measurement Lab.
Utility Programs for Producing Camera Ready Illustrations on a Microcomputer and a Laboratory Plotter.
Technical note (Final),
C. E. Dick. Jan 84, 64p NBS-TN-1184
Also available from Supt. of Docs. as SN003-003-02552-6. Portions of this document are not fully legible.

Keywords: *Graphic arts, *Computer programs, Routines, Microcomputers, Apple II computers, DRAFTS-MAN computer program.

A collection of software routines is described that allows the user to prepare camera ready illustrations in the laboratory or office environment. These routines are written in APPLESOFT BASIC and 6502 assembly code for the Apple II microcomputer which is interfaced with an inexpensive digital plotter. Provisions are made to draw figures composed of straight and curved line segments, letter the figures with a variety of graphic arts fonts, and save the figures on disk for later plotting or revision.

401,484

PB84-244250 Not available NTIS
National Bureau of Standards, Washington, DC.
Using Linewidth Measurement Test Structures to Evaluate Lithographic Processes and Equipment.
Final rept.,
D. Yen, and L. W. Linholm. Mar 84, 14p
Pub. in Test Measurement World 4, n3 p48-61 Mar 84.

Keywords: *Line width, *Semiconductors, *Lithography, *Integrated circuits, Reprints.

Test structures included on the wafer during semiconductor fabrication can help the process engineer evaluate semiconductor materials, process control and process equipment. One of the most important test methods used is the measurement of linewidth. In many cases, the results from electrical measurements on a cross-bridge sheet resistor can be used to determine the electrical linewidth of a conducting layer. Test chips that contain arrays of identical cross bridges can also help determine the uniformity of a lithographic process.

401,486

PB83-205369 PC A03/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Preliminary Examination of 20 GHz G/T Measurements of Earth Terminals.
D. F. Wait, and W. C. Daywitt. Mar 83, 42p NBSIR-83-1686
Sponsored in part by Army Communications-Electronics Command, Fort Monmouth, NJ.

Keywords: *Electromagnetic noise, Figure of merit, Measurement, Microwave communication, *Communication satellite terminals, Ground stations, Satellite communications.

Three basic measurement techniques and the associated measuring systems are examined to determine which are most likely to meet the needs of measuring the figure of merit (G/T) for future 20 GHz satellite systems: use of the Sun as a known source, use of the Sun as an intercomparison source with a calibrated reference terminal, and the use of a satellite signal as an intercomparison source. It is shown that the method of using the Sun as a known source is not very accurate (about 1.5 dB uncertainty), but that using the Sun as a transfer source is useful (0.3 dB to 0.5 dB, depending on measuring system) for Earth terminals with antenna diameter less than 1.8 m (6 ft). For Earth terminals with antenna diameters greater than 1.8 m (6 ft), the Sun cannot be used as a transfer source for technical reasons, but a satellite signal can be used as a transfer source.

401,487

PB84-153865 PC A04/MF A01
National Bureau of Standards, Washington, DC.
Performance Evaluation of Telephone Cable Pedestals in Underground and Atmospheric Environments.
J. L. Fink, and E. Escalante. Jan 84, 61p NBSIR-84-2810
Sponsored in part by Rural Electrification Administration, Washington, DC.

Keywords: *Columns(Supports), Telephone cables, Performance evaluation, Corrosion, Degradation, Sub-surface structures, Pedestals.

Data are given on the corrosion of the metal surfaces and on the degradation of the fiberglass surfaces of the housing, mounting stake and internal and external hardware of telephone cable pedestals. The materials investigated on were exposed for periods up to six years in six different soil and atmospheric environments. Specimens were exposed as either a painted galvanized steel housing with a painted galvanized steel mounting stake, a painted galvanized steel housing with an unpainted galvanized steel mounting stake, a fiberglass housing with a fiberglass mounting stake, a fiberglass housing with an unpainted galvanized mounting stake, or a fiberglass housing with a polyvinylchloride mounting stake. Metals studied included, aluminum, galvanized steel, plated brass, plated steel, steel, and stainless steel alloys.

401,488

PB84-221704 Not available NTIS
National Bureau of Standards, Washington, DC.
Comparison of Two 'Guaranteed' Local Network Access Methods.
Final rept.,
R. Carpenter. Feb 84, 6p
Pub. in Data Communication, 6p Feb 84.

Keywords: Standardization, *Local area networks, *Interfaces, *Communication networks.

Two industry standardization groups, IEEE project 802 and ANSI working group X3T9.5 have recently produced finished proposals for the Physical and Data Link layers of serial broadcast local area networks. There is substantial similarity in the goals of the IEEE 'Token Bus' (TB) variant, and that of the ANSI Local Distributed Data Interface (LDDI). These goals include the absolute prevention of collisions and the ability to bound access latency. The following comparisons show that LDDI offers lower average and worst-case medium access latency than TB, and gives higher throughput in many situations. LDDI is at its best when offered load is concentrated in a few stations.

401,489

PB84-223403 Not available NTIS
National Bureau of Standards, Washington, DC.
Mobile Radio Guide.
Final rept.,
W. W. Scott, Jr. Nov 83, 38p
Sponsored in part by National Inst. of Justice, Washington, DC.
Pub. in NIJ Standard-202-83, 38p Nov 83.

Keywords: *Radio equipment, *Law enforcement, Mobile, Antennas, Selection, Procurement, Frequency allocations, Transmitter receivers, Radiofrequency interference, Maintenance, Safety.

Mobile radios are considered vital equipment in every law enforcement communications system. This user guide was prepared to assist law enforcement officials and others in the selection and procurement of mobile radio equipment. General topics include frequency and design considerations, equipment attributes, service and safety aspects and purchasing considerations. Topics treated in detail include frequency allocation, types of mobile transceivers, antenna coverage, interference, maintenance, and safety and purchasing hints. References and an annotated bibliography are included.

401,490

PB85-114718
(Order as PB85-114700, PC E07/MF E01)
British Telecommunications Research Labs., Martlesham Heath (England).
Single Mode Fibre Specification and System Performance.
D. B. Payne, M. H. Reeve, C. A. Millar, and C. J. Todd. Oct 84, 5p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p1-5 1984.

Keywords: *Optical communication, *Fiber optics, Predictions, Trends, Specifications, Performance, *Optical fibers.

It can now be safely stated that single mode fiber is established as a viable transmission medium for communications networks. This paper considers fiber specifications in isolation from the system specification, trends in optical technology, and speculations about possible system requirements in the future.

401,491

PB85-114742
(Order as PB85-114700, PC E07/MF E01)
Bell Communications Research, Inc., Holmdel, NJ.
Cutoff Wavelength and Modal Noise in Single-Mode Fiber Systems.
N. K. Cheung, and P. Kaiser. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p15-18 1984.

Keywords: *Fiber optics, *Optical communication, Near infrared radiation, *Optical fibers, *Cutoff wavelength.

In practical single-mode fiber communication systems one generally distinguishes between the theoretical cutoff wavelength $\lambda_{sub}(th)$ of the first higher order mode, and the effective cutoff wavelength which may be substantially shorter than $\lambda_{sub}(th)$ by as much as 100 to 200 nm. In this paper the authors report on the observation of modal noise effects for different fiber interconnection schemes containing intentionally overmoded fiber sections.

401,492

PB85-114759
(Order as PB85-114700, PC E07/MF E01)
Yokosuka Electrical Communication Lab. (Japan).
Issues in the Characterization of Coherent Optical Communications Systems.
T. Ito. Oct 84, 6p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p19-24 1984.

Keywords: *Optical communication, Near infrared radiation, Infrared lasers, Fiber optics, Optical fibers.

These few years, research on coherent optical transmission systems has been prosecuted enthusiastically by a couple of laboratories. It raises up world-widely the 'revival' of an interest in coherent systems. The present major interest is to seek ever more sensitive receivers, ever longer repeater spans, ever greater

17. NAVIGATION, COMMUNICATIONS, DETECTION, AND COUNTERMEASURES

17B. Communication

401,485

PB83-189928 PC A16/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Earth Terminal Measurement System Operations Manual (Revised),
David F. Wait. Jan 83, 354p NBSIR-83-1679
Supersedes PB-284 589.

Keywords: Manuals, Radio relay systems, Radiofrequency power, Gain, Measurement, Computer programs, Antennas, *Earth terminal measurement system, Satellite communications, Ground stations, Noise temperature.

The Earth Terminal Measurement System (ETMS) was developed by the National Bureau of Standards to make accurate measurements of earth terminal parameters such as the figure of merit (G/T), antenna gain relative to a reproducible reference level, the noise equivalent flux (NEF), and noise ulterior flux (NUF). This manual includes the theory of the measurements, measurement procedures, measurement troubleshooting, interpretation of the results, and a discussion of the ETMS software.

Field 17—NAVIGATION, COMMUNICATIONS, DETECTION, AND COUNTERMEASURES

Group 17B—Communication

transmission capacities and so on. Laying stress on the sensitivity of a receiver, this paper compares a coherent system with a direct detection system, referring to published or reported experimental data, and describes the future research items.

401,493
PB85-114858

(Order as PB85-114700, PC E07/MF E01)
Bell Labs., Norcross, GA.
Multimode Fiber Measurements - Present and Future.
A. H. Cherin. Oct 84, 6p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p67-72 1984.

Keywords: *Optical communication, *Fiber optics, Bandwidth, Attenuation, Diameters, Optical measurement, *Optical fibers, Multimode, Numerical aperture, Intrinsic quality factors.

Multimode graded-index fibers are commonly used as the transmission medium in the intricacy trunking and loop feeder distribution portions of modern telecommunication systems. It also appears likely that multimode fibers will be used, for the foreseeable future, in local area networks that offer a wide variety of integrated services. Because multimode fibers are used for both short and long distance applications, a number of different measurement methods have been developed to describe their transmission characteristics. This paper reviews some of the standardized multimode measurement methods and highlights current areas of concern related to the measurement of bandwidth, numerical aperture, core diameter, and attenuation. In addition, a performance related specification parameter known as the intrinsic quality factor will be briefly discussed.

401,494
PB85-114874

(Order as PB85-114700, PC E07/MF E01)
BICC Telecommunication Cables Ltd., Prescot (England).
Bandwidth Optimisation of a Multimode Fibre Installation.
S. C. Hampson. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p77-80 1984.

Keywords: *Optical communication, *Telephone lines, *Bandwidth, Telephone exchanges, Frequency response, Optimization, Autocorrelation, Fiber optics, *Optical fibers, Multimode.

The Autocorrelation Function (ACF) Effective Bandwidth was used to predict the concatenated frequency transmission response of a multimode fiber installation. The -3dB (Optical) bandwidth for each route fiber was then measured, and the figure compared with that which had been previously predicted. A program of cross-jointing was then devised in order to achieve the optimum transmission response for the installation. A specific objective of gaining a -3dB (Optical) bandwidth figure greater than 140 MHz for all route fibers was also set and achieved. The installation in question runs from a local telephone exchange to a repeater station, a distance of 22.8 km.

401,495
PB85-114890

(Order as PB85-114700, PC E07/MF E01)
British Telecommunications Research Labs., Martlesham Heath (England).
Distribution of H₂ Gas Along an Inland Optical Fibre Cable.
S. Hornung, S. A. Cassidy, and M. H. Reeve. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p85-88 1984.

Keywords: *Communication cables, *Optical communication, *Fiber optics, *Hydrogen, Distribution, Measurement, *Optical fibers.

Recently a good deal of interest has concentrated on the effects of H₂ on the optical attenuation of optical fibers. The work has mainly focused on the response of optical fibers to relatively high levels of H₂, often at elevated temperatures. Little has been reported of actual levels of H₂ in cables in operational environments. In this paper, the authors report the field measurement of levels of H₂ an inside optical fiber cable and its distribution along the cable length. The cable chosen was a BICC 'Jubilee' type, linking Guildford to Aldershot. It was selected because it contains high

phosphorus doped multimode fiber, which is particularly sensitive to H₂ (2). The authors also report two follow-up experiments, which together with a simple model go some way in explaining the nature of the experimental results.

401,496
PB85-114924

(Order as PB85-114700, PC E07/MF E01)
KDD Research and Development Labs., Tokyo (Japan).
Long-Term High-Stable Optical Fiber Loss Measuring Equipment.
Y. Namihira, H. Wakabayashi, and H. Yamamoto. Oct 84, 4p
Prepared in cooperation with Ando Electric Co. Ltd., Tokyo (Japan).
Included in Technical Digest - Symposium on Optical Fiber Measurements, p99-102 1984.

Keywords: *Communication cables, *Submarine cables, Losses, Measuring instruments, Optical measurement, *Optical fibers, *Fiber optics transmission lines.

Optical fiber submarine cable systems are promising for international transmission lines because of the possibility of a more economical high-capacity digital lines compared with the conventional submarine systems. Optical fiber submarine cable development requires the precise evaluation of cable transmission characteristics over a long period under various environmental conditions such as tensile force, water pressure and ambient temperature. For this reason, cable testing facility which can simulate the ocean bottom conditions are used to evaluate the effects of external conditions on loss. Physical limitations on the cable testing facility, however, limit the cable length to no more than 100 to 200 meters, and, with lengths of cable in this order, a loss measurement resolution of 0.001 dB is required. The authors have developed a technique making use of an LED light source and a high-stability constant-temperature box capable of control to within 0.1 deg C to perform measurements with a dynamic range of approximately 10 dB, a resolution of 0.001 dB and a stability of + or - 0.001 dB over a 5-hour-period. This paper describes a comparison measuring method which enables the measurement of very small variations in optical fiber loss, a capability not available with previously used direct measuring method.

401,497
PB85-114973

(Order as PB85-114700, PC E07/MF E01)
Kokusai Denshin Denwa Co. Ltd., Tokyo (Japan).
High Accurate Automatic Measurement Equipment for Chromatic Dispersion Making Use of the Phase-Shift Technique with LDs.
K. Tatekura, H. Nishikawa, M. Fujise, and H. Wakabayashi. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p119-122 1984.

Keywords: *Communication cables, *Submarine cables, *Optical dispersion, Optical measurement, Fiber optics, *Optical fibers, *Fiber optics transmission lines, Automatic.

In the long haul optical fiber submarine cable system, the accurate knowledge of chromatic dispersion in single-mode fibers is necessary because the mode partition noise can be the dominant limitation on a system error rate as well as transmission loss. Many techniques for the chromatic dispersion measurement have been developed; most of them could be hardly adapted to industrial stage or in the field environment because of complex set-ups and/or delicate operation. In this paper, a high accurate measurement equipment, that makes use of sinusoidally modulated LDs, is demonstrated. It is likely to match all the requirements in respect to the repeatability and absolute accuracy of measurement, the dynamic range, and the easiness in operation.

401,498
PB85-142263

Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Book Review: Optical Fibre Communication.
Final rept.,
R. L. Gallawa. Nov 81, 2p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Spectrum 18, n11 p81-82 1981.

Keywords: *Optical communications, Reviews, Reprints, Optical fibers, Fiber optics transmission lines.

This manuscript reviews the book 'Optical Fibre Communication,' prepared by the technical staff of CSELT, Torino, Italy.

401,499

PB85-142990
Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Personal Radio Guide.
Final rept.,
J. F. Shafer. 1984, 19p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in NIJ (National Institute of Justice) Guide 203-83, 19p 1984.

Keywords: *Transmitter receivers, Portable equipment, Information.

This guide describes the characteristics of personal (handheld) transceivers that are currently available and discusses some of their uses and their application in law enforcement communications systems. The purpose of this guide is to provide general background information that will help law enforcement planners analyze their personal radio needs and enable them to select the best type of equipment to satisfy those needs. In addition to personal radios, the guide discusses accessory equipment such as batteries and antennas. It includes sections on design and construction, operational considerations, cost, maintenance, safety and recent improvements. Topics treated in detail include propagation and coverage, frequency availability, building penetration, battery capacity, chargers and charging techniques, and antenna performance and construction.

401,500

PB85-144830
Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Field Strength Levels in Vehicles Resulting from Communications Transmitters.

Final rept.,
J. F. Shafer. Jun 84, 14p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in NIJ (National Inst. of Justice) Report-0200-83, 14p Jun 84.

Keywords: *Field strength, Measurement, Automobiles, Electric fields, Transmitter receivers, Radar equipment, Law enforcement, Standards.

The report provides the results of an exploratory study to measure the electric field strength levels inside an automobile from communications equipment (transmitters and associated antennas) typical of that likely to be operated in and around the automobile as a law enforcement vehicle, with and without the driver's door open, and with and without front-seat occupants, at frequencies representing the frequency bands of 25 to 50, 150 to 174, 400 to 512, and 806 to 866 MHz. Levels of output power are given for the data presented. Field strength levels are also given for the situation when a metallic prisoner shield or a personal transceiver is used in a vehicle, together with a mobile transceiver, in some cases. Also included are field strength measurements of speed measuring radar devices used in vehicles.

401,501

PB85-170645
Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Fault-Tolerant Hierarchical Broadcast Network.

Final rept.,
W. E. Burr. Dec 84, 7p
Pub. in Proceedings of Conference Computer Networking Symposium, Gaithersburg, MD., December 11, 1984, p11-17.

Keywords: *Networks, *Radio broadcasting, *Local area networks, *Computer networks, Optical fibers, Fault tolerance.

Hierarchical star or rooted tree local networks have been implemented and have many desirable characteristics, including excellent performance, conceptual simplicity, and suitability for optical fiber implementations. They do, however, have a single point of vulnerability to catastrophic failure (the master or root hub) as well as vulnerabilities to single failure of links or hubs high in the hierarchy, which could disable large portions of the network. A generalization of the hub and network structure is presented, which adds redundant network components to eliminate this vulnerabil-

ity and make an extremely robust and fault-tolerant network.

17G. Navigation and Guidance

401,502

PB85-151710 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Separating the Variances of Noise Components in the Global Positioning System.
Final rept.,
D. W. Allan, and M. Weiss. 1983, 16p
Pub. in Proceedings of the Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting, Washington, DC., December 6-8, 1983, p115-131.

Keywords: Frequency stability, Errors, Atomic clocks, *Global positioning system.

Central to the success of the GPS program is the ability to model the frequency stability characteristics of its various components. A persistent challenge in evaluating the Global Positioning System is the separation of the errors of the satellite clocks from those due to the satellite ephemeris errors and/or the signal propagation delay errors. This information is important when one tries to improve the performance of the Global Positioning System. It is necessary to know if a particular component of the system meets specification and which component(s) limits performance. Although one cannot separate the errors themselves, a method has been developed whereby the 'Allan Variances' of critical components to the GPS can be separated. Using a reference clock such as UTC(NBS) or UTC(USNO), for example, the fractional frequency stability of each of the following can be separated from each of the others: the reference clock, the space vehicle clock, the GPS clock, the clock upload correction, the ephemeris and the propagation delay. This technique has the potential to significantly assist in properly setting the parameters to obtain optimum performance from the Global Positioning System e.g. setting the Kalman filter parameters. Results will be given showing some interesting surprises in the characteristics of the system.

17I. Radar Detection

401,503

PB84-226372 Not available NTIS
National Bureau of Standards, Washington, DC.
Application of a Systematic Approach to an Investigation of HF Interference to a Shipboard Radar Set.
Final rept.,
L. D. Driver, and G. R. Reeve. Apr 84, 8p
Pub. in Proc. 1984 IEEE Nat. Symp. Electro-magnetic Compatibility, San Antonio, Texas, April 24-26, 1984, IEEE Cat. No. 84CH2035-4, p211-218.

Keywords: *Radiofrequency interference, *Radar, *Shipborne detectors, Electromagnetic shielding, Field strength, Electromagnetic interference.

This paper describes an investigation of electromagnetic interference to a shipboard radar caused by a co-located HF, one kilowatt transmitter. The test procedures and analysis used to determine the points of EM field entry, the corrective measures taken, and the results achieved are described.



18.

NUCLEAR SCIENCE AND TECHNOLOGY

18A. Fusion Devices (Thermonuclear)

401,504

PB84-217488 PC A18/MF A01
National Bureau of Standards (NML), Boulder, CO.
Fracture and Deformation Div.
Materials Studies for Magnetic Fusion Energy Applications at Low Temperatures - VII.
Technical rept.,
R. P. Reed, and N. J. Simon. May 84, 425p NBSIR-84/3000
See also PB83-259630. Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Superconducting magnets, *Stainless steels, *Composite materials, *Cryogenics, Mechanical properties, Weldments, Castings, Materials, Technology transfer, *Magnetic fusion energy, Steel 304, Steel 18Cr 13Mn 3Ni, Steel 19Cr 10Ni.

Work leading toward development of strong, tough structural alloys for use in superconducting magnets continued this year, with low temperature studies assessing the quantitative dependence of the yield strength, density, and elastic constants of AISI 304 stainless steels upon carbon and nitrogen concentration. Tensile property measurements of developmental austenitic steels from the U.S., Japan, and the U.S.S.R. confirmed a logarithmic dependence of yield strength upon temperature between 4 K and room temperature. Evidence is presented to show that the flow strength and austenite stability of stainless steels are not significantly affected by 8-T fields at 4 K. New instrumentation developed for low-temperature testing included a computer-assisted apparatus that was used to measure threshold fatigue. Low-temperature welding research involved an investigation of the weld reinforcement effect on the weld joint strength and measurements of the 4-K fracture toughness of 25MN - 5Cr steel weldments and 320LR electrodes. In the area of nonmetallics, a standardized test specimen was devised for a screening program to develop radiation-resistant composites for magnet insulation, and models to predict damage in woven glass/epoxy laminates were tested experimentally at low temperatures. Mechanical properties of concrete mortar and polyurethane foam at 4 K are reported.

401,505

PB85-115491 Not available NTIS
National Bureau of Standards, Washington, DC.
Structural Alloys for Superconducting Magnets in Fusion Energy Systems.
Final rept.,
H. I. McHenry, and R. P. Reed. 1980, 18p
Sponsored in part by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Nuclear Engineering and Design, v58 n2 p219-236 May 80.

Keywords: *Superconducting magnets, Stainless steels, Aluminum alloys, Cryogenics, Mechanical properties, Reprints, Steel 304, Steel 310, Steel 316, Aluminum alloy 5083, Aluminum alloy 6061, Aluminum alloy 2219, Steel 21Cr 9Mn 6Ni.

The behavior of selected alloys for superconducting magnet structures in fusion energy systems is reviewed with emphasis on the following: austenitic stainless steels (AISI grades 304, 310S and 316), nitrogen-strengthened austenitic stainless steels (types 304LN, 316LN and 21Cr-6Ni-9Mn) and aluminum alloys (grades 5083, 6061 and 2219). The mechanical and physical properties of the selected alloys at 4 K are reviewed. Welding, the properties of weldments and other fabrication considerations are briefly dis-

cussed. The available information suggests that several commercial alloys have adequate properties at 4 K and sufficient fabrication characteristics for the large magnet structures needed for fusion energy systems.

401,506

PB85-120616 Not available NTIS
National Bureau of Standards, Washington, DC.
Low Temperature Materials Research Program for Magnetic Fusion Energy.
Final rept.,
F. R. Fickett, M. B. Kasen, H. I. McHenry, and R. P. Reed. 1978, 11p
Pub. in Advances in Cryogenic Engineering 24, p52-62 1978.

Keywords: *Nuclear fusion, *Superconducting magnets, Alloys, Mechanical properties, Cryogenics, Reviews, Reprints, *Fusion reactors.

The Cryogenics Division of NBS is currently operating a program for ERDA to develop data on materials properties, both mechanical and physical, of solids which have application in superconducting magnets for magnetic fusion energy. The materials groups considered are: structural alloys; thermal insulators; electrical insulators, films and coatings; structural composites and bulk insulators; conductors; adhesives. The authors have recently completed a survey of materials needs and current choices for proposed MFE devices. The results of the survey will be presented. In addition, the research program and data handbook project, both now underway, will be described.

18D. Nuclear Instrumentation

401,507

PB84-221670 Not available NTIS
National Bureau of Standards, Washington, DC.
Gamma-Ray Component from a Cf Fission Source.
Final rept.,
C. M. Eisenhauer, and R. B. Schwartz. Dec 82, 6p
Pub. in Proceedings of Department of Energy Workshop Personnel Neutron Dosimetry (9th) held at Las Vegas, Nevada on June 24-25, 1982, p28-34 Dec 82.

Keywords: *Dosimeters, *Ionization chambers, Californium isotopes, Nuclear fission, Comparison, Gamma rays, Measurement, *Gamma detection.

Measurements of the gamma ray components from bare and moderated Cf fission sources are described. The three types of detectors used were Hankins-type albedo dosimeters, Mg-Ar ionization chambers, and plastic pocket ionization chambers. Measurement of the gamma-ray component of the moderated Cf source are believed to be spuriously high due to capture gamma rays produced in the Cd of the Hankins dosimeters. Measurements of the gamma-rays from the bare NBS Cf source indicate a significant component of soft photons with energies about = or < 50 keV.

401,508

PB84-224179 Not available NTIS
National Bureau of Standards, Washington, DC.
Radiation Detection and Measurement (Book Review).
Final rept.,
L. Costrell. Jun 80, 72p
Pub. in Nuclear Science and Engineering, v74 n3 p163-234 Jun 80.

Keywords: *Radiation measuring instruments, Books, Reviews, Reprints, *Radiation detection.

A Book Review of 'Radiation Detection and Measurement' by Glenn F. Knoll, John Wiley and Sons (1979) is given.

Field 18—NUCLEAR SCIENCE AND TECHNOLOGY

Group 18D—Nuclear Instrumentation

401,509

PB84-224849 Not available NTIS
National Bureau of Standards, Washington, DC.
Absolute Fission Chambers for High-Energy Neutron Fields.
Final rept.,
D. M. Gilliam, and I. G. Schroder. Nov 82, 2p
Pub. in Proceedings of 1982 Winter Meeting, American Nuclear Society, Washington, DC., November 14-18, 1982, Transactions 43, p286-287.

Keywords: *Fission chambers, *Ionization chambers, *Neutron counters, Nuclear fusion, Fusion reactors, Tokamak type reactors.

The neutron diagnostics systems for both the Tokamak Fusion Test Reactor and the Joint European Torus will use fission ionization chambers for observing the time profiles of neutron production. These systems cover wide dynamic ranges (9 to 12 orders of magnitude) by a combination of the pulse-counting and current modes of operation. The present paper discusses the advantages and possibilities of extending the pulse-counting mode as high as possible into the dynamic range for neutron diagnostics in high-energy neutron fields. A limit of the order of 10 to the 12th power n/((sq cm)sec) is estimated from past fission chamber developments and the present calculations of charged particle emissions.

401,510

PB84-227446 Not available NTIS
National Bureau of Standards, Washington, DC.
Procedural Standards for Radioactivity Measurements.
Final rept.,
C. W. Seidel, and J. M. R. Hutchinson. Dec 80, 10p
Sponsored in part by New England Nuclear Corp., Boston, MA. Nuclides and Sources Div.
Pub. in Proceedings of the Health Soc. Winter Meet. 1980, Hyannis, MA, Dec 8-12, p345-354.

Keywords: *Radiation measuring instruments, *Radioactivity, *Standards, *Calibrating, *Radiation dosage, Ionization chambers, Sodium iodides, Measurement, Gamma detection, Liquid scintillation detectors.

The American National Standards Institute (ANSI) Committee-N42.2 has, since 1973, worked on developing procedural standards for the calibration and usage of: (a) 'dose calibrator' ionization chambers for the assay of radionuclides; (b) germanium detectors for the measurement of gamma-ray emission of radionuclides; (c) sodium iodide detector systems; (d) liquid scintillation counting systems. These procedures have become National Standards within the last 2 1/2 years. Other standards are currently being developed. The composition of the committee and writing groups, the objectives that were set in developing the procedural standards and the interactions with the appropriate regulatory groups, instrument manufacturers as well as the National Bureau of Standards are presented. The Standards included a section on precautions as well as one on the sources of error to minimize the potential of obtaining and using erroneous data and to give the user a better understanding of the measurement system.

401,511

PB84-244029 Not available NTIS
National Bureau of Standards, Washington, DC.
Three-Dimensional Imaging of X-Ray Objects.
Final rept.,
L. I. Yin, S. M. Seltzer, M. J. Bielefeld, and J. I. Trombka. 1983, 2p
Pub. in Am. Nucl. Soc. Trans. 45, p256-257 1983.

Keywords: *X rays, *Gamma rays, Computerized simulation, Reprints, *Imaging techniques, Three dimensional, Tomography.

By means of computer-simulated results, the authors demonstrate in this paper the imaging of extended x-ray- and gamma-ray-emitting objects using a Non-Overlapping Redundant Array (NORA). The basic concept has been used by the authors previously in the development of a laboratory device for the real-time viewing of x-ray objects. Here they explore the feasibility of using NORA for the imaging of weak x-ray and gamma-ray objects in both analog and digital modes.

401,512

PB85-112043 Not available NTIS
National Bureau of Standards, Washington, DC.
National Bureau of Standards Small-Angle Neutron Scattering Spectrometer.
Final rept.,
C. J. Glinka. 1982, 3p
Sponsored in part by Argonne National Lab., IL.
Pub. in Proceedings of Symposium of Neutron Scattering, Argonne, IL., August 12-14, 1981, n89 p395-397 1982.

Keywords: *Neutron spectrometers, *Neutron scattering, Performance, Design, *Research facilities, *Position sensitive detectors.

A new facility for small-angle neutron scattering is near completion at the NBS Research Reactor. The instrument uses a 65 x 65 sq cm position-sensitive detector, variable incident wavelength, and a novel converging beam collimation system. The instrument and its capabilities are discussed, along with measurements indicative of its performance.

401,513

PB85-113025 PC A02/MF A01
National Bureau of Standards (NML), Gaithersburg, MD.
Calibrated Glass Standards for Fission Track Use (Supplement to NBS SP 260-49).
Final rept.,
B. S. Carpenter. Sep 84, 25p NBS/SP-260/92
Library of Congress catalog card no. 84-601112. Also available from Supt. of Docs as SN003-003-02610-7.

Keywords: *Standards, Thermal neutrons, Neutron irradiation, Uranium, Glass, *Standard reference materials, *Fission tracks, *Neutron monitors.

Two glasses of different uranium concentrations were prepared and reissued for certification by the National Bureau of Standards as standards for use as neutron monitors to aid fission track studies. These Standard Reference Materials (SRM's) and their uranium concentrations are: SRM 962a (37.4 ppm) and SRM 963a (0.823 ppm). These glass wafers were irradiated in the National Bureau of Standards Research Reactor and the neutron fluence was monitored using copper and gold foils, as well as an iron-cobalt foil.

401,514

PB85-123461 Not available NTIS
National Bureau of Standards, Washington, DC.
Nuclear Track Determination of Lithium and Boron in Various Matrices.
Final rept.,
L. J. Piliore, and B. S. Carpenter. 1981, 8p
Pub. in Nuclear Instruments and Methods in Physics Research 188, n3 p639-646 1981.

Keywords: *Alpha particle detectors, *Lithium, *Boron, *Tritons, Particle tracks, Thermal neutrons, Trace elements, Neutron reactions, Reprints.

In recent experiments it has been demonstrated that trace amounts of lithium and boron can be determined uniquely by recording their thermal neutron-induced reaction products in nuclear track detectors. In some samples it may be difficult to isolate the source of alpha particle emissions, induced by thermal neutrons, because these reactions are common to a number of elements. Lithium and boron will undergo a significantly larger number of alpha-producing nuclear reactions than equivalent amounts of these other elements, because of their large thermal neutron cross-sections and isotopic abundances. By careful chemical etching, the alpha particle tracks from neutron-induced boron reactions can be enlarged selectively to an easily discernible size. The boron distribution within the sample is determined by measuring these etched alpha particle tracks in the detector. The boron-alpha detector also serves the role of a particle absorber, stopping all alpha particles produced at the sample surface from reaching a second detector positioned behind it. Tritons, generated by neutron-induced lithium reactions, penetrate and produce etchable tracks within the second detector.

401,515

PB85-124345 Not available NTIS
National Bureau of Standards, Washington, DC.
Microchannel Plate Neutron Detector.
Final rept.,
R. A. Schrack. 1984, 8p
Sponsored in part by Nuclear Regulatory Commission, Washington, DC., and Department of Energy, Washington, DC.
Pub. in Nuclear Instruments and Methods in Physics Research 222, p499-506 1984.

Keywords: Neutron radiography, Lithium, Reprints, *Position sensitive detectors, *Neutron detectors, Microchannel electron multipliers, Two dimensional.

A two-dimensional, position-sensitive neutron detector using a microchannel plate electron multiplier with resistive anode has been developed for use in resonance neutron radiography. The resolution characteristics of the detector are determined for different scintillator arrangements. The best resolution obtained with a 0.5 mm thick scintillator with a black backing is 0.75 mm. The use of the detector is demonstrated in producing separated images of three elements in a complex matrix sample.

401,516

PB85-140663 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Measurement of the (235)U Mass in a Large Volume Multiplated Fission Ionization Chamber.
Final rept.,
O. A. Wasson, and M. M. Meier. 1981, 12p
Pub. in Nuclear Instruments and Methods 190, n3 p571-582, 15 Dec 81.

Keywords: *Uranium 235, *Mass, Ionization chambers, Neutron beams, Nuclear fission, Reprints.

The mass of (235)U contained in a large-volume multi-deposit fission ionization chamber used for neutron cross section experiments was measured relative to the National Bureau of Standards reference deposit 25S-2-1. The mass ratio used the thermal neutron induced fission reaction in a uniform 25 cm diameter neutron beam from the thermal column of the NBS reactor. The mass was independent of the geometrical area and areal density variation of the deposits, absolute neutron flux, thermal neutron energy distribution, and neutron cross sections. The (235)U mass in the chamber is 0.1709 g with a one standard deviation uncertainty of 1.2%.

401,517

PB85-141372 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Design and Calibration of an Absolute Flux Detector for 1-15 MeV Neutrons.
Final rept.,
M. S. Dias, R. G. Johnson, and O. A. Wasson. 1984, 14p
Pub. in Nuclear Instruments and Methods in Physics Research 224, p532-546 1984.

Keywords: *Calibrating, Neutron beams, Design, Performance, Reprints, *Neutron detectors, MeV range 01-10, MeV range 10-100.

An absolute neutron flux monitor having fast timing and a calculable response has been developed for use in a collimated beam of 1-15 MeV neutrons. The detector consists of dual thin plastic scintillators in which the proton recoil spectrum distortion caused by the escape of protons from the first scintillator is eliminated experimentally. The absolute detector efficiency was measured at 2.45 and 14.0 MeV neutron energies using the associated-particle technique at the NBS Positive-Ion Van de Graaff facility. The efficiency and pulse height distributions were calculated using a Monte Carlo based program in order to extend the efficiency throughout the 1-15 MeV interval. The uncertainty in the efficiency is 1-2% (1 standard deviation).

18E. Nuclear Power Plants

401,518

PB85-108611 Not available NTIS
National Bureau of Standards, Washington, DC.
Tornado-Borne Missile Speed Probabilities.
Final rept.,
E. Simiu, and M. R. Cordes. Jan 83, 15p
Sponsored in part by Nuclear Regulatory Commission, Washington, DC.
Pub. in Jnl. of Structural Engineers 109, n1 p154-168 Jan 83.

Keywords: *Nuclear power plants, Velocity, Estimates, Tornadoes, Missiles, Probability theory, Reprints, Computer applications.

A procedure is developed for estimating speeds with which postulated missiles hit any given set of targets in a nuclear power plant or similar installation. Hit speeds corresponding to probabilities of occurrence are calculated for a given nuclear power plant under various assumptions concerning the magnitude of the force opposing missile takeoff, direction of tornado axis of translation, number and location of missiles, and size of target area.

18F. Radiation Shielding and Protection

401,519

PB84-221720 Not available NTIS
National Bureau of Standards, Washington, DC.
Physics and Mathematics of Beta-Particle Dosimetry for Radiation Protection.
Final rept.,
R. Loevinger, S. M. Seltzer, and H. T. Heaton, II. Jan 84, 14p
Pub. in Proceedings of Int. Beta Dosimetry Symposium, Washington, DC., February 15-18, 1983, p1-14 Jan 84.

Keywords: *Radiation protection, *Beta particles, *Dosimetry, Point kernels, Transport theory.

Fast electrons interact with matter through many elastic and inelastic collisions with atomic electrons and nuclei. The effects of these interactions are often described in terms of collision stopping power, radiative stopping power, angular scattering, electron range, and range straggling. Electron transport theory combines these effects to provide a description of the penetration of the electrons, and the deposition of energy in materials of interest. Calculations of interest in radiation protection have been performed for mono-energetic electron sources and for beta-particle sources, and the results can be expressed in terms of point and plane kernels. The energy dependence of the results can often be greatly reduced by suitable scaling. The physical information and mathematical methods that constitute the basis of beta-particle dosimetry for radiation protection are surveyed.

401,520

PB85-126001 PC A14/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Building Penetration Project,
J. C. Wyss, W. J. Anson, and R. D. Orr. Sep 84, 310p NBSIR-84/3009
Sponsored in part by Army Communications Command, Fort Huachuca, AZ.

Keywords: *Electromagnetic radiation, *Buildings, *Attenuation, Computer programs, Electromagnetic shielding, Construction materials, Penetration, Electrical properties, Dimensions, Design, Architecture, Shielding.

This report documents a computer program which calculates building attenuation of electromagnetic radiation over the frequency range 10 kHz - 10 GHz. Attenuation (in dB) is computed from building shape, dimensions, room layout, and the electrical properties of construction materials; no electromagnetic measurements are required. Details of the structure and use of the program are given.

401,521

PB85-136265 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Effect of Phantom Geometry on the Conversion Factor from Exposure to Absorbed Dose.
Final rept.,
M. Ehrlich, and C. G. Soares. 5 Mar 84, 3p
Pub. in Radiation Protection Dosimetry 8, n4 p261-263, 5 Mar 84.

Keywords: *Radiation dosage, *Gamma rays, Reprints, Thermoluminescent dosimetry, Conversion factors, KeV range 10-100, KeV range 100-1000, MeV range 01-10, Phantoms.

The conversion factors from exposure to absorbed dose in water phantoms of slab and spherical geometries are deduced from TLD measurements in polymethylmethacrylate phantoms, for photon energies between about 20 keV and 1.25 MeV, and for shallow and deep depths in the phantoms. The conversion factors measured in the slab are found to exceed those measured in the sphere by at most 10 percent for the shallow depth and by somewhat less for the deep depth. The effect is most pronounced for photon energies between 80 and 140 keV. The results are compared with those deduced from calculations and measurements available in the literature.

18H. Radioactivity

401,522

PB84-239342 Not available NTIS
National Bureau of Standards, Washington, DC.
Dedication, Wilfrid Basil Mann.
Final rept.,
B. M. Coursey, and W. L. McLaughlin. 1983, 2p
Pub. in International Jnl. of Applied Radiation and Isotopes 34, n8 pii-iv 1983.

Keywords: *Radioactivity, *Metrology, *Scientists, Environmental surveys, Standards, Reprints, *Mann Wilfrid Basil.

Dr. Wilfrid Mann's peripatetic early career as diplomat and scientist is described in his recent book 'Was There a Fifth Mann, Quintessential Recollections'. Having read for his Doctorate in Physics at Imperial College, London in the 30's, interspersed with Fellowships for research with Niels Bohr and Martin Knudsen in Copenhagen and with Ernest Lawrence at Berkeley, Dr. Mann divided the war years between London and Washington in researching, teaching, and scientific liaison. For his war-time ordnance work at the British Central Scientific Office in Washington, he received the Medal of Freedom. Returning, in 1945, to Imperial College to lecture and to complete the assembly of the Van de Graaff accelerator, he was soon recruited for a new project on radioactive-tracer work at the Canadian National Research Council's laboratory, which under John Cockcroft's directorship had just moved from Montreal to Chalk River. There he set up the first radioactivity-standards laboratory. The Chalk River work was interrupted in 1948 by another Scientific Liaison mission at the British Embassy in Washington, but by this time Dr. Mann's sights were firmly set on a career in radionuclide metrology.

401,523

PB84-242015 PC A03/MF A01
American National Standards Inst., New York.
American National Standard N43.10; Safe Design and Use of Panoramic, Wet Source Storage Gamma Irradiators (Category IV).
Final rept.
Jul 84, 36p ANSI-N43.10-1984, NBS/HB-142
Also available from Supt. of Docs as SN003-003-02598-4. Library of Congress catalog card no. 84-601091.

Keywords: *Gamma irradiation, *Radiation protection, *Standards, Gamma rays, *American national standards, Gamma sources.

This standard applies to panoramic, wet source storage irradiators (Category IV) that contain sealed gamma emitting sources for the irradiation of objects or materials. It establishes the criteria to be used in the proper design, fabrication, installation, use, and maintenance of these irradiators which will ensure a high degree of radiation safety at all times. The requirements of the standard are grouped as (1) general considerations, (2) manufacturer's responsibility, and (3)

owner's responsibility. Included in the first group are general radiation protection criteria, sealed source performance requirements, and radiation survey needs. Among the manufacturer's responsibilities are criteria for maximum external radiation levels, integrity of shielding, and controls and indicators. The requirements for users include safety-related servicing, administrative procedures, operator qualifications, and routine safety tests.

401,524

PB84-242981 PC A03/MF A01
American National Standards Inst., New York.
American National Standard N542; Sealed Radioactive Sources, Classification.
Final rept.
Jul 78, 30p ANSI-N542-1977, NBS/HB-126

Keywords: *Radioactivity, *Radiation protection, *Standards, Classifications, *American national standards, *Radiation sources.

This standard establishes a system of classification of sealed radioactive sources based on performance specifications related to radiation safety. It provides a manufacturer of sealed sources with a series of tests for evaluating the safety of his product under specified conditions, and also assists a user of such sources to select a type which suits the intended application insofar as maintenance of source integrity is concerned. Tests are prescribed for temperature, external pressure, impact, vibration, and puncture over a range of severity. Sealed source performance requirements are identified for a variety of source applications, in terms of a specific degree of severity of each test. Appendixes are included on the subjects of leak test methods, quality assurance and control, brachytherapy sources, self-luminous light sources, and special form radioactive material.

401,525

PB84-244714 Not available NTIS
National Bureau of Standards, Washington, DC.
Distribution of Origins of Sputtered Particles and the Shape of the Target Region Affected by the Cascade Recoils.
Final rept.,
M. L. Roush, F. Davarya, G. P. Chambers, T. D. Andreadis, and J. He. 1984, 4p
Pub. in Nuclear Instruments and Methods in Physics Research B2, p693-696 1984.

Keywords: *Ion irradiation, Silicon, Argon, Computerized simulation, Sputtering, Reprints.

The recoil cascade resulting from Ar bombardment of Si has been studied by computer simulation. The average behavior of the cascade is determined by combining the results for a large number of incident particle histories. By sorting recoils according to the number of scatterings which precede their production, information is assembled concerning the manner in which the recoil cascade grows in size and shape. Results are also presented concerning the distribution of the origins of the particles which sputter. Here, distributions are given in terms of the transverse distance from the point of incidence of the bombarding ion.

401,526

PB85-137446 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
National Bureau of Standards Rocky Flats Soil Standard Reference Material.
Final rept.,
K. G. W. Inn, W. S. Liggett, and J. M. R. Hutchinson. 1984, 8p
Pub. in Nuclear Instruments and Methods in Physics Research 223, p443-450 1984.

Keywords: *Radioactive contaminants, *Soils, *Standards, Plutonium 239, Concentration(Composition), Sampling, Chemical analysis, Reprints, *Standard reference materials, Rocky Flats Plant, Plutonium 240, Natural emissions.

The National Bureau of Standards (NBS) in collaboration with a number of environmental laboratories of the ICRM has recently issued a soil standard certified for radionuclidic concentrations of activation and fission products and natural radionuclides. Initial disagreements between laboratories of measured concentrations have led to a careful examination of the characteristics of the sample and the radiochemical procedures employed by the participants. A number of assay problems were identified and are discussed. The

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sample was found to contain an average of approximately 1.8 'hot' (239 + 240)Pu particles per bottle of 90 g of soil. A statistical analysis of over seventy measurements was used to determine that the homogeneity of the material excluding hot particles is satisfactory. A sampling method for using this material for quality control of plutonium measurements which minimizes the effect of hot particles is described.

401,527

PB85-137768 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Development of a Regenerative Radon-in-Water Radioactivity Standard.
Final rept.,
J. M. R. Hutchinson, P. A. Mullen, and R. Colle.
1984, 7p
Pub. in Nuclear Instruments and Methods in Physics Research 223, p451-457 1984.

Keywords: *Radioactivity, *Standards, *Water analysis, Potable water, Water quality, Quality control, Water, Concentration(Composition), Reprints, *Radon 222, Radium 226.

NBS has developed a prototype standard that generates samples of radium-free (222)Rn gas dissolved in distilled water. This standard is intended to be used for quality control of the U.S. Environmental Protection Agency's program to survey drinking water. It consists of a generator and delivery system which can accurately dispense solutions of (222)Rn with known concentration into, for example, a liquid scintillation vial containing scintillation cocktail. The prototype consists of a source of (226)Ra which is deposited on an ion exchange filter and sandwiched between two layers of thin polyethylene tape and immersed in water in a specially constructed accumulation chamber. The chamber is then flushed and (222)Rn is allowed to accumulate for a measured time and flushed again into a large syringe from which the standard solution is dispensed. From the measurements made at NBS over the past two years, the (222)Rn in the ion exchange filter-polyethylene sandwich, and therefore, the concentration of radon dissolved in the water, can be predicted accurately. Other characteristics of the system will be reported.

401,528

PB85-143923 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Reflection of 252Cf Fission Neutrons from a Concrete Floor.
Final rept.,
L. Linpei. 1983, 5p
Pub. in Radiation Protection Dosimetry 5, n4 p227-231 1983.

Keywords: *Fission neutrons, *Neutron albedo, Reflection, Concretes, Floors, Reprints, *Californium 252.

The effect of (252)Cf fission neutrons reflected from a concrete floor, on the response of (235)U in a NBS fission chamber was measured. It was found that the reflected neutrons contribute 0.12% of the response at the usual source detector distance of 5 cm. By varying the source height above the floor, the author found that relative contributions of reflected neutrons were as high as 300%. It was found that the contribution from reflected neutrons varies as the inverse square of the distance of the detector from the image source created by regarding the floor as a mirror.

401,529

PB85-148047 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Basic Radionuclide Measurements at the U.S. National Bureau of Standards.
Final rept.,
D. D. Hoppes. 1984, 9p
Pub. in Environment International 10, p99-107 1984.

Keywords: *Radioactive isotopes, *Radioactivity, *Calibrating, Metrology, Reprints, Standard reference materials.

Methods presently used for the direct measurement of the activity of radionuclides are summarized. The application of these and other methods to the basic calibrations maintained in the Radioactivity Group at the U.S. National Bureau of Standards are then examined, with short descriptions of some of the available instruments. Calibration methods and uncertainties are given for 79 radionuclides.

401,530

PB85-148054 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Statistical Assessment of Subsampling Procedures.
Final rept.,
W. S. Liggett, K. G. W. Inn, and J. M. R. Hutchinson.
1984, 9p
Pub. in Environment International 10, p143-151 1984.

Keywords: *Radioactivity, *Sampling, Environmental impacts, Plutonium 239, Normal density functions, Normality, Reprints, Standard reference materials, Plutonium 240, Hypothesis testing.

As shown by the examples in this paper, the concentrations in subsamples are not necessarily independently and normally distributed despite vigorous grinding and mixing of the original sample. Studies of the statistical properties of subsample concentrations should test for deviations from independence and normality and, if deviations are found, should model the observed distribution. The tests include an analysis of variance to check for less variation among nearby subsamples than among widely spaced subsamples, as well as the computation of the probability plot correlation coefficient to check for nonnormality. These tests are illustrated with (239)Pu + (240)Pu measurements on subsamples prepared for use as standard reference materials. These materials are used in quality assurance for environmental radioactivity measurements.

401,531

PB85-148096 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Radioactivity Standards for Environmental Monitoring.
Final rept.,
K. G. W. Inn, P. A. Mullen, and J. M. R. Hutchinson.
1984, 7p
See also PB-290 521. Sponsored by Department of Energy, Washington, DC., Environmental Protection Agency, Washington, DC., and Nuclear Regulatory Commission, Washington, DC.
Pub. in Environment International 10, p91-97 1984.

Keywords: *Radioactivity, *Standards, Environmental surveys, Gamma rays, Reprints, Radiation monitoring, Radon 222.

The current environmental-monitoring-standards efforts of the low-level radioactivity laboratory in the Radioactivity Group of the National Bureau of Standards are described. The calibration efforts include traceability programs, natural-matrix Standard Reference Materials, alpha-particle-emitting standards, and international radioactivity intercomparisons. New radiometry efforts under development include a prototype radon-222 in water standard, gamma-ray emission-rate measurement techniques in the 60-keV region, and atom-counting techniques for radioactivity measurements.

18I. Reactor Engineering and Operation

401,532

PB84-224856 Not available NTIS
National Bureau of Standards, Washington, DC.
Requirements for Referencing Reactor Pressure Vessel Surveillance Dosimetry to Benchmark Neutron Fields.
Final rept.,
E. D. McGarry. 1982, 20p
Pub. in Proceedings of International Atomic Energy Agency Meeting, Vienna, Austria, Oct 12-16, 1981, p29-45, 1982.

Keywords: *Pressure vessels, Nuclear reactor safety, Calibrating, Accuracy, Neutron irradiation, *Neutron dosimetry, Benchmarks, Light water reactors.

The objective of benchmark field referencing is to guarantee measurement accuracy of dosimetry methods for LWR-PV Dosimetry Surveillance by carrying out various types of calibration irradiations in well-characterized neutron fields. The participation of the National Bureau of Standards in particular phases of benchmarking is discussed and the status of activities is given. Notable applications to date are given.

18J. Reactor Materials

401,533

PB84-229533 Not available NTIS
National Bureau of Standards, Washington, DC.
Computerized Site Security Monitor and Response System.
Final rept.,
R. T. Moore. 1 Jun 81, 9p
Sponsored in part by Defense Nuclear Agency, Washington, DC. See also PB84-294343.
Pub. in Proceedings of Annual Symposium Role of Behavioral Science in Physical Security (5th), Gaithersburg, MD., June 11-12, 1980, p9-17, 1 Jun 84.

Keywords: *Nuclear materials management, *Nuclear weapons, *Security, Monitors, Computer networks, Optical communication, Detectors, Reliability, Maintainability, *Safeguards, Computer applications, State of the art.

An integrated, state-of-the-art, computer-based system has been defined to enhance and improve the overall physical security of storage sites for nuclear weapons and materials. It would provide for the interconnection of a distributed network of computers with a survivable, fiber optics communications network. This distributed processing system would monitor and control the various physical security sub-systems on the site, including intrusion alarms and alarm assessment subsystems, access control equipments, deterrent systems. Sensors responsive to meteorological and environmental stimuli are provided to permit the use of correlation techniques to identify certain classes of nuisance alarms. The system is intended to provide timely, accurate and unambiguous information about the site security status or the progress of an attack or intrusion attempt and to provide local security forces with appropriate preprogrammed response initiatives.

401,534

PB84-242965 Not available NTIS
National Bureau of Standards, Washington, DC.
Neutron Resonance Transmission Analysis of Reactor Spent Fuel Assemblies.
Final rept.,
C. D. Bowman, R. A. Schrack, J. W. Behrens, and R. G. Johnson. 1983, 9p
Pub. in Proceedings of World Conference on Neutron Radiography (1st), San Diego, CA., December 7-10, 1981, p503-511 1983.

Keywords: *Nuclear fuel reprocessing, *Assaying, Uranium isotopes, Plutonium isotopes, Americium isotopes, Neutron beams, *Spent fuels, *Neutron resonance transmission analysis, Safeguards.

A method called Neutron Resonance Transmission Analysis (NRTA) is under study which would use a pulsed neutron beam for nondestructive isotopic assay of a complete spent fuel assembly. Neutrons removed from the collimated beam by absorption or scattering in the resonances of the various isotopes in the spent fuel appear as dips in the neutron transmission. The method is completely insensitive to matrix materials such as oxide, fuel cladding, and other structural members. Measurements on spent fuel buttons using the NBS linac as a pulsed neutron source demonstrate a high accuracy capability for the isotopes (234,235,236,238) U, (239,240,241,242) Pu, (241) Am, (243) Am, and several fission products. The NRTA method offers high speed and modest operational cost, and it can be implemented with commercially available medical or radiographic gamma-ray generators adapted for neutron production.

20.

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19.

ORDNANCE

20A. Acoustics

401,535
PB85-102770 Not available NTIS
National Bureau of Standards, Washington, DC.
Possibilities for International Cooperation in Standardizing Measurement Methods for Nuclear Safeguards.
Final rept.,
H. T. Yolken. 1979, 7p
Sponsored in part by International Atomic Energy Agency, Vienna (Austria).
Pub. in Proceedings of IAEA (International Atomic Energy Agency) Symposium, Nuclear Materials Safeguards, Vienna, Austria, October 2, 1978, p243-249 1979.

Keywords: *Nuclear materials management, Measurement, Standards, *International cooperation, *Safeguards, Nuclear facilities.

The need to accurately determine the amount of fissionable materials in nuclear fuel cycle facilities is of clear importance to both international and domestic safeguards activities. A suggested international measurement and standards system is described. Finally, a number of recommendations for implementing and carrying forward an international cooperative effort in standardization of measurements for nuclear safeguards are presented.

401,536
PB85-144483 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Neutron Resonance Transmission Analysis of Reactor Fuel Samples.
Final rept.,
J. W. Behrens, R. G. Johnson, and R. A. Schrack. 1984, 7p
Pub. in Nuclear Technology 67, p162-168 Oct 84.

Keywords: *Nuclear fuels, Fission products, Isotope availability, Reprints, *Spent fuels, *Isotope ratio, Neutron resonance transmission analysis, Time-of-flight method.

Neutron resonance transmission analysis (NRTA) was used to measure the isotopic content of fresh and spent nuclear reactor fuel samples. Using the National Bureau of Standards 100-MeV electron Linac as a pulsed neutron source, neutron transmission spectra were measured for two samples of fresh reactor fuel and two samples of spent fuel. The transmission spectra were fit using the well-known and unique neutron cross sections for each isotope of interest. For the fresh fuel samples, the (235)U and (238)U contents were determined and compared to the results of a destructive analysis. Excellent agreement was obtained. For the spent fuel samples, the abundances of 11 actinides and 5 fission products were obtained. NRTA was shown to be a method for nondestructive analysis with high isotopic discrimination and high accuracy.

401,537
PB85-145365 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Improved Mass Measurement Accuracy Using the PNB (Preloaded Narrow-Band) Load Cell Scale.
Final rept.,
S. Suda, P. Pontius, and R. Schoonover. 1981, 6p
Pub. in Nuclear Materials Management 10, p266-271, 15 Jul 81.

Keywords: *Nuclear materials management, *Mass, *Weight measurement, Measurement, Comparison, Load cells, Reprints, *Safeguards.

The PNB Load Cell Scale is a Preloaded, Narrow-Band calibration mass comparator. It consists of (1) a frame and servo-mechanism that maintains a preload tension on the load cell until the load an unknown mass is sensed, and (2) a null-balance digital instrument that suppresses the cell response associated with the preload thereby improving the precision, and accuracy of the measurements. Ideally, the objects used to set the preload should be replica mass standards that closely approximate the density and mass of the unknowns. The advantages of the PNB scale are an expanded output signal over the range of interest which increases both the sensitivity and resolution, and minimization of the transient effects associated with loading and unloading of load cells. An area of immediate and practical application of this technique to nuclear material safeguards is the weighing of UF₆ cylinders where in-house mass standards are currently available and where the mass values are typically assigned on the basis of comparison weighings. Several prototypical

versions of the PNB scale have been assembled at the U.S. National Bureau of Standards. A description of the instrumentation, principles of measurements, and applications are presented in this paper.

19A. Ammunition, Explosives, and Pyrotechnics

401,538
PB84-217454 PC A02/MF A01
National Bureau of Standards (NEL), Washington, DC.
Law Enforcement Standards Lab.
Test Procedure for Armor-Piercing Handgun Ammunition.
Final rept.,
D. E. Frank. May 84, 10p NBSIR-84/2884
Sponsored in part by National Inst. of Justice, Washington, DC.

Keywords: *Revolvers, *Armor piercing ammunition, *Firing tests(Ordnance), Test facilities, Targets, Metal plates, Aluminum alloys, Penetration tests.

A test method and test parameters are defined for discriminating between armor-piercing handgun ammunition and nonarmor-piercing handgun ammunition. A multi-plate aluminum test target is described where the number of plates perforated by the bullet, when fired at the test target out of an industry standard velocity gun, performs the discrimination between armor-piercing and nonarmor-piercing bullets.

19D. Explosions, Ballistics, and Armor

401,539
PB85-123420 Not available NTIS
National Bureau of Standards, Washington, DC.
Police Handgun Ammunition.
Final rept.,
L. D. Shubin, and D. E. Frank. Aug 84, 3p
Sponsored in part by National Inst. of Justice, Washington, DC.
Pub. in Police Chief LI, n8 p23-25 Aug 84.

Keywords: *Guns(Ordnance), *Ammunition, Terminal ballistics, Weapons effects.

This is an article to announce the availability of National Institute of Justice Report 100-83, 'Police Handgun Ammunition: Incapacitation Effects. Volume I: Evaluation' and National Institute of Justice Report 101-83, 'Police Handgun Ammunition: Incapacitation Effects. Volume II: Experimental Data.'

401,540
PB84-227040 Not available NTIS
National Bureau of Standards, Washington, DC.
Line Source and Site Characterizations for Defining the Sound Transmission Loss of Building Facades.
Final rept.,
F. F. Rudder, Jr. Mar 83, 22p
Pub. in Jnl. of Sound and Vibration, v91 n3 p403-424 Mar 83.

Keywords: *Buildings, *Sound transmission, Noise(Sound), Reprints, *Acoustic attenuation.

An analytical model is presented for defining the sound transmission loss of building facades exposed to noise from line sources. The model describes the non-diffuse sound field incident upon the facade in terms of both source and site parameters. The effects of facade orientation relative to the line source and the sound propagation with distance are introduced as a single term in the definition of the facade sound transmission loss. This term defines a mean angle of incidence for the exterior sound field that is equivalent to a point source location relative to a point on the facade. Numerical results are presented estimating the magnitude of these effects and it is shown that alternate methods for conducting field measurements of building facade sound transmission loss may be related using this model.

401,541
PB85-120699 Not available NTIS
National Bureau of Standards, Washington, DC.
Further Development and Clinical Evaluation of the Expanding Aperture Annular Array System.
Final rept.,
S. I. Parks, M. Linzer, and T. H. Shawker. 1979, 6p
Pub. in Jnl. of Ultrason. Imag. 2, n4 p378-383 1979.

Keywords: *Ultrasonic radiation, Focusing, Sensitivity, Reprints, *Imaging techniques.

This paper describes a more sensitive version of the expanding aperture annular array system reported recently. A preliminary clinical evaluation is presented.

401,542
PB85-134062 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Acoustical Holography with an Annular Aperture.
Final rept.,
S. J. Norton. 1982, 10p
Pub. in Jnl. of the Acoustical Society of America 71, n5 p1169-1178, 5 May 82.

Keywords: *Holography, Apertures, Resolution, Reprints, *Acoustic holography, Imaging techniques, Ultrasonic holography, Synthetic apertures.

A synthetic-aperture imaging system using an annular array of transducer elements is analyzed. The aperture is assumed to consist of N elements, where each element serves both as a source and receiver of sound, giving rise to (N squared) amplitude and phase measurements around the annular circumference. Because of source-receiver reciprocity, however, (N/2)(N-1) of these measurements (where (N/2)(N-1) is the number of element pairs on the annulus) are redundant, giving a total of (N squared)-(N/2)(N-1) = (N/2)(N+1) independent pulse-echo measurements. It is shown how suitable processing of these measurements can yield a high-resolution image of a reflecting object in a plane parallel to the annulus and located within its Fresnel region. Moreover, the resultant resolution is shown to be equivalent to that of a full circular aperture twice the diameter of the annulus. This approach differs from the (J squared)-synthesis of Wild in that the annular array acts as a source as well as a receiver and that no as-

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assumptions regarding the spatial coherence of the reflecting object are required. Numerical reconstructions based on simulated data are presented. Possible areas of application of the annular imaging system include medical ultrasonic imaging, underwater acoustic imaging, and microwave imaging.

401,543
PB85-141547 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Analog Time Domain Computation of Intensity for Band-Limited Noise in a Standing-Wave Tube.
Final rept.,
T. W. Bartel, and S. L. Yaniv. Nov 84, 4p
Pub. in *Jnl. of Acoustical Society of America* 76, n5 p1573-1576 Nov 84.

Keywords: Sound waves, Standing waves, Acoustic measurement, Analog systems, Computation, Bandwidth, Reprints, *Sound intensity, Standing wave tubes.

The analog computation of acoustic intensity to determine the sound power radiated from an open ended standing-wave tube (R.K. Cook and T.M. Proctor, *J. Acoust. Soc. Soc.* 65, 1542-1555 (1979)) was extended to sound waves composed of band-limited random noise. The bandwidth extension was achieved through the use of a two-channel wideband $\pi/2$ phase shifting network. Comparison with the free-field method for determining sound power yielded agreement within 0.25 dB for bandwidths of 1/3-octave.

401,544
PB85-145381 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Choosing Among Intense Acoustic Background Stimuli - Acoustic Menu.
Final rept.,
G. A. Zerdy, and J. A. Molino. 1974, 1p
Pub. in *Jnl. of the Acoustical Society of America* 56, n8 64p 1974.

Keywords: *Noise(Sound), *Acoustics, *Stimulus(Psychophysiology), Loudness, Noise pollution, Responses, Frequencies, Human behavior, Reprints, Preferences.

Preferential relations among acoustic stimuli were determined for human subjects by a procedure that employed no verbal descriptions of the stimuli. Stimuli were presented in pairs to subjects as they studied Russian on a teaching machine. Thirteen different subjects were employed in each of two experiments. They were instructed that they could 'change the sounds that you hear' by pressing a telegraph key. Each key press switched the acoustic background from the current to the alternate member of a stimulus pair. The pair member presented was alternated periodically independently of the subjects' responses. The stimuli were four pure tones (125, 1000, 4000, and 8000 Hz at A-weighted sound levels ranging from 90 - 112 dB) and a low-level white noise. The proportion of time which subjects spent in the acoustic background stimuli varied significantly as a function of frequency even though equivalent A-weighted sound levels were presented. This finding suggests that A-weighting the sound levels does not accurately describe the preference (indifference) relationships among the stimuli employed.

401,545
PB85-151694 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Acoustical Laboratory Accreditation Program of the United States.
Final rept.,
R. J. Peppin, and D. B. Thomas. 1984, 4p
Pub. in *Proceedings of Federation of Acoustical Societies of Europe*, Sandefjord, Norway, August 21-24, 1984, p139-142.

Keywords: *Test facilities, *Laboratories, *Acoustic measurement, *Accreditation, National Voluntary Laboratory Accreditation Program.

Laboratory accreditation is the determination and recognition that a laboratory has the competence to carry out specific tests or calibrations. In the field of acoustical testing, the United States currently has a program to accredit laboratories. It is the National Voluntary Laboratory Accreditation Program (NVLAP) which is operated by the National Bureau of Standards. The purpose of the NVLAP is to provide a testing laboratory examination service over a broad range of product areas wherever a need is identified. The Acoustics

Laboratory Accreditation Program (Acoustics LAP) of NVLAP was implemented in September, 1982, at the request of an acoustical insulation manufacturer. Laboratories can request NVLAP accreditation for one or more of 50 national and international test methods. These methods involve the measurement of the acoustical properties of materials and the sound power and sound pressure levels of products such as industrial machinery, office machines, and motor vehicles. Laboratories interested in applying for accreditation of their acoustical testing services will receive an application package which includes a list of test methods in the product area of interest, a statement of fees for participation, and a handbook which describes the technical requirements for accreditation.

20B. Crystallography

401,546
PB84-155191 PC A08/MF A01
JCPDS-International Centre for Diffraction Data, Swarthmore, PA.
Standard X-ray Diffraction Power Patterns: Section 20 - Data for 71 Substances.
Final rept.,
M. C. Morris, H. F. McMurdie, E. H. Evans, B. Paretzkin, and H. S. Parker. Jan 84, 153p NBS-MONO-25-SECT-20
Also available from Supt. of Docs. as SN003-003-02548-8. See also PB82-117805. Library of Congress catalog card no. 53-61386.

Keywords: *Crystal structure, *X ray diffraction, *Standards, Lattice parameters, Inorganic compounds, Tables(Data), *Powder patterns.

Standard x-ray powder diffraction patterns are presented for 71 substances. These patterns, useful for identification, were obtained by manual or automated diffractometer methods or were calculated from published crystal structure data. The lattice constants from the experimental work were refined by least-squares methods, and reflections were assigned Miller indices consistent with space group extinctions. Relative intensities, calculated densities, literature references, and other relevant data are included.

401,547
PB84-218866 Not available NTIS
National Bureau of Standards, Washington, DC.
Microstructure of Dielectric Thin Films Formed by E-Beam Coevaporation.
Final rept.,
E. N. Farabaugh, and D. M. Sanders. 1983, 4p
Pub. in *Jnl. of Vacuum Science and Technology A*, v1 n2 p356-359 1983.

Keywords: *Dielectric films, *Zirconium oxides, *Magnesium oxides, *Silicon dioxide, *Microstructure, X ray diffraction, Thin films, Glass, Coatings, Optical properties, Reprints, *Coevaporation, Amorphous materials.

X-ray diffraction measurements were made on a series of mixed films in the ZrO₂-MgO and ZrO₂-SiO₂ systems as part of a larger study to investigate the relationship between processing parameters and morphology of dielectric thin films produced by coevaporation. The primary interest was to determine if amorphous coatings produced by coevaporation would have optical properties superior to their polycrystalline counterparts as is the case in the bulk. The first experiments involved determining the importance of both quantity and composition of dopants which could be used to achieve amorphous films. While using x-ray diffraction to evaluate the extent of film crystallinity in doped ZrO₂ films, it was observed that first the lattice spacing normal to the film-substrate interface progressively decreased as either MgO or SiO₂ were added and that upon reaching 46 and 21 mol%, respectively, the crystallinity disappeared completely. The intent of this work is to present these results and discuss their possible significance.

401,548
PB84-219021 Not available NTIS
National Bureau of Standards, Washington, DC.
Structures of Lithium Inserted Metal Oxides: Li₂FeV₃O₈.
Final rept.,
R. J. Cava, A. Santoro, D. W. Murphy, S. Zahurak, and R. S. Roth. 1983, 9p
Pub. in *Jnl. of Solid State Chemistry* 48, p309-317 1983.

Keywords: *Crystal structure, *Neutron diffraction, Lithium inorganic compounds, Reprints, *Lithium iron vanadates.

Neutron diffraction powder profile analysis has been used to determine the structure of Li₂FeV₃O₈. The compound is prepared from FeV₃O₈, which has the VO₂(B) structure type, by a lithium insertion reaction employing n-BuLi. Only minimal distortion of the host lattice occurs on Li insertion. The Li ions occupy five coordinate square pyramidal sites with an average Li-O bond distance of 2.04 Å. These five coordinate sites occur commonly in the capped perovskite cavities of crystallographic shear structures based on ReO₃.

401,549
PB84-221076 Not available NTIS
National Bureau of Standards, Washington, DC.
Diffuse Neutron Scattering in Sodium and Potassium Cyanide.
Final rept.,
J. M. Rowe, and S. Susman. 15 Apr 84, 6p
Pub. in *Physical Review B* 29, n8 p4727-4732, 15 Apr 84.

Keywords: *Sodium cyanide, *Potassium cyanides, Neutron scattering, Crystal structure, Reprints.

Diffuse neutron scattering has been measured in NaCN at 295 K and KCN at 175 and 295 K. In both samples, strong scattering from the soft shear mode (related to the translation-rotation coupling which leads to the phase transition from the high temperature cubic NaCl phase to the low temperature-orthorhombic phase) is observed. The asymmetry of this scattering about certain reciprocal lattice points is direct evidence both of the bilinear nature of the coupling, and of its sign (and hence of the relative importance of overlap and quadrupolar interactions). In NaCN, additional structured diffuse scattering is observed which is absent in KCN at both measured temperatures. This scattering is assumed to arise from short range order in CN orientations, but the data are not consistent with simple models of steric hindrance that have been proposed for the short range correlations in NaCN.

401,550
PB84-221084 Not available NTIS
National Bureau of Standards, Washington, DC.
Crystal Structure of Rubidium Cyanide at 4 K Determined by Neutron Powder Diffraction.
Final rept.,
J. M. Rowe, J. J. Rush, and F. Luty. Feb 84, 3p
Sponsored in part by National Science Foundation, Washington, DC.
Pub. in *Physical Review B* 29, n4 p2168-2170, 15 Feb 84.

Keywords: *Crystal structure, Neutron diffraction, Rubidium compounds, Cyanides, Monoclinic lattices, Cryogenics, Reprints, *Rubidium cyanides.

The crystal structure of RbCN at 4 K has been determined by neutron powder diffraction. The structure is monoclinic, space group (C sub c), and is very similar to that determined recently for (KCN) (x) (KBr) (1-x). No evidence for ordering of the (CN)(-1) ion dipoles is found at 4 K.

401,551

PB84-223163 Not available NTIS

National Bureau of Standards, Washington, DC.

Investigation of the Two-Dimensional Shape of Ion-Implanted Regions.

Final rept.,

P. Roitman, J. Albers, and D. R. Myers. 15 Jun 84, 8p

Contract DE-AC04-76DP00789

See also DE82-011546. Sponsored in part by Naval Ocean Systems Center, San Diego, CA.

Pub. in Jnl. of Applied Physics 55, n12 p4436-4443, 15 Jun 84.

Keywords: *Silicon, Arsenic, Single crystals, Shape, Reprints, *Ion implantation, Two dimensional.

The two-dimensional shape of arsenic ion-implanted regions in single-crystal silicon were investigated both experimentally and theoretically. Experimentally, two techniques were shown to have the necessary sub-micron resolution: a junction etch process and a SEM-induced current collection method. A comparison of junction depths determined by the etch technique, the EBIC techniques with the depths calculated using several amorphous target codes was made.

401,552

PB84-224872 Not available NTIS

National Bureau of Standards, Washington, DC.

Certification of Si Powder Standard Reference Material SRM 640a.

Final rept.,

C. R. Hubbard. 1983, 4p

Pub. in Jnl. of Applied Crystallography 16, p285-288 1983.

Keywords: *Silicon, *X ray diffraction, *Standards, Calibrating, Lattice parameters, Powder(Particles), Reprints, *Standard reference materials.

A new lot of high purity silicon powder with mean crystallite size of about 2 micrometers has been certified as Standard Reference Material 640a. This SRM can be used as both an external and an internal 2 theta calibration standard. The lattice parameter, uncorrected for refraction, is $a = 5.430825(11)$ for λ (Cu(K sub α sub 1)) = 1.5405981 Å at 25°C. Comparison with the lattice parameter of silicon powder from the same boule with a larger mean crystallite size shows a small decrease in lattice parameter, possibly due to surface tension effects.

401,553

PB84-225366 Not available NTIS

National Bureau of Standards, Washington, DC.

Pearson Symbol.

Final rept.,

C. R. Hubbard, and L. D. Calvert. 1981, 16p

Pub. in Bulletin Alloy Phase Diagram, v2 n2 p153-157 1981.

Keywords: *Crystal structure, Symbols, Reprints, *Pearson symbols.

The Pearson Symbol is readily used for classifying crystal structures. Rules for assigning this symbol are reviewed and notes concerning unusual cases are given. Several examples of the use of the Pearson Symbol are presented. Tables for conversion between the Strukturbericht structure designations and the Pearson Symbols are appended.

401,554

PB84-244797 Not available NTIS

National Bureau of Standards, Washington, DC.

Bond-Deformation Model for Rocksalt-Structure Compounds.

Final rept.,

A. L. Dragoo. 15 Mar 84, 17p

Pub. in Physical Review B 29, n6 p3533-3549, 15 Mar 84.

Keywords: *Alkaline earth oxides, *Chemical bonds, Elastic properties, Strains, Electrostatics, Reprints, *Alkali halides, Cubic lattices.

The bond-deformation model is developed for compounds having the rocksalt structure—namely, the alkali halides and the alkaline-earth oxides. The full set of nearest-neighbor bond-deformation parameters is presented, and the parameters are related to the Larrangian and internal strains and to the atomic displacements. The next-nearest-neighbor bond-stretching parameters are shown to be reducible to the near-

est-neighbor parameters. A variety of central-force and non-central-force interactions is identified in the expansion of the short-range portion of the strain energy. By a transformation of variables the short-range contributions to the dynamical matrix are obtained. Expressions are derived for the elastic constants and for the force constant associated with the homogeneous polarization of the lattice.

401,555

PB84-244805 Not available NTIS

National Bureau of Standards, Washington, DC.

Coupled Convective Instabilities at Crystal-Melt Interfaces.

Final rept.,

S. R. Coriell, G. B. McFadden, R. F. Boisvert, M. E.

Glicksman, and Q. T. Fang. May 84, 11p

Pub. in Jnl. of Crystal Growth 66, n3 p514-524 May 84.

Keywords: Buoyancy, Stability, Prandtl number, Interfaces, Convection, Lead(Metal), Reprints, *Crystal melt, Instability, Succinonitrile.

The stability of the parallel flow between a vertical crystal-melt interface and a vertical wall held at a temperature above the melting point of the crystal is analyzed for Prandtl numbers, P , ranging from 0.01 to 100. Three modes of instability occur: (1) a buoyant mode, (2) a shear mode, and (3) a coupled crystal-melt mode. The buoyant and shear modes are similar to those that occur for flow between two vertical rigid walls held at different temperatures. For Prandtl numbers greater than approximately two, the coupled crystal-melt mode occurs at a lower Grashof number than the other two modes. Specific results are given for succinonitrile ($P = 22.8$) and lead ($P = 0.0225$). These calculations and similar calculations for a cylindrical geometry were motivated by, and are in general agreement with, recent experiments on succinonitrile.

401,556

PB84-245844 Not available NTIS

National Bureau of Standards, Washington, DC.

Matrix Method for Lattice Symmetry Determination.

Final rept.,

V. L. Himes, and A. D. Mighell. 1982, 2p

Pub. in Acta Crystallogr. Section A 38, p748-749 Sep 82.

Keywords: *Crystal symmetry, Matrices(Mathematics), Crystal structure, Reprints.

A new general approach for the determination of metric lattice symmetry has been devised. The central focus of the method is on the determination of matrices relating any primitive cell of the lattice to itself rather than on determining reduced cells or conventional cells. The method can conveniently be used in routine structure work as it readily detects the highest possible metric symmetry within any specified range of cell parameter errors.

401,557

PB85-104644 Not available NTIS

National Bureau of Standards, Washington, DC.

Decay of Pair Correlations in Three Dimensional Crystals.

Final rept.,

R. F. Kayser, Jr., J. B. Hubbard, and H. J. Raveche.

1981, 8p

Pub. in Physical Review B 24, n1 p51-58, 1 Jul 81.

Keywords: *Crystals, Statistical mechanics, Elastic properties, Reprints, Three dimensional, Landau model.

The long range behavior of spatial correlations in three dimensional crystals is analyzed in the context of the Landau model.

401,558

PB85-104768 Not available NTIS

National Bureau of Standards, Washington, DC.

Impedance Spectrum of a Single Grain-Boundary in Yttrium Stabilized Zirconia.

Final rept.,

A. L. Dragoo, C. K. Chiang, A. D. Franklin, and J.

Bethin. 1982, 7p

Pub. in Solid State Ionics 7, n3 p249-255 1982.

Keywords: *Zirconium oxides, *Grain boundaries, *Electrical impedance, Single crystals, Alternating current, Yttrium, Bicrystals, Reprints, Temperature dependence.

Impedance measurements are reported for a bicrystal and single crystals of yttrium-stabilized ZrO₂ (YSZ) over the frequency range from 100 to 10 to the 7th power Hz, and for temperatures from 200 to 500°C in air. The grain boundary introduces an additional somewhat depressed arc when the impedance is plotted in the complex-plane. These data and an examination by both optical and scanning electron microscopy reveal the 'grain boundary' to be a gap between the adjacent crystals, with occasional bridges of YSZ. These results illustrate the potential of the method of impedance spectroscopy for studying internal boundaries in solid conductors.

401,559

PB85-104818 Not available NTIS

National Bureau of Standards, Washington, DC.

Single Crystal Neutron Diffraction Study of Ammonium Nitrate Phase III.

Final rept.,

C. S. Choi, and H. J. Prask. 1982, 5p

Pub. in Acta Crystallographica Section B 38, p2324-2328 Sep 82.

Keywords: *Ammonium nitrate, *Crystal structure, *Neutron diffraction, Single crystals, Hydrogen bonds, Solid solutions, Potassium nitrate, Reprints.

The crystal structure of ammonium nitrate phase III has been studied at room temperature by neutron diffraction, using a single crystal containing 5% KNO₃ in solid solution form. The ammonium ions are thermally disordered into two orientations, displaced by an angle of approximately 42 degrees about an axis parallel to the c-axis.

401,560

PB85-107365 Not available NTIS

National Bureau of Standards, Washington, DC.

Phonons in LiC₆.

Final rept.,

H. Zabel, A. Magerl, and J. J. Rush. 1983, 4p

Pub. in Physical Review B 27, n6 p3930-3933 1983.

Keywords: *Phonons, Lattice vibrations, Neutron scattering, Layers, Reprints, *Lithium carbides.

The authors have measured the longitudinal (001) and the out-of-plane transverse (100) phonon modes of LiC₆ by inelastic neutron scattering, including the observation of very-high-energy phonon groups, tentatively assigned to optic modes. The phonon branches yield interlayer force constants and elastic moduli C_{33} and C_{44} which are considerably larger than those of the heavy alkali-metal stage-1 compounds. Yet, LiC₆ still shows an omega approximately equal to q squared dispersion of the transverse basal-plane mode, characteristic for layered materials.

401,561

PB85-110195 Not available NTIS

National Bureau of Standards, Washington, DC.

Relaxation Modes of Point Defect Pairs In Ionic Crystals: Approximate Solutions for the Three-Shell Model.

Final rept.,

A. D. Franklin, and K. F. Young. 1982, 9p

Pub. in Jnl. of Physics and Chemistry of Solids 43, n4 p357-365 1982.

Keywords: *Ionic crystals, *Point defects, Face centered cubic lattices, Alkaline earth compounds, Sodium chloride, Potassium chloride, Fluorides, Reprints.

A perturbation technique is used to obtain first-order expressions for the relaxation frequencies for the relaxation modes of the three-shell model of pairs of coupled defects moving on the same fcc lattice (e.g., divalent cation-cation vacancy in the rocksalt structure) or on interpenetrating fcc lattices (vacancy pairs in the rocksalt structure, or interstitial anion - excess valency cation in the fluorite structure). For the dielectrically-active T(1u) modes, expressions are given for the relaxation intensities in the zero-order approximation. These results are then used to discuss experimental data for NaCl and KCl containing divalent cations and for alkaline earth fluorides containing trivalent rare earth ions.

401,562
PB85-111797 Not available NTIS
 National Bureau of Standards, Washington, DC.
Editors' Preface of 'Crystal Growth 1980' Proceedings of the International Conference on Crystal Growth (6th), Held at Moscow, USSR on September 10-16, 1980.
 Final rept.,
 E. I. Givargizov, D. Elwell, R. Ghez, F. A. Kuznetsov, and H. S. Peiser. 1981, 492p
 Sponsored in part by International Union of Crystallography.
 Pub. in Jnl. on Crystal Growth, v52 pt1 492p 1981.

Keywords: *Crystal growth, *Meetings, Crystallography, United Soviet Socialist Republic.

Some details of the International Conference on Crystal Growth are given and organizational assistance is acknowledged.

401,563
PB85-115574 Not available NTIS
 National Bureau of Standards, Washington, DC.
View of the Relation between the Continuum Theory of Lattice Defects and Non-Euclidean Geometry in the Linear Approximation.
 Final rept.,
 R. de Wit. 1981, 32p
 Pub. in International Jnl. of Energy Science 19, n12 p1475-1506 1981.

Keywords: *Crystal defects, Dislocations(Materials), Deformation, Plastic properties, Differential geometry, Reprints.

A view is presented of the relation between the continuum theory of defects in crystals and the mathematical theory of non-metric, non-Riemannian geometry. Both theories are treated in the linear approximation. The lattice defects consist of disclinations, dislocations, and extra-matter, which are identified with the following three important tensors from non-Euclidean geometry: the Riemann-Christoffel curvature tensor, the Cartan torsion tensor, and the nonmetric Q-tensor. Two examples are given to illustrate the concepts of the paper. One example is related to the deformations associated with constant dislocation distribution and the other to the deformations of a constant disclination distribution.

401,564
PB85-115590 Not available NTIS
 National Bureau of Standards, Washington, DC.
Some Exact Results for a Two-Dimensional Crystal Growth Problem.
 Final rept.,
 E. A. Dimarzio, and C. M. Guttman. 1982, 9p
 Pub. in Jnl. of Crystal Growth 57, n2 p403-411 1982.

Keywords: *Crystal growth, Surface roughness, Reprints, Two dimensional.

The growth rate $G(\alpha_1, \beta_1; \alpha_2, \beta_2; L)$ for growth perpendicular to an edge L units long is calculated as a function of the rate constants α_1 (attachment) and β_1 (detachment) for nucleation along the edge and of the rate constants α_2 and β_2 for lateral filling in of nucleated regions along the edge. The bistrif problem ($L=2$) shows 4 distinct regions of growth. The first two of these are not realizable thermodynamically but may be realizable at large supercoolings. G for arbitrary L is also obtained for certain special choices of the rate constants. Various measures of surface roughness are defined.

401,565
PB85-120806 Not available NTIS
 National Bureau of Standards, Washington, DC.
FeNb₃Se₁₀: A New Structure Type Related to NbSe₃.
 Final rept.,
 R. J. Cava, V. L. Himes, A. D. Mighell, and R. S. Roth. 1981, 4p
 Pub. in Jnl. of Physical Review B 24, n6 p3634-3637 1981.

Keywords: *Crystal structure, *X ray diffraction, Physical properties, Reprints, *Iron niobium selenide.

The crystal structure of FeNb₃Se₁₀ consists of two NbSe₆ trigonal prismatic chains of the type found in NbSe₃ and a double chain of edge shared MSe₆ octahedra, both running parallel to the monoclinic b axis. The metal atom disorder, critical to the interpretation

of previously observed electronic properties, is confined to the octahedral chains.

401,566
PB85-129385 Not available NTIS
 National Bureau of Standards, Washington, DC.
Rational Functions as Profile Models in Powder Diffraction.
 Final rept.,
 N. Pyrras, and C. Hubbard. 1983, 6p
 Pub. in Jnl. of Applied Crystallography 16, p289-294 1983.

Keywords: *Rational functions, *X ray diffraction, *Crystal structure, Silicon, Reprints.

Rational functions, the ratio of two polynomials, are shown to be good approximations to powder diffraction profiles. These functions are generalizations of the Lorentzian, the modified Lorentzian, and the profile model of Parrish (Parrish, Huang & Ayers (1976). Trans. Am. Crystallogr. Assoc. 12, 55-73). The simplest of these functions is of the form $f(x) = 1/(1 + A(1)(x \text{ squared}) + A(2)(x \text{ to the 4th power})$ with constants $A(1)$ and $A(2)$ that describe the shape of the profile, $x = 2\theta - 2(\theta \text{ sub } 0)$ and $2(\theta \text{ sub } 0)$ the position of the peak maximum. This function approximates very well Pearson VII distributions with exponents between 1 and 3. An asymmetric profile model with different $A(1), A(2)$ parameters for the two halves of the peaks was fitted to silicon X-ray powder diffraction profiles and gave unweighted agreement factors from $R(2) = 0.02$ to 0.04 for peaks varying from 28 to 137 degrees 2θ .

401,567
PB85-130656
 (Order as PB85-130078, PC A99/MF A01)
 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
Work Related to the Determination of the Avogadro Constant in the PTB (Physikalisch-Technische Bundesanstalt),
 P. Seyfried. 1984, 4p
 Included in Precision Measurement and Fundamental Constants II, p313-316 1984.

Keywords: *Fundamental constants, *Density(Mass/volume), *Lattice parameters, *Silicon, Density measurement, Crystal lattices, *Avogadro constant.

The $d(220)$ -lattice spacing in a highly pure nearly perfect silicon crystal was measured and found to be $d(220) = 192.015.560$ fm with an uncertainty of \pm or -6×10 to the -8 th power $d(220)$ in vacuum at 22.50C. Thus for this crystal the first of the three quantities, $d(220)$, density ρ , and molar mass M , from which the Avogadro constant $N(A)$ can be derived, is known with sufficient accuracy. The $d(220)$ -value given is -1.8×10 to the -6 th power $d(220)$ smaller than that reported by Deslattes et al. and used in his determination of $N(A)$. Carbon and oxygen impurities in our crystal cannot explain this large difference. A possible change in $N(A)$ of $+5.4 \times 10$ to the -6 th power of its value should be taken into account. Density standards in the form of cubes made of a ceramic material with trade name Zerodur have been prepared. These standards will be used for density measurements of silicon samples found to be uniform by high resolution double crystal and Moire-topography.

401,568
PB85-130664
 (Order as PB85-130078, PC A99/MF A01)
 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
Absolute Determination of the (220)-Lattice Spacing in Silicon,
 P. Becker, and H. Siegert. 1984, 4p
 Included in Precision Measurement and Fundamental Constants II, p317-320 1984.

Keywords: *Lattice parameters, *Silicon, Optical interferometers, Crystal lattices, Measurement, X ray interferometry.

The (220)-lattice plane spacing in a silicon crystal was measured using a combined x-ray and optical interferometer. The experimental set-up and important characteristic features of the interferometer crystals and the translation device are described in detail. The results of several individual measurements are discussed to explain the evaluation method applied. The results of 170 measurements are characterized by a standard deviation $|\sigma| = 6 \times 10$ to the -8 th power.

401,569
PB85-130672
 (Order as PB85-130078, PC A99/MF A01)
 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
Systematic Uncertainties in the Determination of the Lattice Spacing $d(220)$ in Silicon,
 H. Siegert, and P. Becker. 1984, 4p
 Included in Precision Measurement and Fundamental Constants II, p321-324 1984.

Keywords: *Lattice parameters, *Silicon, Length, Precision, Correction, Uncertainty.

The origin and magnitude of corrections and uncertainties connected with the absolute determination of the $d(220)$ lattice plane spacing in a silicon crystal are discussed. Contributions of crystal material, temperature, optical wavelength, alignment parameters, and guiding errors are estimated. A total correction of the mean value $n/m = (\lambda/2d)$ is calculated. The total uncertainty, comprising random and systematic uncertainties, amounts to \pm or -6×10 to the -8 th power $d(220)$. The uncertainty of the mean contributes by less than one percent to this value, while the main part results from the uncertainties of the crystal temperature and the Abbe error.

401,570
PB85-135556 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Structure of Ammonium Calcium Phosphate Heptahydrate, Ca(NH₄)PO₄·7H₂O.
 Final rept.,
 S. Takagi, M. Mathew, and W. E. Brown. 1984, 3p
 Sponsored in part by American Dental Association Health Foundation, Chicago, IL.
 Pub. in Acta Crystallographica C40, p1111-1113 1984.

Keywords: *Crystal structure, Calcium phosphates, Hydrates, Reprints, *Ammonium calcium phosphate heptahydrate, Struvite.

$M(r) = 279.19$, monoclinic, $P2(1)$, $a = 6.300(1)$, $b = 11.929(2)$, $c = 7.176(2)$ Å, $\beta = 91.62(2)$ degrees, $V = 539.08$ cubic Å, $Z = 2$, $D(m) = 1.71$, $D(x) = 1.720$ Mg/(m cubed), $T = 298$ K, Mo K alpha , $\lambda = 0.7107$ Å, $\mu = 0.76/\text{mm}$, $F(000) = 296$, $R = 0.021$ for the 453 reflections used in the refinement. The structure consists of $\text{Ca}(\text{H}_2\text{O})_7$ polyhedra and PO_4 groups linked together by hydrogen bonds forming an interpenetrating layer-type structure, similar to struvite, $\text{Mg}(\text{NH}_4)\text{PO}_4 \cdot 6\text{H}_2\text{O}$. All seven water molecules are coordinated to the $\text{Ca}(2+)$ ion, forming a distorted pentagonal bipyramid.

401,571
PB85-140986 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Lessons from the I.U.Cr. (International Union of Crystallography) X-ray Attenuation Project.
 Final rept.,
 D. C. Creagh, and J. H. Hubbell. Aug 84, 1p
 Grant NSF-EAR82-06256
 Sponsored by Department of Energy, Washington, DC.
 Pub. in Acta Crystallographica, Section A: Crystal Physics, Diffraction, Theoretical and General Crystallography 40 (Supplement), p C-175 1984.

Keywords: *Crystallography, Absorption, Attenuation, Silicon, Photons, X rays, Reprints, *X Ray Attenuation Project.

The I.U.Cr. X ray Attenuation Project, which was inaugurated in 1978 under the auspices of the Commission for Crystallographic Apparatus, is now almost finished. Some laboratories have yet to report their results and we are still receiving inquiries by laboratories wishing to join the project. It is our intention to provide specimen materials to these laboratories and to produce, at a later stage, addenda to the project reports which are now in the final stages of preparation.

401,572
PB85-143683 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Refinement of the Crystal Orientation Matrix for the Flat-Cone Diffractometer.
 Final rept.,
 A. Wlodawer, L. Sjoelin, and A. Santoro. 1982, 4p
 Pub. in Jnl. of Applied Crystallography 15, n1 p79-81
 1982.

Keywords: *Diffractometers, Proteins, Molecules, Orientation, Reprints, *Flat cone diffractometers.

A procedure for refining a crystal orientation matrix for the flat-cone diffractometer is discussed. The positions of the centers of gravity of reflections obtained during routine data collection are transformed in such a way that they can be used as input to the least-squares procedures of Busing and Levy (Acta Cryst. 22, 457-464, 1967) or Schoemaker and Bassi (Acta Cryst. A26, 97-101, 1970). The orientation matrix can be refined on the basis of the positions of all observed reflections, and not only of a selected sample, thus increasing its reliability. The procedure is particularly suited for protein crystallographic studies, as it makes it possible to compensate for crystal movements and electronic drifts encountered during data collection.

401,573
PB85-145175 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Second Generation Automated Powder Diffractometer Control System.
 Final rept.,
 R. L. Snyder, C. R. Hubbard, and N. C. Panagiotopoulos. 1982, 16p
 Pub. in Advances in X-Ray Analysis 25, p245-260
 1982.

Keywords: *X ray diffraction, *Diffractometers, Real time operations, Automation, Reprints, Powder patterns, AUTO system, Control systems.

The real-time x-ray powder diffractometer control system AUTO incorporates several advances in data collection and analysis. Counting procedures for selected data collection are optimized to achieve either a preselected statistical error in minimum time or a minimum error in fixed total time. Run files are employed to greatly simplify quantitative analysis procedures and for controlling repetitive runs. External calibration curves for 2 theta are used to eliminate all but sample dependent aberrations to peak positions. A generalized data file structure is used to document the instrumental variables and sample parameters.

401,574
PB85-145332 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Atomic Structure of (001)W.
 Final rept.,
 R. T. Tung, W. R. Graham, and A. J. Melmed. 1982, 23p
 Pub. in Surface Science 115, n3 p576-598 1982.

Keywords: *Tungsten, *Surfaces, Reprints, *Field ion microscopy.

Results of a field-ion microscope study of the clean surface structure of the (001) surface plane of tungsten are presented. The major conclusions are that (001) W is reconstructed over the temperature range 15-580K, and that the reconstructed surface contains an alternating vertical component to the displacements of the W surface. Details of this newly developed experimental approach for the study of surface reconstruction are reported, along with a number of control experiments which exclude the possibility that these results are artifacts due to the experimental technique. The discussion includes a comparison of the present results with those drawn from other experimental techniques, primarily low energy electron diffraction.

401,575
PB85-145530 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Neutron Diffraction Structure Determination of the High-Temperature Form of Lithium Tritantalate, H-LiTa3O8.
 Final rept.,
 J. L. Hodeau, M. Marezio, A. Santoro, and R. S. Roth. 1984, 18p
 Pub. in Jnl. Solid State Chemistry 51, p275-292 1984.

Keywords: *Crystal structure, X ray diffraction, Electron diffraction, Neutron diffraction, Single crystals,

Lattice parameters, Reprints, *Lithium tantalates, High temperature.

The crystal structure of H-LiTa3O8 has been reexamined by electron and neutron diffraction techniques. Neutron Weissenberg and electron diffraction photographs show that the space group of the compound is Pmmn and not Pmma as determined previously by X-ray diffraction techniques. There are eight molecules in the unit cell of lattice parameters $a = 16.718(2)$ Å, $b = 7.696(1)$ Å, $c = 8.931(1)$ Å. These values show that the b axis of the new cell is doubled with respect to the parameter measured by X-rays. The structural refinement was based on 1074 independent reflections measured on a single crystal with a four-circle neutron diffractometer. The large thermal vibrations found for the lithium atoms and the ionic conductivity of H-LiTa3O8 at high temperatures are consistent with weak Li-O bonding.

401,576
PB85-151629 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Atomic Structure and Optical Constants of (001) Tantalum.
 Final rept.,
 S. T. Ceyer, A. J. Melmed, J. J. Carroll, and W. R. Graham. 1984, 5p
 Pub. in Surface Science 144, pL444-L448 1984.

Keywords: *Tantalum, Polarimetry, Surfaces, Optical properties, Reprints, Low energy electron diffraction, Ellipsometry.

Low-energy-electron diffraction evidence is presented to show that the clean (001)Ta surface is not reconstructed, that it has the normal (1x1) symmetry, at temperatures from about 650-15 K. Optical constants, determined by ellipsometry, are given for clean (001)Ta measured in the visible spectrum. The results are put into context with previous work.

20C. Electricity and Magnetism

401,577
PB84-218049 PC A08/MF A01
 National Bureau of Standards (NEL), Washington, DC.
 Center for Electronics and Electrical Engineering.
Bibliography of Data on Electrical Breakdown in Gases.
 Final rept.,
 R. J. Van Brunt, and W. E. Anderson. Apr 84, 174p
 NBS/TN-1185
 Also available from Supt. of Docs as SN003-003-02571-2. Sponsored in part by Department of Energy, Washington, DC. Div. of Electric Energy Systems.

Keywords: *Gases, *Bibliographies, *Electrical faults, *Dielectric breakdown, Vapors, Tables(Data), Surfaces, Electric coronas, Indexes(Documentation), Critical fields, Ionization, Plasmas(Physics).

This report consists of a bibliography of currently published data on electrical breakdown in gases. The bibliography contains a list of archival papers and books published since 1950, an index indicating the references that give particular types of data for each gas, an author index, and a list of relevant, regular technical conferences. The citations given in the bibliography contain experimental or theoretical data on breakdown which include: (1) sparking potentials; (2) breakdown voltages; (3) critical fields, or field-to-gas density ratios; (4) corona inception voltages; (5) voltage-time characteristics; (6) relative and absolute dielectric strengths; and (7) breakdown probabilities. Types of data considered include those which apply to uniform and nonuniform fields; ac, dc, and impulse voltages; and possible effects of particles, surfaces, interfaces, and corona. This bibliography is intended to serve as a guide in locating data on breakdown which are most relevant to particular applications.

401,578
PB84-219468 Not available NTIS
 National Bureau of Standards, Washington, DC.
Transient Fields in Dispersive Media.
 Final rept.,
 E. Marx. Nov 83, 6p
 Pub. in Jnl. of Mathematical Physics 24, n11 p2602-2607 1983.

Keywords: *Electromagnetic scattering, Electromagnetic fields, Integral equations, Wave equations, Max-

wells equations, Plasmas(Physics), Reprints, Three dimensional, Transients.

The problem addressed in this paper is the determination of transmitted and scattered fields produced by a transient electromagnetic field incident on a three-dimensional body when the body and the surrounding medium are allowed to be dispersive. Instead of decomposing the pulse into its Fourier components, the solution is carried out in the time domain to take advantage of marching-in-time procedures. Maxwell's equations are suitably modified, and the reduction of the problem to the solution of an integral equation for a single tangential vector field is adapted to dispersive media. A simple conductor and a collisionless plasma are studied as examples.

401,579
PB84-219831 Not available NTIS
 National Bureau of Standards, Washington, DC.
Electromagnetic Scattering from Perfectly Conducting Rough Surfaces in the Resonance Region.
 Final rept.,
 D. Maystre. Nov 83, 11p
 Pub. in Institute of Electrical and Electronics Engineers, Transactions on Antennas and Propagation AP-31, n6 p885-895 Nov 83.

Keywords: *Electromagnetic scattering, Light scattering, Cylindrical bodies, Surface roughness, Approximation, Computation, Electric current, Reprints, Computer applications.

A rigorous integral formalism for the problem of scattering from a cylindrical, perfectly conducting rough surface of arbitrary shape is introduced. The computer code issued from this theory enables us to show the low range of the incident field on the surface current density. This phenomenon is explained using a new approximate theory, able to express the scattered field in the form of an integral whose integrand is known in closed form. Using the rigorous computer code, we prove that the new approximate theory is always better than the Kirchhoff approximation in the resonance region. Finally, it is shown that the phenomenon of low range of the incident field permits the rigorous computation of the field scattered from a rough surface of arbitrary width.

401,580
PB84-226851 Not available NTIS
 National Bureau of Standards, Washington, DC.
Intense Source of Monochromatic Electrons: Photoemission from GaAs.
 Final rept.,
 C. S. Feigerle, D. T. Pierce, A. Seiler, and R. J. Celotta. May 84, 3p
 Pub. in Applied Physics Letters 44, n9 p866-868, 1 May 84.

Keywords: *Gallium arsenides, Monochromatic radiation, Photoelectric emission, Reprints, *Electron sources, *Photoemission.

Measurements have been performed on the cathode currents and width of the energy distribution of photoemission from negative electron affinity (NEA) - GaAs. Distributions as narrow as 31 meV (FWHM) have been obtained. The measured currents are compared to those which are currently available by coupling thermionic cathodes with electron monochromators and found to be at least 10 times as intense for distributions of equivalent width.

401,581
PB84-227032 Not available NTIS
 National Bureau of Standards, Washington, DC.
Dipole Radiation in the Presence of a Rough Surface. Conversion of a Surface-Polariton Field into Radiation.
 Final rept.,
 G. S. Agarwal. Nov 82, 11p
 Pub. in Physical Review B26, n10 p5832-5842 Nov 82.

Keywords: Gratings(Spectra), Surface roughness, Surfaces, Greens function, Reprints, *Dipole radiation, Polaritons.

The characteristics of the radiation produced by a dipole, located near the rough surface of a material medium, are examined. The field distribution is calculated at any point outside the medium for arbitrary orientation of the dipole moment, thus enabling one to obtain the electromagnetic Green's function in the presence of surface roughness. The medium can have

Field 20—PHYSICS

Group 20C—Electricity and Magnetism

either local or nonlocal dielectric function and the results are valid to first order in roughness. The surface roughness converts the surface polariton field, excited even in the absence of roughness, into radiation and thus leads to the well-defined resonances in the far field radiation pattern. Numerical results for the case of metallic as well as dielectric gratings are given. The effect of the nonlocality of the dielectric function on the resonances in the radiation is shown to be significant in certain cases.

401,582

PB84-227099 Not available NTIS
National Bureau of Standards, Washington, DC.
Operational Considerations of a Reverberation Chamber for EMC Immunity Measurements; Some Experimental Results.
Final rept.,
M. L. Crawford, and G. H. Koepke. Apr 84, 8p
Pub. in Proceedings of 1984 IEEE (Institute of Electrical and Electronics Engineers, Inc.) National Symposium Electromagnetic Compatibility, San Antonio, TX, April 24-26, 1984, p47-54.

Keywords: *Electromagnetic compatibility, Measurement, Performance, Microwaves, *Reverberation chambers.

This paper describes measurement procedures and results obtained from evaluation of a 2.74 m x 3.05 m x 4.57 m shielded chamber modified into a mode tuned reverberation chamber. A brief description of the measurement setup and resonant cavity theory is given. The measurements described include an evaluation of the chamber's: (1) excitation and receiving antennas' voltage standing wave ratio and efficiency, (2) mode tuner effectiveness, (3) loss, and (4) electromagnetic test field statistical characteristics. In addition, the measurement results of two techniques to determine the field strength in the reverberation chamber are compared. Results shown cover the frequency range 200 MHz to 18 GHz.

401,583

PB85-115426 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 89, Number 2, March-April 1984.
Apr 84, 85p
See also PB85-115434 through PB85-115467 and PB84-235530. Also available from Supt. of Docs as SN003-003-72086-1.

Keywords: *Glow discharges, *Calibrating, *Shear modulus, *Standards, Curve fitting, Iteration, Ultrasonic radiation, Power, Transferring, Hollow cathodes.

Contents:

- Hollow Cathode Discharges - Analytical Applications;
- An Iterative Calibration Curve Procedure;
- Determination of the Viscoelastic Shear Modulus Using Forced Torsional Vibrations;
- An Ultrasonic Absolute Power Transfer Standard.

401,584

PB85-115434
(Order as PB85-115426, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Hollow Cathode Discharges: Analytical Applications,
R. Mavrodineanu. 14 Sep 83, 43p
Also available from Supt. of Docs as SN003-003-72086-1.
Included in Jnl. of Research of the National Bureau of Standards, v89 n2 p143-185 Mar-Apr 84.

Keywords: *Glow discharges, Hollow cathodes, Grimm discharges, Paschen discharges.

The low pressure glow discharges considered in this paper are the hollow cathode (Paschen), and the flat cathode (Grimm). Both discharges have similar voltage-current characteristics which are responsible for their radiation stability. The analytical sample is supplied to the discharge through a sputtering mechanism which provides a stable and non-selective source of particles. Some of the fundamental properties of the glow discharge and sputtering phenomena will be discussed, including the relation between the geometry of the discharge, and the nature and pressure of sustaining gas, and current, on the emission characteristics of the discharges.

401,585

PB85-120749 Not available NTIS
National Bureau of Standards, Washington, DC.
Superconductivity.
Final rept.,
R. P. Hudson. 1981, 5p
Pub. in Collier's Encycl. 21, p637-641 1981.

Keywords: *Superconductivity, Superconductors, Cryogenics, Reprints.

The article on SUPERCONDUCTIVITY in Collier's Encyclopaedia is revised and brought up to date.

401,586

PB85-130946
(Order as PB85-130078, PC A99/MF A01)
National Physical Lab., Teddington (England). Div. of Electrical Science.
Realization of the Electrical SI Units,
B. P. Kibble. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p461-464 1984.

Keywords: Electrical resistance, Electric current, Measurement, *Ampere, *Fine structure constant, Quantum Hall effect, Kilograms, Ohm, Moving coil experiments.

The ampere is unique in the set of SI units in that the accuracy with which it can be realized is still insufficient for accurate measurements of the fundamental constants. Possible ways of improving this situation are described. In contrast, the ohm is in good shape, and a new cryogenic phenomenon concerning a quantized Hall effect in a MOSFET structure enables a more accurate non-QED measurement of the fine structure constant to be made in terms of it. A change of base units to eliminate the artifact-based definition of the kilogram is a more speculative possibility.

401,587

PB85-130953
(Order as PB85-130078, PC A99/MF A01)
Laboratoire Central des Industries Electriques, Fontenay-aux-Roses (France).
Absolute Determination of the Volt at LCIE (Laboratoire Central des Industries Electriques),
N. Elnekave, and A. Fau. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p465-468 1984.

Keywords: *Electric potential, *Standards, Electrometers, Measurement, Precision, *Volt, *Voltage standards.

The absolute determination of the volt using Kelvin's electrometer which was carried out in 1978 is now repeated with an improved volt balance. The new instrument includes a larger active electrode and a reduced gap between it and the guard ring. Second order corrections due to gap effects have been calculated by finite element methods and checked through rheographic mapping. It is estimated that random errors associated with the use of the new instrument will amount to less than 4 ppm.

401,588

PB85-130961
(Order as PB85-130078, PC A99/MF A01)
Commonwealth Scientific and Industrial Research Organization, Lindfield (Australia). Div. of Applied Physics.
CSIRO (Commonwealth Scientific and Industrial Research Organization) Absolute Volt Project,
G. J. Sloggett, W. K. Clothier, D. J. Benjamin, M. F. Currey, and H. Bainsfather. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p469-473 1984.

Keywords: *Electric potential, *Standards, Electrometers, Measurement, Precision, Mercury, Optical interferometers, Helium neon lasers, *Voltage standards, *Volt.

A liquid electrometer of unique design has been constructed to provide a precise absolute voltage standard. In this progress report the instrument is described and critical aspects of its performance are assessed. Known sources of uncertainty are consistent with a volt determination at or below the 1 ppm level. The principal areas of remaining work are discussed.

401,589

PB85-130979
(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Washington, DC. Electrical Measurements and Standards Div.
Status of the Measurement of the NBS (National Bureau of Standards) Ampere in SI Units,
P. T. Olsen, W. D. Phillips, and E. R. Williams. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p475-478 1984.

Keywords: *Electric current, *Standards, Fundamental constants, Measurement, *Ampere, Current balances.

The authors report on the status of a preliminary measurement of the NBS as-maintained ampere in terms of the SI, or absolute, ampere by a method which avoids the usual determination of dimensions of current-carrying coils. As a result, a major source of uncertainty is removed from the experiment. The preliminary work reported here has a statistical uncertainty on the order of 1 ppm. Systematic errors have not been fully evaluated, but the authors believe them to be on the order of 30 ppm or less.

401,590

PB85-130987
(Order as PB85-130078, PC A99/MF A01)
Tokyo Univ. (Japan). Faculty of Engineering.
Feasibility Study of an Absolute Determination of the Magnetic Flux Quantum,
K. Hara, F. Shiota, and T. Kubota. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p479-482 1984.

Keywords: *Magnetic measurement, Josephson junctions, Superconductors, Cryogenics, Feasibility, *Magnetic flux, Magnetic levitation, SQUID devices.

The principle and an experimental study of a new method to determine the magnetic flux quantum (ϕ sub 0) is described. Magnetic energy proportional to (ϕ sub 0) squared is substituted for and measured in terms of gravitational potential energy. A superconducting magnetic levitation system consisting of a persistent current coil and a superconducting floating body is employed for this energy substitution.

401,591

PB85-142495 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Development of Nb3Sn Cabled Conductor by External Diffusion Process and Effect of Strain on the Critical Current.
Final rept.,
G. Pasztor, and J. W. Ekin. 1984, 9p
Pub. in Advances in Cryogenic Engineering 30, p787-795 1984.

Keywords: *Superconductors, Niobium intermetallics, Tin intermetallics, Transmission lines, Strains, Reprints, Critical current, Niobium tin.

Two prototype primary cables to be used in the 12 T extension of the test facility SULTAN have been developed and evaluated. The fabrication route adopted for the Nb3Sn basic strand was an external diffusion technique. The strand was found to have a maximum (strain-free) overall critical-current density significantly higher than in commercial bronze processed Nb3Sn conductors, equal to about 60,000 A/sq cm at 12 T, for example. The elastic strain sensitivity of the critical current was comparable to bronze processed Nb3Sn, while the irreversible strain limit of 1.5% was significantly higher. The large resistance between strands in the cable results in a long current transfer length.

401,592

PB85-145209 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Emission Characteristics of Electrically Small Radiating Sources from Tests Inside a TEM Cell.
Final rept.,
I. Sreenivasiah, D. C. Chang, and M. T. Ma. 1981, 9p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electromagnetic Compatibility 23, n3 pt1 p113-121 Aug 81.

Keywords: *Dipoles, *Emission, Magnetic dipoles, Dipole moments, Cells, Model tests, Electromagnetic radiation, Reprints, TEM cells.

An electrically small radiating source of arbitrary nature may be modeled by an equivalent dipole system consisting of three orthogonal electric dipoles and three orthogonal magnetic dipoles, each excited with arbitrary amplitude and phase. A method of determining the individual dipole moments and the cross-components of such a dipole system, by tests inside a TEM cell, is presented along with some experimental results.

401,593

PB85-148005 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Theoretical and Experimental Investigations of Loading Effects Due to a Perfectly Conducting Rectangular Cylinder in a Transverse Electromagnetic Cell.

Final rept.,

M. Kanda. 1981, 6p

Pub. in Proceedings of Symposium and Technical Exhibition on Electromagnetic Compatibility (4th), Zurich, Switzerland, March 10-12, 1981, p401-406.

Keywords: *Electromagnetic compatibility, Analysis(Mathematics), Electromagnetic interference, Distortion, Moments, Magnetic properties, Conductivity, Electrostatics, Experimental data, Integral equations, Waveguides, Green function.

The study of electromagnetic compatibility (EMC), that is the electric and biological system effects due to electromagnetic (EM) radiation and EM calibration, require accurate EM measurement techniques for defining the EM interference (EMI) characteristics. Thus, fully enclosed rectangular transverse electromagnetic (TEM) transmission lines with thin inner conductors are often used for generating standard known test fields. In all cases it is desirable that only the dominant TEM mode should propagate. The purpose of this paper is to discuss the loading effects, i.e., the electromagnetic field distortion caused by an object under test in a TEM cell. In the theoretical analysis, the frequency domain integral equation for the magnetic field, or equivalently, the current density on the surface of a perfectly conducting cylinder in a parallel plate waveguide is solved by the method of moments to predict the degree of magnetic field distortion.

401,594

PB85-151611 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Streamer Initiation in Liquid Hydrocarbons under Divergent Field Conditions.

Final rept.,

G. J. FitzPatrick, E. O. Forster, R. E. Hebner, and E. F. Kelley. Oct 84, 6p

Pub. in Proceedings of 1984 Annual Report Conference on Electrical Insulation and Dielectric Phenomena, Claymont, DE., October 21-25, 1984, p291-296.

Keywords: *Electric discharges, *Cyclohexane, Cathodes, High voltage, Dielectric breakdown.

The initiation of streamers at the surface of a needle cathode in contact with cyclohexane has been investigated using an improved optical system, allowing for high magnification of the cathode, in conjunction with a high speed framing camera. To cover a broad range of conditions the gap between the electrodes was varied from 0.2 to 0.5, 1.0 and 2.0 cm. Also, the rate of rise of the applied voltage at each gap setting ranged from 17 to 23, 29, and 35 KV/s. The streamer initiation was found to occur at a voltage which was independent of both the gap and the rate of rise of the voltage. The shape of the cathode point was found to influence the scatter of the initiation voltage particularly at the lowest applied voltages but it did not affect the average value. The significance of these observations will be discussed. The implications of these findings on the charge carrier injection process will be analyzed.

20D. Fluid Mechanics

401,595

PB84-101187 PC A07/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.

Gas Orifice Meter Discharge Coefficients as Determined by Mass Flow Measurements.

D. B. Mann, J. A. Brennan, C. F. Sindt, J. F. LaBrecque, and S. E. McManus. Aug 83, 139p
NBSIR-83-1685

Sponsored in part by Gas Research Inst., Chicago, IL.

Keywords: *Gas flow, *Orifice flow, Flow measurement, Orifice meters, Mass flow, Flow rate.

Performance data of gas orifice meter runs and plates have been generated under a U.S. gas industry supported program. The data have been developed using nitrogen gas and a unique NBS gas flow measurement facility capable of directly measuring the mass of gas metered by the orifice device. Direct comparison of predictions from empirical equations can now be made at orifice bore Reynolds Numbers near four million. Two meter runs for each of four nominal line sizes and two sets of orifice plates with up to six beta ratios per set were interchanged in order to develop full meter performance characteristics. Orifice meter and flow reference system data are used to calculate discharge and expansion coefficients which in turn are compared to those derived from existing equations. Orifice meter performance data and system descriptions are provided.

401,596

PB84-223189 Not available NTIS
National Bureau of Standards, Washington, DC.

Asymmetric Instabilities in Buoyancy-Driven Flow in a Tall Vertical Annulus.

Final rept.,

G. B. McFadden, S. R. Coriell, and R. F. Boisvert.
Jun 84, 3p

Sponsored in part by National Aeronautics and Space Administration, Washington, DC.

Pub. in Physics of Fluids 27, n6 p1359-1361 Jun 84.

Keywords: *One dimensional flow, Buoyancy, Cylindrical bodies, Stability, Heat transfer, Reprints, Coaxial cylinders, Instability.

Linear stability of the one-dimensional flow between infinite vertical coaxial cylinders induced by heating the inner cylinder is considered for various radius ratios $\kappa < 1$ and for Prandtl numbers P appropriate to air and water. For air with $P = .71$ the least stable disturbance is non-axisymmetric for $\kappa < .44$ and is axisymmetric for $\kappa < .44$, and in either case the instability is due to the action of the shear forces. For water with $P = 3.5$, the situation is similar, except that the asymmetric shear mode is superceded by an axisymmetric instability driven by buoyancy forces for $.03 < \kappa < .18$. Wave speeds, wave numbers, and critical Grashof numbers for these cases and for the case of zero Prandtl number are given.

401,597

PB84-227222 Not available NTIS
National Bureau of Standards, Washington, DC.

Stokes-Maxwell Relations for the Distorted Fluid Microstructure.

Final rept.,

S. Hess, and H. J. M. Hanley. 1983, 4p

Pub. in Physics Letters 98A, n1-2 p35-38, 3 Oct 83.

Keywords: *Fluids, Kinetic theory, Microstructure, Relaxation time, Reprints, Stokes-Maxwell relations.

Relationships between the coefficients of the expansion of the pair correlation function for a fluid subjected to a shear are derived from a model kinetic equation. They equate a relaxation time with the viscosity and shear modulus of the fluid. Nonlinear phenomena are considered. The results are tested using nonequilibrium molecular dynamic simulation data for a soft sphere system close to freezing. Agreement between the theory and the simulations is satisfactory.

401,598

PB84-245752 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Chemical Engineering.

Numerical Solutions for Steady Natural Convection in a Square Cavity.

Final rept.,

E. F. Moore, and R. W. Davis. Mar 84, 34p NBSIR-84/2830

Keywords: *Fluid dynamics, *Convection, Numerical analysis, Analysis(Mathematics), Fluid flow, Viscous flow, Cavity flow.

Numerical solutions have been obtained for steady natural convection in a square cavity. The numerical method used was developed for unsteady, incompressible, viscous fluid flow. The similarity parameters were chosen to match those of an international comparison exercise. Results are presented and compared with those obtained by other researchers using different methods.

401,599

PB85-104065 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Applied Mathematics.

Finite Difference Calculations of Buoyant Convection in an Enclosure. Part 2. Verification of the Nonlinear Algorithm.

Final rept.,

R. G. Rehm, H. Baum, P. D. Barnett, and D. M. Corley. Sep 84, 36p NBSIR-84/2932

See also PB84-137801.

Keywords: *Convection, Fluid dynamics, Mathematical models, Fires, Enclosures, Combustion, Smoke.

Earlier, a novel mathematical model of buoyant convection in an enclosure was developed. The nonlinear equations constituting this model have recently been solved by finite difference methods in two dimensions. In this paper two solutions, obtained in special cases, to the model equations are presented. For both cases the solutions to the partial differential equations and to the finite difference equations used to approximate the differential equations are obtained by combinations of analytical and numerical techniques.

401,600

PB85-104875 Not available NTIS
National Bureau of Standards, Washington, DC.

Air-Flows Induced by Sparse Clouds of Droplets.

Final rept.,

D. S. Bright, R. A. Fletcher, and H. R. Baum. 1984, 7p

Pub. in Aerosol Science and Technology 3, n2 p187-193 1984.

Keywords: *Air flow, Drops(Liquids), Velocity measurement, Interactions, Fluid flow, Navier-Stokes equations, Reprints.

Very slow air flows induced by a column of 5-20 micrometer diameter droplets settling in a 9 mm diameter chamber were measured with a laser light velocimeter apparatus. The air flow velocity was measured as the difference between the Doppler-measured Stokes settling velocity of individual droplets and the settling velocity calculated from simultaneous measurements of droplet optical diameter. Experimental conditions included a wide range of droplet sizes, relatively slow air motion, and many droplets being in the laser beam at the same time.

401,601

PB85-129229 Not available NTIS
National Bureau of Standards, Washington, DC.

Diffusion in a Laminar Flow: Shear Rate Dependence of Correlation Functions and of Effective Transport Coefficients.

Final rept.,

S. Hess, and J. C. Rainwater. 1 Feb 84, 9p

Pub. in Jnl. of Chemical Physics 80, n3 p1295-1303, 1 Feb 84.

Keywords: *Laminar flow, *Diffusion theory, *Couette flow, Shear flow, Transport theory, Normal density functions, Tensors, Reprints.

The diffusion equation for independent Brownian particles suspended in a fluid undergoing plane Couette shear flow is solved in Fourier space by means of the Campbell-Baker-Hausdorff expansion for the product

Field 20—PHYSICS

Group 20D—Fluid Mechanics

of exponentials of noncommuting operators. Explicit solutions are derived and numerically evaluated for an initial Gaussian distribution with no source and for a continuous stationary source with a Gaussian spatial distribution. For the latter problem, the tensor describing the curvature of the steady-state distribution at the origin is analyzed in some detail and is shown to possess a dependence on shear rate very similar to that of the pressure tensor obtained in computer simulations of simple liquids under shear by Hanley and Evans.

401,602

PB85-135523 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Numerical Solutions for Laminar Orifice Flow.
Final rept.,
G. E. Mattingly, and R. W. Davis. 1977, 8p
Pub. in American Society of Mechanical Engineers Paper 77-WA/FE-13, 8p 1977.

Keywords: *Orifice flow, *Laminar flow, *Flow measurement, Incompressible flow, Axisymmetric flow, Orifice meters, Reynolds number, Pressure, Numerical analysis, Discharge coefficient, Flow velocity.

Numerical solutions have been obtained for laminar, axisymmetric, incompressible flow through a variety of concentric orifice meters for different Reynolds numbers. Flow fields are presented using velocity and pressure variables, and streak patterns are used to exhibit salient dynamic features. Good agreement is found between the computed discharge coefficients and corresponding experimental data.

401,603

PB85-142065 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Pressure Tensor and Viscosity Coefficients of a Soft Sphere Liquid under Shear.
Final rept.,
S. Hess, and H. J. M. Hanley. 1983, 8p
Pub. in International Jnl. of Thermophysics 4, n2 p97-114 1983.

Keywords: *Liquids, *Shear flow, Viscosity, Pressure, Distortion, Properties, Particles, Nonequilibrium flow, Molecular flow, Rheological properties, Spheres, Non-Newtonian fluids, Reprints.

General properties and consequences of the distortion of the structure of a simple liquid subjected to a planar shear flow are reported. In particular, the orientational distribution of particles in the first coordination shell around a given particle is analyzed and the effect of this distribution on the pressure tensor is discussed. The distorted distribution gives rise to a set of non-Newtonian viscosity coefficients reflecting the occurrence of normal pressure differences in the liquid. Numerical values of these viscosities are given for a soft sphere fluid at 7/8 of the freezing density using the technique of nonequilibrium molecular dynamics. A wide range of shear rates is considered and all viscosity coefficients are found to be functions of the shear rate.

401,604

PB85-145456 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Asymptotic Behavior of Three Particle Correlations.
Final rept.,
H. J. Raveche, and R. F. Kayser. Feb 84, 3p
Pub. in Physical Review A: General Physics 29, n2 p1003-1005 Feb 84.

Keywords: *Fluids, Compressibility, Correlations, Reprints.

The three particle correlation function, $(G \text{ sub } 3) (r \text{ sub } 12, r \text{ sub } 13, r \text{ sub } 23)$, for a fluid with a longrange pair potential is computed in two limits: (a) all $(r \text{ sub } ij)$ approaches infinity, and (b) one distance, say $(r \text{ sub } 12)$, fixed and $(r \text{ sub } 13)$, $(r \text{ sub } 23)$ approaches infinity. In both cases, the pair potential times the square of the isothermal compressibility appears.

401,605

PB85-151645 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Asymptotic Density Correlations and Corrections to Scaling for Fluids with Non-Finite-Range Interactions.
Final rept.,
R. F. Kayser, and H. J. Raveche. Feb 84, 3p
Pub. in Physical Review A: General Physics 29, n2 p1013-1015 Feb 84.

Keywords: *Fluids, Density(Mass/volume), Correlations, Correction, Interactions, Reprints, Correlation functions, Scaling laws.

The asymptotic behavior of the pair-correlation function in fluids with realistic long-range pair potentials is shown to give rise to a correction to scaling that has not been previously taken into account.

20E. Masers and Lasers

401,606

PB83-125633 PC A04/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Documentation of the NBS C, K, and Q Laser Calibration Systems,
William E. Case. Sep 82, 74p NBSIR-82-1676

Keywords: *Laser beams, *Calibrating, Lasers, Power, Energy, Computer applications.

This report provides a complete guide for the documentation of the NBS laser power and energy calibration systems. The report also describes a detailed procedure for operating the three (C, K, and Q) calibration systems under computer control.

401,607

PB84-175124 PC A22/MF A01
National Bureau of Standards, Washington, DC.
Laser Induced Damage in Optical Materials: 1982.
Final rept.,
H. E. Bennett, A. H. Guenther, D. Milan, and B. E. Newnam. Jan 84, 502p NBS-SP-669
Also available from Supt. of Docs. as SN003-003-02563-1. Sponsored in part by American Society for Testing and Materials, Philadelphia, PA., Office of Naval Research, Arlington, VA., Department of Energy, Washington, DC., and Defense Advanced Research Projects Agency, Arlington, VA. Library of Congress catalog card no. 83-600625. See also PB84-127869.

Keywords: *Optical materials, *Radiation damage, *Laser materials, *Meetings, Laser beams, Mirrors, Surfaces, Thin films, Optical coatings, Ultraviolet lasers, Infrared lasers, *Laser damage.

The proceedings contain papers presented at the Fourteenth Annual Symposium on Optical Materials for High Power Lasers held at the National Bureau of Standards in Boulder, Colorado, November 16-17, 1982. The Symposium was held under the auspices of ASTM Committee F-1, Subcommittee on Laser Standards, with the joint sponsorship of NBS, the Defense Advanced Research Project Agency, the Department of Energy, the Office of Naval Research, and the Air Force Office of Scientific Research. Approximately 200 scientists attended the Symposium, including representatives of the United Kingdom, France, Japan, West Germany, and the USSR. The Symposium was divided into sessions concerning Materials and Measurements, Mirrors and Surfaces, Thin Films and finally Fundamental Mechanisms. As in previous years, the emphasis of the papers presented at the Symposium was directed toward new frontiers and new developments. Particular emphasis was given to materials for high power apparatus. The wavelength range of prime interest was from 10.6 micrometers to the uv region. Highlights included surface characterization, thin film-substrate boundaries, and advances in fundamental laser-matter threshold interactions and damage mechanisms.

401,608

PB84-226398 Not available NTIS
National Bureau of Standards, Washington, DC.
Sulfur Dioxide Submillimeter Wave Lasers.
Final rept.,
J. P. Sattler, and W. J. Lafferty. 1984, 23p
Pub. in Reviews of Infrared and Millimeter Waves 2, p359-381 1984.

Keywords: *Gas lasers, *Submillimeter waves, Optical pumping, *Sulfur dioxide lasers, Laser radiation.

A review of current work on SO₂ submillimeter lasers is given, including both optically pumped as well as discharge systems. The optically pumped laser emissions result from pumping the far P-branch of the $(\nu \text{ sub } 1)$ band with a CO₂ laser. After assignment of the $(\nu \text{ sub } 1)$ band, all laser transitions have been very satisfactorily assigned. The assignment of the discharged laser lines has occupied several laboratories for sometime and is still not completely satisfactory. The lines, however, appear to originate in the $(\nu \text{ sub } 1) + (\nu \text{ sub } 2)$ and $3(\nu \text{ sub } 2)$ band systems which have a weak Fermi resonance crossing at high K levels. As in the case of the H₂O and HCN discharge laser systems, the laser transitions appear to originate in the energy levels with the greatest amount of resonance mixing.

401,609

PB84-239904 Not available NTIS
National Bureau of Standards, Washington, DC.
Tunable Laser Stabilization Techniques for Ultra-high Resolution Spectroscopy.
Final rept.,
J. L. Hall. 1983, 19p
Contract N00014-77-C-0656, Grant NSF-PHY79-04928
Pub. in Proceedings of Beijing/Shanghai International Conference on Lasers, Beijing, China, June 1980, p15-33 1983.

Keywords: *Spectroscopy, Resolution, Light(Visible radiation), Near infrared radiation, *Laser spectroscopy, *Laser stability, *Tunable lasers, Continuous wave lasers, *Dye lasers, Laser radiation.

The rapid development of tunable cw laser techniques gives us the possibility at present to match a single-frequency dye laser to an interesting quantum transition basically located anywhere within the visible or near infrared portions of the spectrum. However, a number of technical problems need to be overcome before one can enter the domain of high resolution spectroscopy and precision measurement. We discuss here generic dye laser problems and several of the laser control techniques that have proven useful. To conclude, and to show the power of these techniques, we present a rather high resolution illustration of the two-photon Ramsey fringe technique. For convenience in presentation, we will usually assume the laser to be a cw dye laser operating in the visible range. However, in view of the rapid development of broadly-tunable lasers using color centers as the active medium, we may be quite sure that ultrahigh stability laser radiation will be available from the visible up to about 3.3 micrometers in the near future.

401,610

PB85-115509 Not available NTIS
National Bureau of Standards, Washington, DC.
Current Status of NBS (National Bureau of Standards) Low-Power Laser Energy Measurement.
Final rept.,
E. D. West, and W. E. Case. 1974, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement, v23 n4 p422-425 Dec 74.

Keywords: *Power measurement, Laser beams, Heat measurement, Calorimeters, Calibrating, Radiometry, Reprints, *Laser radiation, *Calorimetry.

A set of four electrically calibrated calorimeters is used at the Boulder Laboratories of the National Bureau of Standards to test and calibrate devices for measuring laser powers in the range 100 W to 1 W and energies in the range 0.03 to 10 J. Each of these calorimeters is separately subjected to an analysis of errors. For each experiment time-temperature data are analyzed by a conventional calorimetric method based on the first law of thermodynamics. This method evaluates the energy stored in the calorimeter and the heat exchanged with the surroundings in order to arrive at the energy from the laser. The four calorimeters have

been intercompared using an argon laser beam at 514.5 nm wavelength. The intercomparison will reveal systematic differences between calorimeters and serves as a check on the estimates of the limits of systematic error.

401,611
PB85-124089 Not available NTIS
National Bureau of Standards, Washington, DC.
Dye Laser Frequency Stabilization Using Optical Resonators.
Final rept.,
J. Hough, D. Hils, M. D. Rayman, M. Long-sheng, and L. Hollberg. 1984, 7p
Sponsored in part by Office of Naval Research, Arlington, VA., and National Science Foundation, Washington, DC.
Pub. in Applied Physics B 33, p179-185 1984.

Keywords: *Frequency stability, Line width, Heterodyning, Reprints, *Dye lasers, Optical resonators.

The authors describe a study, performed using heterodyne techniques, of the frequency fluctuations of two completely independent ring dye lasers locked to independent reference cavities. Single laser linewidths of less than 750 Hz were achieved, the principal limitation being residual vibrations from the noisy laboratory environment. With future design and environmental improvements, ultranarrow linewidths are expected, thus providing a useful tool for a great variety of high precision experiments.

401,612
PB85-128809 Not available NTIS
National Bureau of Standards, Washington, DC.
Critique of Tunable Infrared Lasers.
Final rept.,
A. S. Pine. 1982, 9p
Pub. in Philosophical Transactions of the Royal Society of London, Series A: Mathematical and Physical Sciences 307, p481-489 1982.

Keywords: *Infrared lasers, Semiconductor lasers, Near infrared lasers, Reprints, *Tunable lasers, Raman lasers, Color center lasers, Nonlinear optics, Raman scattering.

The operating characteristics of tunable infrared semiconductor, spin-flip Raman, difference-frequency, color center and vibronic lasers are reviewed for application to spectroscopy at ultra-high resolution. Emphasis is placed on sub-Doppler molecular studies with these lasers.

401,613
PB85-130169 (Order as PB85-130078, PC A99/MF A01)
Bonn Univ. (Germany, F.R.).
Precision Frequency Metrology for Lasers in the Visible and Application to Atomic Hydrogen,
B. Burghardt, H. Hoeffgen, G. Meisel, W. Reinert, and B. Vowinkel. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p49-51 1984.

Keywords: *Frequency measurement, Microwave frequencies, Photodiodes, *Laser radiation, Visible radiation, Frequency difference, Hydrogen atoms.

A multi-step method is discussed that permits the determination of frequency differences between lasers in the visible in cases where the beat frequency is too large for direct detection. A step width of 80 GHz is used; the beat signal is picked up with millimeter-wave GaAs photodiodes. The resulting beat signals can be measured without further smoothing using a frequency counter. The authors report on experiments with atomic hydrogen, applying the method to measure transition frequencies aiming to determine the Rydberg frequency and the electron/proton mass ratio with increased precision.

401,614
PB85-130177 (Order as PB85-130078, PC A99/MF A01)
National Research Lab. of Metrology, Sakura (Japan).
System for Light Velocity Measurement at NRLM (National Research Laboratory of Metrology),
K. Tanaka, T. Sakurai, N. Ito, T. Kurosawa, and A. Morinaga. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p53-56 1984.

Keywords: *Carbon dioxide lasers, *Frequency measurement, *Wavelengths, Frequency standards, Inter-

mediate infrared radiation, *Light speed, Frequency difference, Infrared upconversion, Proustite, Water vapor lasers, Alcohol lasers.

A system for making an absolute measurement of the wavelength and frequency of a stabilized carbon-dioxide laser is under construction. The wavelength has been measured by an up-conversion technique using Proustite with reference to an iodine stabilized laser. For the frequency measurement, a water vapor laser and an optically pumped alcohol laser have been constructed. Tungsten-nickel and tungsten-cobalt point contact diodes with precision mounts as harmonic generators and mixers have been developed and used for evaluating the stability of the carbon-dioxide laser by beat frequency counting.

401,615
PB85-130193 (Order as PB85-130078, PC A99/MF A01)
Fizicheskii Inst., Moscow (USSR).
Double-Mode Method of Sub-Doppler Spectroscopy and Its Application in Laser Frequency Stabilization,
N. G. Basov, M. A. Gubin, V. V. Nikitin, A. V. Nikulchin, and V. N. Petrovskii. 1984, 4p
Prepared in cooperation with Institute of Physical Engineering, Moscow (USSR).
Included in Precision Measurement and Fundamental Constants II, p65-68 1984.

Keywords: *Frequency stability, Frequency standards, Helium neon lasers, Methane.

The authors present some results of the investigation of the proposed high sensitivity method of sub-Doppler spectroscopy and laser frequency stabilization which is based on the parameters of a double-mode (DM) gas laser containing an internal absorption cell. A short DM He-Ne/CH₄ laser was constructed which has relative frequency stability better than 10 to the -14 power and radiation spectral width approx = or < 10 Hz. When a telescopic beam expander was used inside the cavity of the short DM He-Ne/CH₄ laser, supernarrow reference spectral lines of about 3 kHz in width were obtained, and the magnetic hyperfine structure (hfs) of the (F sub 2, sup 2) methane line was resolved.

401,616
PB85-130201 (Order as PB85-130078, PC A99/MF A01)
Istituto di Metrologia Gustavo Colonnetti, Turin (Italy).
He-Ne ((127)I2) Lasers at 0.633 micrometer (and at 0.604 micrometer),
F. Bertinotto, B. I. Rebaglia, P. Cordiale, S. Fontana, and G. B. Picotto. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p69-72 1984.

Keywords: *Helium neon lasers, *Frequency standards, Frequency stability, Wavelengths, Visible radiation, Iodine 127.

Although iodine stabilized, 0.633 micrometer lasers are used as practical wavelength standards, no common agreement exists as to the operating conditions. It is shown that on the basis of such an agreement, reproducibility of + or - 20 kHz or (+ or - 4 x 10 to the -11th power) nu can be attained. This study proposes such conditions and shows that for reproducibility to exceed (10 to the -10th power) nu, certain cavity configurations must be discarded. Preliminary observations of strong absorption lines of iodine at the emission wavelength of 0.604 micrometer are also reported.

401,617
PB85-130219 (Order as PB85-130078, PC A99/MF A01)
Paris-11 Univ., Orsay (France).
Recent Work on 612 nm He-Ne Stabilized Lasers,
A. Brillet, P. Cerez, and C. N. Man-Pichot. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p73-76 1984.

Keywords: *Helium neon lasers, *Frequency standards, Absorption spectra, Visible radiation, Iodine 127.

The authors report on the metrological properties of 612 nm He-Ne lasers frequency stabilized on (127)I₂ saturated absorption lines. They describe the new results of spectroscopic and metrological interest, obtained both with conventional internal cell devices and with the new technique using an external cell inside a Fabry-Perot resonator. A reproducibility of 6 x (10 to the -13th power) is obtained with this last technique.

401,618
PB85-130227 (Order as PB85-130078, PC A99/MF A01)
National Inst. of Metrology, Beijing (China).
Iodine and Methane Stabilized He-Ne Lasers as Wavelength Standards,
N. C. Shen, Y. X. Wu, Y. M. Sun, C. Y. Li, and X. B. Zhang. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p77-79 1984.

Keywords: *Frequency standards, *Helium neon lasers, Frequency stability, Wavelengths, Standards, Iodine, Methane, Reproducibility, Iodine 127.

The iodine and methane stabilized lasers designed by NIM and Peking University can be used as wavelength standards. The authors have compared the frequency differences of the lasers between NIM and BIPM in Paris in April 1980. The relative frequency differences are 2.9 x 10 to the -11th power for iodine and 6.3 x 10 to the -12th power for methane, respectively. When the laser power is given a fixed value, the frequency variation of the iodine stabilized laser can be very small. The power shift and standard power value are discussed in this paper.

401,619
PB85-140762 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Three Phase Excitation of a Hollow Cathode Laser.
Final rept.,
R. D. Reid, G. J. Collins, and K. B. Persson. 1980, 2p
Pub. in Institute of Electrical and Electronics Engineers Jnl. of Quantum Electronics 16, n1 p3-4 Jan 80.

Keywords: *Lasers, Excitation, Direct current, Reprints, Helium copper lasers, Hollow cathodes, Three phase, Laser outputs.

A new hollow cathode discharge scheme using three phase electrical power at 60 Hz to generate excitation in a sputtered He-Cu laser has been demonstrated. The authors' results indicate that time independent laser output can be obtained from an ac power supply using overlapping excitation regions, each excited with a different electric phase. Two distinct hollow cathode designs are presented. One of these achieved a time independent or quasi-dc output power of 350 mW.

401,620
PB85-140994 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Heterodyne Frequency Measurements and Frequency Calibration Standards for Tunable Diode Lasers.
Final rept.,
J. S. Wells, and F. R. Petersen. 1983, 9p
Pub. in SPIE 438, p110-118 1983.

Keywords: *Frequency measurement, *Frequency standards, *Calibrating, Infrared radiation, Hydrogen bromide, Deuterium compounds, Reprints, *Tunable lasers.

New frequency calibration tables are required to keep abreast of the resolution attainable by currently available tunable lasers. One key to the generation of table with requisite accuracy involves accurate heterodyne frequency measurements, another key consists of reliable fitting and analysis. Coordinated activity in NBS involves selection of suitable molecular calibration candidates, their frequency measurement and analysis, and dissemination of the results in the form of frequency calibration tables. Current status of these efforts is described.

401,621
PB85-141034 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Simple, High Power, Nanosecond Pulse Nd:YAG Laser.
Final rept.,
A. Charlon, and P. Ewart. Jun 84, 4p
Pub. in Optics Communication 50, n4 p241-244, 15 Jun 84.

Keywords: *Solid state lasers, *Lasers, Light pulses, Reprints, *YAG lasers, Neodymium lasers, Nanosecond pulses.

A relatively simple, Q-switched and self-injected oscillator is described which employs a passive forming network to produce single, one nanosecond duration

Field 20—PHYSICS

Group 20E—Masers and Lasers

laser pulses with nanosecond jitter times. Peak powers of 50 MW were obtained from the Nd:YAG system with 5% amplitude stability at 10 Hz repetition rates.

401,622

PB85-143667 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Water-Cooled 2 kW Calorimeter for Laser Power Measurement.

Final rept.,
P. A. Simpson, and R. W. Zimmerer. 1981, 3p
Pub. in Proceedings of the Technical Program - Electro-Optics/Laser 81, Conference and Exposition, Anaheim, CA., November 17-19, 1981, p237-239.

Keywords: *Calorimeters, *Power measurement, *Carbon dioxide lasers, Calibrating, *Laser radiation, *High power lasers.

To meet the growing need for reliable monitoring of industrial high power CO₂ lasers, a calorimeter was designed to be both easily used, reliable, and accurate. A maximum continuous power input of 2 kilowatts was specified in order to handle commonly used CO₂ lasers. Two different measurement methods are discussed. First results indicate a sensitivity of 7.8 W/mV. The 1/e response time is approximately 6 seconds.

401,623

PB85-145415 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Frequency Stability and Stabilization of a Chemical Laser.

Final rept.,
J. Munch, M. A. Kolpin, and J. Levine. 1978, 6p
Pub. in IEEE Jnl. of Quantum Electronics 14, n1 p17-22 Jan 78.

Keywords: *Chemical lasers, *Frequency stability, Stabilization, Reprints, *Hydrogen fluoride lasers, *Deuterium fluoride lasers.

The authors have built a low-power CW HF/DF chemical laser, designed to achieve high-frequency stability. Measurements are reported which characterize the instantaneous spectral width of the laser output to less than one part in 10 to the 11th power ($\Delta\nu < 1$ kHz) and the variations in absolute frequency of this emission with time to four parts in 10 to the 10th power ($\Delta\nu \pm 20$ kHz) per 0.1 ms. Two experiments to actively stabilize the laser frequency are reported. In one experiment the laser was locked to a high-finesse Fabry-Perot to five parts in 10 to the 9th power ($\Delta\nu = \pm 250$ kHz) for many minutes. In the other experiment, one laser was locked to another using heterodyne beat spectroscopy to 1.7 parts in 10 to the 9th power ($\Delta\nu = \pm 85$ kHz). The stabilization experiments were limited by the feedback loops used.

20F. Optics

401,624

PB82-208620 PC A03/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.

Characterization of a Concentric-Core Fiber.
Final rept. 1 Oct 80-1 Oct 81,
B. L. Danielson, D. L. Franzen, R. L. Gallawa, E. M. Kim, and M. Young. Apr 82, 29p NBSIR-82-1661
Sponsored in part by Army Communications Research and Development Command, Fort Monmouth, NJ.

Keywords: *Fiber optics, Transmission loss, Attenuation, Backscattering, Refractive index, Concentric cylinders, Radiation patterns.

Several optical properties of a concentric-core fiber are examined. These include attenuation, radiation patterns, pulse broadening, index profile, backscatter signatures, and capture fraction. Experimental techniques are briefly described and the significance of the measured parameters is discussed.

401,625

PB84-164938 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Measurement Lab.

Retroreflectance MAP (Measurement Assurance Program) Service for Coefficient of Luminous Intensity.

Final rept.,
K. L. Eckerle, and J. J. Hsia. Feb 84, 59p NBS-SP-671
Also available from Supt. of Docs. as SN003-003-02554-7. Library of Congress catalog card no. 84-601001.

Keywords: *Luminous intensity, Coefficients, Errors, Accuracy, Experimental design, Tables(Data), *Retroreflection, *Retroreflectors, Uncertainty, Measurement assurance program.

This publication is written for those participating in the retroreflectance measurement assurance program (MAP) service provided by the National Bureau of Standards. This service is to verify the accuracy of measurement of coefficient of luminous intensity (R). This paper presents the techniques and procedures that are pertinent to participating in the MAP service, as well as a detailed explanation of the error analyses. Uncertainties for both retroreflectance and luminous transmittance were determined from two pilot studies carried out with the assistance of two industrial laboratories and by research performed on the elements of the MAP package.

401,626

PB84-192202 PC A03/MF A01
National Bureau of Standards, Boulder, CO.

Measurement of Multimode Optical Fiber Attenuation: An NBS (National Bureau of Standards) Special Test Service.

R. L. Gallawa, G. E. Chamberlain, G. W. Day, D. L. Franzen, and M. Young. Feb 84, 30p NBSIR-83-1691
See also PB83-251207.

Keywords: *Fiber optics, *Attenuation, *Optical communication, Near infrared radiation, Telecommunication, Measurement, Tests, Fiber optics transmission lines, Optical waveguides, National Bureau of Standards.

This document is one of a series that describes optical fiber measurement procedures and capabilities at the National Bureau of Standards (NBS). The authors concentrate here on the measurement of attenuation of multimode, telecommunication-grade fibers for the wavelength range of 850 nm to 1300 nm. The document gives details on the measurement procedure, which is based on the Electronics Industries Association Recommended Standard as published in RS 455. The procedure is based on two restricted launch conditions, either of which may be used to control the modal power distribution at launch. The intent is to approximate the conditions that exist in a long link, to the end that the reported attenuation coefficient is indicative of what can be expected in long, concatenated links.

401,627

PB84-216936 Not available NTIS
National Bureau of Standards, Washington, DC.

Scattering Theory of Distortion/Correction by Phase Conjugation.

Final rept.,
G. S. Agarwal, A. T. Friberg, and E. Wolf. Apr 83, 12p
Pub. in Jnl. of the Optical Society of America, v73 n5 p529-538 Apr 83.

Keywords: *Electromagnetic scattering, *Light scattering, Monochromatic radiation, Integral equations, Reprints, *Phase conjugation, Iterative methods.

The correction of wave distortions by the technique of optical phase conjugation is examined first on the basis of a newly derived integral equation for scattering of monochromatic scalar waves in the presence of a phase-conjugate mirror. The solution is developed in an iterative series, and the first- and second-order terms are analyzed and illustrated diagrammatically. A generalization of the integral equation is then presented, which takes into account the electromagnetic nature of light. It is also shown that if the conjugated wave is generated without losses or gains and with a complete reversal of polarization, a total elimination of distortions may be achieved by this technique under circumstances that frequently occur in practice.

401,628

PB84-216969 Not available NTIS
National Bureau of Standards, Washington, DC.

Optical Properties of Small Metal Spheres: Surface Effects.

Final rept.,
P. Apell, and D. R. Penn. Apr 83, 4p
Pub. in Physical Review Letters, v50 n17 p1316-1319, 15 Apr 83.

Keywords: *Particles, *Light scattering, Optical properties, Metals, Spheres, Surfaces, Reprints.

For many years it has been assumed that the optical properties of small spheres can be understood by means of a Drude form for the dielectric function that incorporates a boundary scattering rate $1/(\tau_{\text{sub } s})$ approximately $= (v_{\text{sub } f})/R$ where $(v_{\text{sub } f})/R$ is the Fermi velocity and R is the sphere radius. We calculate an effective scattering rate of the form $1/(\tau_{\text{sub } s}) = f \cdot (v_{\text{sub } f})/R$ and evaluate f as a function of photon frequency and electron density. It is pointed out that the largest contribution to f is due to the profile of the electron density of the sphere surface rather than the classical boundary scattering that is reduced an order of magnitude by electron screening.

401,629

PB84-217108 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.

Center for Mfg. Engineering.
Free-Space Propagation of Light Pulses,
E. Marx. May 84, 54p NBSIR-84-2835

Keywords: *Light pulses, *Light transmission, *Computer programs, Electromagnetic fields, Plane waves, Greens function, Wave equations, Transients.

A transient electromagnetic field in free space is completely specified when the initial values of the electric and magnetic fields are given. Green's function for the scalar wave equation can then be used to find the field at later times. A group of computer programs that implement these equations and process the output are presented in this report.

401,630

PB84-218346 PC A03/MF A01
National Bureau of Standards, Washington, DC.

Self-Study Manual on Optical Radiation Measurements: Part 1. Concepts. Chapter 11. Linearity Considerations and Calibrations.

Final rept.,
J. B. Shumaker. Apr 84, 45p NBS/TN-910-7
Also available from Supt. of Docs as SN003-003-02577-1. See also PB83-192633.

Keywords: *Optical measurement, *Radiometry, Calibrating, Attenuation, Nonlinearity, Linearity.

This is the seventh in a series of Technical Notes (910-) entitled 'Self-Study Manual on Optical Radiation Measurements'. In this chapter the author reviews the radiometric treatment of a non-linear radiometer. The emphasis is on the underlying radiometric principles and the experimental evaluation of a true response function so that such 'real' radiometer-output signals can be used in the idealized equations appropriate for linear radiometers. Several common techniques are discussed: beam addition, beam attenuation, the inverse-square law, and a number of other techniques in which non-radiometric measurements provide some or all of the basis for the response-function calibration. Many references are given; they should permit the reader to pursue the experimental details of any of the techniques in greater depth.

401,631

PB84-221290 Not available NTIS
National Bureau of Standards, Washington, DC.

Theory of Optical Edge Detection and Imaging of Thick Layers.

Final rept.,
D. Nyysönen. Oct 82, 12p
Pub. in Jnl. of the Optical Society of America 72, n10 p1425-1436 Oct 82.

Keywords: *Optical microscopes, Line width, Coherence, Measurement, Lithography, Microscopy, Reprints, *Edge detection, Microlithography.

The optical microscope measurement of small objects, 0.5 to 10 micrometers in diameter, is complicated by the apparent change in the dimension of the object

with a change in the spatial coherence of the illumination. Coherent edge-detection methods have been developed for the measurement of line objects on integrated-circuit photo masks and wafers. A generalization is presented of the coherent threshold equation that permits the extension to any state of partial coherence of the illumination as well as extension to the measurement of nonplanar objects. In the latter case, a waveguide model is developed for imaging of lines patterned in thick layers and is compared with experimental data.

401,632

PB84-222983 PC A03/MF A01
National Bureau of Standards (NML), Washington, DC.
Radiometric Physics Div.

NBS (National Bureau of Standards) Response to the Fourth CORM (Council for Optical Radiation Measurements) Report on Pressing Problems and Projected National Needs in Optical Radiation Measurements,

K. D. Mielenz. Jun 84, 49p NBSIR-84/2889

Keywords: *Optical measurement, *Radiometry, *Spectrophotometry, Calibrating, Standards, Infrared detectors, Council for Optical Radiation Measurements.

This publication constitutes the NBS Response to the Fourth CORM Report. It describes NBS policies for radiometry and spectrophotometry, the current status of projects suggested by CORM, and future plans. It also contains specific proposals for collaborative CORM/NBS efforts to provide needed standards and measurement services. With permission by CORM, the Fourth CORM Report itself is included as an appendix.

401,633

PB84-223270 Not available NTIS
National Bureau of Standards, Washington, DC.

Long Wave Infrared Testing at NBS (National Bureau of Standards).

Final rept.,
C. R. Yokley. 1983, 7p
Pub. in Society of Photo-Optical Instrumentation Engineers 416, p2-8 1983.

Keywords: *Optical tests, *Far infrared radiation, *Calibrating, Blackbody radiation, Sensitivity, Cryogenics, Infrared detectors, Test facilities, Reprints.

At present, National Bureau of Standards (NBS) work in the Long Wave Infrared (LWIR) spectral region is performed using three calibration facilities. Two recent calibrations for the LWIR community will be described to illustrate the features and limitations of the present NBS facilities. Future plans to enlarge and upgrade the cryogenic facility to provide increased sensitivity will be described. Systematic studies of the errors due to diffraction, polarization, and attenuation are also planned for the upgraded facility. Future work to explore the possibility of basing calibrations on self-calibration techniques with LWIR detectors will also be described.

401,634

PB84-223395 Not available NTIS
National Bureau of Standards, Washington, DC.

Present NBS (National Bureau of Standards) Capability in Optical Fiber Measurements.

Final rept.,
G. W. Day, and D. L. Franzen. 1981, 5p
Pub. in Proceedings of Int. DoD/Industry Fiber Optics Standards Conf. (1st), Washington, DC., April 21-23, 1981, p132-136.

Keywords: *Fiber optics, Measurement, Attenuation, Bandwidth.

The design and performance of three systems now in use at the National Bureau of Standards for the measurement of attenuation and bandwidth of multimode optical fibers are reviewed. A brief discussion of measurement conditions, particularly launching conditions, is included.

401,635

PB84-223577 PC A03/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Mfg. Engineering.

Metrological Consequences of the Hard Optical Boundary Assumption.

Final rept.,
A. G. Lieberman. Jul 84, 31p NBS-TN-1198
Also available from Supt. of Docs as SN003-003-02594-1.

Keywords: *Reflection, Metrology, Vacuum, Interfaces, Sodium, Surface properties, Plane waves, Laser beams, Phase shift, Errors, *Polarized light, *Metal surfaces, Lang-Kohn model, Ricatti equation, Jellium.

The reflection of s-polarized light propagating in vacuum by a metal surface is examined for two descriptions of the vacuum-metal interface: the exponential surface transition and the Lang-Kohn transition. Both models treat the metal as a lossless, non-magnetic jellium material, but differ in the spatial distributions of their constituent charges. The displacement of the optical surface relative to the mechanical surface caused by the transition is evaluated for each model. Computerized results are presented for the optical displacement and phase change upon reflection from a sodium surface for the theoretically superior Lang-Kohn model. The measurement errors which result from ignoring the vacuum-metal transition become more significant as the angle of incidence is increased.

401,636

PB84-223833 Not available NTIS
National Bureau of Standards, Washington, DC.

Demonstration of Broadband Schottky Barrier Mixers for Visible Laser Light and Application to High Resolution Spectroscopy.

Final rept.,
H. U. Daniel, B. Maurer, M. Steiner, H. Walther, and J. C. Bergquist. 1983, 3p
Prepared in cooperation with Max-Planck-Inst. fuer Quantenoptik, Garching (Germany, F.R.) and Munich Univ. (Germany, F.R.). Fachbereich Physik.
Pub. in Proceedings of Int. Conference Laser Spectroscopy (6th), Interlaken, Switzerland, June 27-July 1, 1983, p432-434.

Keywords: *Mixers, Microwave frequencies, Light(Visible radiation), Spectrometers, Broadband, Resolution, *Laser spectrometers, Schottky barrier devices, Dye lasers, Laser radiation.

Visible lasers, frequency separated by as much as 1 THz, are mixed on Schottky Barrier Mixers with a suitable microwave frequency, or its harmonic, to give a difference frequency near DC. Schottky Barrier Mixers exhibit vast improvement in sensitivity, in stability, and in nonlinear microwave generation as compared to the metal-insulator-metal point contact diodes. A broadly tunable frequency-offset-locked dye laser spectrometer, which uses a Schottky Barrier Mixer, demonstrates for the first time the broadband, but high resolution capability of such a device.

401,637

PB84-223858 Not available NTIS
National Bureau of Standards, Washington, DC.

Birefringence Measurements in Single Mode Optical Fiber.

Final rept.,
G. W. Day. 1983, 8p
Sponsored in part by Department of Defense Calibration Coordination Group, Redstone Arsenal, AL.
Pub. in Proceedings of SPIE International Society for Optical Engineering, San Diego, CA., August 23-24, 1983, p72-79.

Keywords: *Fiber optics, *Birefringence, Polarization, Detectors.

Because their cores are not perfectly circular or because of stress, inherent to the structure or externally applied, practical single mode fibers are birefringent. These sources of birefringence are reviewed briefly. A simple model for the fiber consists of a combination of one linearly birefringent element and one circularly birefringent element. Depending on the magnitude of the birefringence, different techniques of evaluating the parameters of the model may be suitable. Several methods appropriate for low and high birefringence fiber are described and some of their advantages and disadvantages outlined.

401,638

PB84-225218 Not available NTIS
National Bureau of Standards, Washington, DC.

Geometrical Alignment Errors in the Measurement of Prismatic Retroreflectors.

Final rept.,
K. L. Eckerle, J. J. Hsia, and W. S. Liggett, Jr. 1984, 6p
Pub. in Color, v9 n1 p23-28 1984.

Keywords: Measurement, Alignment, Errors, Reprints, *Retroreflectors, Retroreflection.

Measurements of the coefficient of luminous intensity (C.I.L.) for prismatic retroreflectors contain errors due to misalignment of the photometric range and samples. A procedure for assessing these errors has been developed for the two-orientation hexagon cube clear prismatic retroreflector that is included in the NBS Measurement Assurance Program (MAP) for retroreflection. This procedure involves experiments in which the geometrical setting of the range is deliberately varied so that the dependence of the C.I.L. on small variations in the geometry can be estimated. Results of this experiment are reported along with some repeated measurements of C.I.L. for an internal NBS MAP. Similar coefficients have previously been reported for retroreflective bead sheeting, and their implication is discussed in an appendix.

401,639

PB84-225374 Not available NTIS
National Bureau of Standards, Washington, DC.

Sum Frequency Generation of cw 194 nm Radiation in Potassium Pentaborate.

Final rept.,
H. Hemmati, J. Bergquist, and W. Itano. 1982, 6p
Pub. in Laser Techniques for Extreme Ultraviolet Spectroscopy, v90 n2 p485-490 1982.

Keywords: *Far ultraviolet radiation, Continuous radiation, Argon lasers, Frequency multipliers, Reprints, *Sum frequency mixing, *Potassium borates, Tunable lasers, Dye lasers, Nonlinear optics, Second harmonic generation, Ammonium phosphates, Ammonium dihydrogen phosphate.

Narrowband, tunable cw radiation in the 194 nm region has been produced by sum frequency mixing in a potassium pentaborate (KB5) crystal. The input wavelengths required for 90 degree phase-matched sum frequency mixing (SFM) are approximately 257 nm and 792 nm. The tunable 792 nm radiation was obtained from a cw dye laser. The 257 nm radiation was obtained by frequency doubling the output of a cw argon ion laser in an ammonium dihydrogen phosphate (ADP) crystal. It is estimated that several microwatts of 194 nm radiation in a bandwidth of less than 10 MHz can be produced when all operating conditions are optimized.

401,640

PB84-225507 Not available NTIS
National Bureau of Standards, Washington, DC.

Role of Backscatter Signatures in Optical Fiber Characterization.

Final rept.,
B. L. Danielson. 1981, 5p
Pub. in Proceedings of International DoD/Industry Fiber Optics Standards Conference (1st), Washington, DC., April 21-23, 1981, 1, p137-141.

Keywords: *Fiber optics, *Reflectometers, *Backscattering, Measurement, Optical waveguides.

The optical time domain reflectometer is a versatile instrument which can be used to measure several important physical, dimensional, and transmission properties of optical fibers. The author discusses some of these areas, some problems involved in the interpretation of backscatter signatures, and some possible military applications area in which it may be desirable to base specifications and tolerances on signature features.

Field 20—PHYSICS

Group 20F—Optics

401,641
PB84-227065 Not available NTIS
National Bureau of Standards, Washington, DC.

Estimating Index Profiles of 1.3 Micrometer Single Mode Fibers by Near-Field Measurements at Blue Wavelengths.

Final rept.,
E. M. Kim, D. L. Franzen, M. Young, and P. M. Rodhe. Dec 83, 5p
Pub. in Jnl. of Lightwave Technology LT-1, n4 p562-566 Dec 83.

Keywords: *Fiber optics, Light(Visible radiation), Reprints, Near field, Refractive index, Blue(Color).

Near-field intensity measurements are obtained at the wavelength of 0.45 micrometer for fibers designed to operate in a single mode at 1.3 micrometers. At blue wavelengths, the fibers are sufficiently multimode so the near-field scan gives an approximation to the index profile. Near-field scans from six fibers are compared to actual index profiles as determined by the refracted ray method. Experimental near-field scans are also compared to theoretical predictions from a model using numerical solutions to the scalar wave equation.

401,642
PB84-227388 Not available NTIS
National Bureau of Standards, Washington, DC.

High Pressure Polycrystalline Sodium Chloride Window and Mounting Arrangement for CO₂ Laser Transmission.

Final rept.,
J. W. Bransford. Jan 84, 2p
NASA Order-H-43201B
Pub. in Review of Scientific Instruments 55, n1 p125-126 Jan 84.

Keywords: *Infrared windows, *Sodium chloride, Carbon dioxide lasers, Laser beams, Polycrystalline, Mountings, Reprints.

A design for an unclamped high pressure window made from polycrystalline sodium chloride is presented. The window is used to pass a CO₂ laser beam into a pressure chamber operating at pressures from 1.034 x 10 to the 5th power Pa to 13.8 MPa.

401,643
PB84-242502 Not available NTIS
National Bureau of Standards, Washington, DC.

Submicrometer Interdigital Silicon Detectors for the Measurement of Picosecond Optical Pulses.

Final rept.,
R. J. Phelan, Jr., D. R. Larson, N. V. Frederick, and D. L. Franz. 1983, 5p
Pub. in Proceedings of SPIE, Int. Soc. Optical Engineering, San Diego, CA, Aug 24-26 1983, p207-211.

Keywords: *Infrared detectors, *Optical detection, *Optical measurement, Semiconductor diodes, Silicon, Light pulses, Schottky barrier devices, Amorphous materials, Amorphous silicon, Picosecond pulses.

Interdigital silicon Schottky barrier diodes have been evaluated for picosecond pulse measurements. Structures with clearly defined receiving apertures and sub-micrometer contact spacings were created with electron beam lithography. The detectors exhibit saturation currents corresponding to the absorbed optical power. Impulse response widths were less than 50 ps, and response maps yielded uniform patterns. A peak quantum efficiency of over 30 percent was obtained, and the usable spectral responsivity extends beyond 2 micrometers.

401,644
PB84-242957 Not available NTIS
National Bureau of Standards, Washington, DC.

Apparatus for Convenient Cover Lifting on a Nicolet Vacuum FT-IR System.

Final rept.,
R. A. Forman, and A. Baghdadi. 1983, 1p
Pub. in FT-IR Spectral Lines 5, n1 p20 1983.

Keywords: *Optical spectrometers, *Mirrors, Adjusting, Reprints, *Beam splitters.

The large cover for the vacuum bench of the Nicolet 8000 is somewhat unwieldy to remove on a regular basis. Because of constraints set by the special nature of the experiments in place in our sample chamber, we have found it a bit inconvenient to routinely change the beamsplitter through the normal sample hole. We have

devised a relatively simple and inexpensive method of raising and lowering the cover, which makes the use of the spectrometer much more convenient.

401,645
PB85-100352 Not available NTIS
National Bureau of Standards, Washington, DC.

Effective Two-Level Description of Pressure Induced Extra Resonances in Four-Wave Mixing.

Final rept.,
G. S. Agarwal. Nov 82, 7p
Pub. in Physical Review A 26, n5 p2761-2767 Nov 82.

Keywords: Pressure, Reprints, *Four wave mixing, Bloch equations.

The possibility of formulating a treatment of pressure induced extra resonances (PIER) in four wave mixing, in terms of effective two-level equations, is examined. Using the method of time averaging, effective two-level equations, which are valid for arbitrary slowly varying field envelopes, are obtained. Such equations are found to have a structure that is very different from that of Bloch equations. In the new structure, important inhomogeneous terms appear that are crucial for PIER. The present description is then used to study the effect of laser fluctuations on PIER.

401,646
PB85-111813 Not available NTIS
National Bureau of Standards, Washington, DC.

Need for Standard Launch Conditions in Fiber Measurements.

Final rept.,
R. L. Gallawa, D. L. Franzen, and G. W. Day. 1981, 1p
Pub. in Proceedings of Fiber Optics and Comm. Proceedings, San Francisco, CA., September 1-3, 1981, p114.

Keywords: *Fiber optics, *Optical communication, Attenuation, Bandwidth, Measurement, Standards, Comparison.

Measurement of fiber attenuation and bandwidth is influenced by source characteristics, launch conditions, and modal excitation efficiency. This talk will concentrate on the reasons behind proposed standard launch conditions and will discuss results of a recent interlaboratory measurement comparison.

401,647
PB85-114700 PC A07/MF A01
National Bureau of Standards (NEL), Boulder, CO.

Electromagnetic Technology Div.
Technical Digest - Symposium on Optical Fiber Measurements, 1984.

Oct 84, 150p NBS/SP-683
See also PB85-114718 through PB85-115004 and PB83-129148. Also available from Supt. of Docs as SN003-003-02604-2. Library of Congress catalog card no. 84-601092. Prepared in cooperation with Optical Society of America, Washington, DC. and Institute of Electrical and Electronics Engineers, Inc., New York. Optical Waveguide Communications Committee.

Keywords: *Fiber optics, *Optical communication, *Meetings, Optical measurement, Optical dispersion, *Optical fibers, Multimode.

This volume contains summaries of 31 papers presented at the Symposium on Optical Fiber Measurements held October 2-3, 1984, at the National Bureau of Standards, Boulder, Colorado. Subjects include measurements on singlemode fiber, multimode fiber, fiber designed for sensing applications, instrumentation, field measurements, and standards.

401,648
PB85-114726 (Order as PB85-114700, PC E07/MF E01)

Bell Communications Research, Inc., Holmdel, NJ.
Effective Cut-Off Wavelength for Single-Mode Fibers: The Combined Effect of Curvature and Index Profile.

V. S. Shah. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p7-10 1984.

Keywords: *Fiber optics, Optical measurement, *Optical fibers, Cutoff wavelength.

In single mode transmission systems, the effective cut-off wavelength is an important design parameter separating the single-modal and bi-modal regime in an optical fiber. In light of the importance of the effective cut-

off wavelength in system design and the need to standardize its range, a study program is in progress in our Laboratory to gain further understanding of the dependence of the effective cut-off wavelength (with the bend diameter as a parameter) on three fibers are reported here.

401,649
PB85-114734 (Order as PB85-114700, PC E07/MF E01)

Doctor Neher Lab., Leidschendam (Netherlands).
Length and Curvature Dependence of Effective Cutoff Wavelength and LP₁₁-Mode Attenuation in Single-Mode Fibers.

H. T. Nijhuis, and K. A. H. van Leeuwen. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p11-14 1984.

Keywords: *Fiber optics, Optical measurement, *Optical fibers, *Cutoff wavelengths.

The authors report on measurements of the length and curvature dependence of the effective cutoff wavelength in a number of single-mode fibers with various types of index-profile, aimed at establishing such empirical rules. The results indicate approximately linear relations between the cutoff wavelength and the logarithm of the fiber length, and between cutoff wavelength and the inverse of the radius of curvature to which the fiber is bent.

401,650
PB85-114767 (Order as PB85-114700, PC E07/MF E01)

Laboratoires de Marcoussis - Centre de Recherches (France).

Bending and Microbending Loss Sensitivity of Step Index Single Mode Fibers.

J. Auge, P. Dupont, and L. B. Jeunhomme. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p25-28 1984.

Keywords: *Fiber optics, Bending, Losses, Attenuation, Sensitivity, *Optical fibers, Fiber optics transmission lines.

Single-mode optical fibers with step index core and matched index or depressed index claddings are finding an increasingly large variety of applications, in long range transmission, signal processing, and sensing devices. These applications involve very different bending and microbending conditions, and it is therefore necessary to get an in-depth knowledge of bend and microbend losses as a function of fiber parameters. The authors have used the basket-weave test to experimentally determine the losses in various matched cladding and depressed cladding fibers. The results are found to agree reasonably well with simple loss models, and the behavior of both fiber types is discussed in some details.

401,651
PB85-114775 (Order as PB85-114700, PC E07/MF E01)

Karlsruhe Univ. (Germany, F.R.).
Refractive-Index Profile and Modal Dispersion Prediction for a Single-Mode Optical Waveguide from Its Far-Field Radiation Pattern.

W. Freude, and A. Sharma. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p29-32 1984.

Keywords: *Fiber optics, Optical dispersion, Far field, Laguerre functions, *Optical waveguides, Optical fibers, Refractive index, Near fields.

The authors expanded measured far-fields in M Gau(beta)-Laguerre functions, the coefficients of which are determined with a least relative-error squares fit by matrix inversion. Thereby the near-field is given, from which the refractive-index profile can be calculated. Using wavelength dependent far-field data measured with an incoherent source, the waveguide dispersion may be deduced. Besides the general benefits of far-field measurements (uncritical methanical and optical setup), the advantage of the method lies in its inherent insensitivity against noise, so that the practical resolution limit is only given by the amount to which cladding modes and stray light can be reduced.

401,652
PB85-114783

(Order as PB85-114700, PC E07/MF E01)
British Telecommunications Research Labs., Martlesham Heath (England).
Simple Near-Field Scanning System for Refractive Index Profiles and Mode Spot Shape,
C. A. Millar. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p33-36 1984.

Keywords: *Optical scanners, *Fiber optics, Optical measurement, Resolution, *Optical fibers, *Refractive index, Near field.

Measurements of refractive index profile and mode spot intensity distribution are fundamentally important for single-mode fiber characterization. Using the Transmitted Near Field technique, the two measurements are essentially the same, but with different sources and detectors in place. This paper describes a straight-forward apparatus which, when appropriate sources and detectors are used, permits high-resolution, real-time near field scanning.

401,653
PB85-114791

(Order as PB85-114700, PC E07/MF E01)
Centro Studi e Laboratori Telecomunicazioni, Turin (Italy).
Spot-Size Measurements in Single-Mode Fibres,
R. Caponi, G. Coppa, P. Di Vita, and U. Rossi. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p37-40 1984.

Keywords: *Fiber optics, Dimensional measurement, *Optical fibers.

It is known that the dimensional specification of single-mode fibers is performed on the basis of the so-called mode field diameter. It has not been possible, up to now, to agree (e.g., in the CCITT) an acceptable definition of such a parameter, and the matter is presently strongly debated. In order to clarify the situation, it seems convenient firstly to review some definitions of parameters related to the mode field diameter and successively to discuss various techniques proposed recently for its measurement. It is not our aim to penetrate the measurement problems of each proposed method, but we want to analyze them critically in order to understand what actually is being measured and how useful that quantity can be. Finally we expose a novel and very promising technique that permits a direct measurement of the mode field diameter making use of suitable masks.

401,654
PB85-114809

(Order as PB85-114700, PC E07/MF E01)
Corning Glass Works, NY.
Compatibility of National and International Standards for Optical Fiber,
P. R. Reitz. Oct 84, 7p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p41-47 1984.

Keywords: *Fiber optics, *Standards, Optical measurement, Compatibility, Comparison, Tests, *Optical communication, *Optical fibers.

In the last several years we have witnessed the rapid growth and acceptance of optical fiber communications; this has been accompanied by a noticeable maturation of standards activities. In large measure the existing measurement standards are very similar, particularly considering the diverse frames of reference from which they have been created. There remains, however, a significant number of important detail differences that must yet be resolved. This resolution will require great consideration to fairly weigh the requirements for simplicity and flexibility with the desire for uniformity and technical correctness. This is the ongoing challenge of standardization.

401,655
PB85-114817

(Order as PB85-114700, PC E07/MF E01)
Naval Research Lab., Washington, DC.
Optical Fiber Sensors,
A. Dandridge, J. H. Cole, and G. H. Sigel. Oct 84, 6p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p49-54 1984.

Keywords: *Fiber optics, *Detectors, Interferometers, *Optical fibers.

Recently, many types of sensors using optical fibers, either as the transduction element or as a communication link to an optical sensor, have been developed. These devices range from simple on/off types of device to highly sensitive interferometric designs. The wide range of these devices means there is no one type of fiber to fill the requirements of fiber sensors. In this paper, the authors describe the various types of fiber optic sensors, however, the emphasis will be on the properties of the fiber used in the sensors, rather than the source, demodulation or systems aspects.

401,656
PB85-114825

(Order as PB85-114700, PC E07/MF E01)
Rhode Island Univ., Kingston. Dept. of Physics.
Phase Velocity and Loss Coefficient of Optical Fibers Viewed as Stiff Strings,
F. W. Cuomo. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p55-58 1984.

Keywords: *Fiber optics, *Phase velocity, Modulus of elasticity, Vibration, Losses, *Optical fibers.

The standing wave method has been widely used in the determination of the damping properties of viscoelastic solids in the 100-10,000 Hz range, and loss coefficients have been obtained either by the experimental observation of the decay modulus or the half-power bandwidth of each resonant peak. This paper investigates by this method the behavior of optical fibers to mechanical vibrations. It is found that for plastic clad fibers the phase velocities are largely dependent on the tension and mass density while for other fibers tested the system behaves as a stiff string whereby the modulus of elasticity takes on a more pronounced role. Experimental data are presented to illustrate the differences in loss factors and phase velocities for several optical fiber configurations.

401,657
PB85-114833

(Order as PB85-114700, PC E07/MF E01)
Bell Labs., Norcross, GA.
Polarization Shuttle Pulse Technique,
C. S. Brown, and F. T. Stone. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p59-62 1984.

Keywords: *Fiber optics, *Birefringence, Polarization(Waves), Optical measurement, *Polarization shuttle pulse technique, *Optical fibers.

To satisfy the many applications of single-mode fibers, both high- and low-birefringence fibers are being developed, and the need for practical and repeatable measurement techniques to characterize the polarization properties of such fibers is increasing. Several birefringence-measurement techniques are currently in use; however, only a few can measure low birefringence. The most popular, the cut-back method, is destructive and exhibits poor repeatability. In this paper, the authors report on a new technique, the polarization shuttle pulse (PSP) method, for measuring birefringence and related polarization effects in low birefringence (i.e., $\Delta\beta = 3.6$ degree/m to 360 degree/m) single-mode fibers of short lengths (20 to 100 cm).

401,658
PB85-114841

(Order as PB85-114700, PC E07/MF E01)
Southampton Univ. (England). Dept. of Electronics.
New Technique for the Measurement of Axial-Stress in Optical-Fiber Preforms,
M. P. Varnham, S. B. Poole, and D. N. Payne. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p63-66 1984.

Keywords: *Fiber optics, *Stresses, Thermal stresses, Measurement, *Optical fibers.

The ability to measure the axial stress in optical-fiber preforms is essential for the development of highly-birefringent and other specialist fibers, in which high levels of thermal stress are deliberately introduced to modify the fiber propagation characteristics. In this paper the authors present a new method for measuring the axial stress profile which should see widespread adoption as a result of its simplicity and convenience. The method has the advantage that it uses the same hardware and software that are commonly used in transverse refractive-index profiling and it is therefore readily incorporated into existing equipment. The technique can also in principle be applied to two-

dimensional stress profiling of asymmetric preforms. In addition, the work provides a new insight into how thermal stresses affect fibre refractive-index profiling techniques.

401,659
PB85-114866

(Order as PB85-114700, PC E07/MF E01)
Bell Labs., Norcross, GA.
Systematic Approach to Specifying Multimode Fiber Manufacturing Tolerances,
D. W. Peckham, S. C. Mettler, and R. B. Kummer. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p73-76 1984.

Keywords: *Fiber optics, *Splices, Manufacturing, Losses, Tolerances(Mechanics), *Optical fibers, Intrinsic quality factors.

A systematic approach to fiber parameter specification which includes the effects on splice loss of parameter deviations has been presented. An example has been presented which illustrates the possible improvements in splice loss performance and yield obtainable with this approach.

401,660
PB85-114882

(Order as PB85-114700, PC E07/MF E01)
Siecor Optical Cable, Hickory, NC.
Automated Differential Fiber Strain Measurement System for Single and Multimode Fiber,
K. H. Hafemeister, T. A. Clarke, and E. J. Buonopane. Oct 84, 4p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p81-84 1984.

Keywords: *Fiber optics, *Strain measurement, Loads(Forces), Optical measurement, *Optical fibers, Fiber optics transmission lines, Multimode.

This paper describes a fiber strain measurement system that can, as one option, measure the load level at which the fibers in the cable first see strain, thus ensuring the parameters of the cable design are met. This system also determines the amount of strain seen on a fiber at any stress situation and can evaluate the amount of residual strain cabled fibers see after tensile load is released.

401,661
PB85-114908

(Order as PB85-114700, PC E07/MF E01)
York Technology Ltd., Chandler's Ford (England).
Advances in Optical Time-Domain Reflectometry,
A. H. Hartog. Oct 84, 6p
Included in Technical Digest - Symposium on Optical Fiber Measurements, p89-94 1984.

Keywords: *Fiber optics, Optical communication, Attenuation, Losses, Near infrared radiation, *Optical time domain reflectometry, *Optical fibers.

The following topics are discussed: Performance criteria in OTDR; Operation at long wavelength and with single-mode fibers; Long-range single mode OTDR at 1300 nm.

401,662
PB85-114916

(Order as PB85-114700, PC E07/MF E01)
Laboratoires de Marcoussis - Centre de Recherches (France).
1.3 Micrometer Portable Reflectometer for the Field Test of Single-Mode Fiber Cables,
J. J. Bernard, E. Depresles, L. Jeunhomme, J. L. Moncelet, and M. Carratt. Oct 84, 4p
Prepared in cooperation with Compagnie Lyonnaise de Transmissions Optiques (France).
Included in Technical Digest - Symposium on Optical Fiber Measurements, p95-98 1984.

Keywords: *Reflectometers, *Fiber optics, Optical measurement, Near infrared radiation, Portable equipment, Backscattering, Attenuation, *Optical time domain reflectometers, *Optical fibers.

The growth of single-mode optical fiber transmission systems at 1.3 micrometers requires test instruments for field use, specially designed for attenuation measurements, splices control, detection and localization of possible breaks. The authors describe in this paper a new portable optical time-domain reflectometer using the correlation technique designed for the field test of

Field 20—PHYSICS

Group 20F—Optics

single-mode fiber codes. This device, presently being developed, shows a 15 dB one-way dynamic range together with a 10 m ultimate spatial resolution.

401,663

PB85-114957

(Order as PB85-114700, PC E07/MF E01)

ITT Electro-Optics Div., Roanoke, VA.

Accurate Specification of Single-Mode Dispersion Measurements,

F. P. Kapron, and T. C. Olson. Oct 84, 4p

Included in Technical Digest - Symposium on Optical Fiber Measurements, p111-114 1984.

Keywords: *Fiber optics, *Optical dispersion, Near infrared radiation, Measurement, *Optical fibers.

Fiber chromatic dispersion is usually specified in terms of a maximum absolute value over a particular wavelength range. However, a maximum + or - 3.5 ps/km-nm between 1280 and 1340 nm, for example, is a worst-case estimate that ignores the better fiber performance attainable over much of the wavelength window. High bitrate single-mode systems will require a more flexible and precise specification, such as proposed in this paper, that does not stress manufacturing measurement time or yield.

401,664

PB85-114965

(Order as PB85-114700, PC E07/MF E01)

Corning Glass Works, NY.

Multiple-Wavelength System for Characterizing Dispersion in Single-Mode Optical Fibers,

R. A. Modavis, and W. F. Love. Oct 84, 4p

Included in Technical Digest - Symposium on Optical Fiber Measurements, p115-118 1984.

Keywords: *Fiber optics, *Optical dispersion, Near infrared radiation, Optical measurement, *Optical fibers.

It is important to be able to characterize chromatic dispersion in single-mode fibers for purposes of quality control and process feedback. The measurement system should be simple to use and maintain, yet contain sufficient accuracy and precision to satisfy transmission system design considerations. This paper discusses such a system which uses a 5-wavelength method and compares the measurement results with those obtained using a fiber Raman laser. Algorithms have been developed which extend the capability from step-index profile fiber designs previously considered to newer and more complex designs which sift and flatten the chromatic dispersion.

401,665

PB85-114981

(Order as PB85-114700, PC E07/MF E01)

Bell Labs., Norcross, GA.

Precision Interferometric Measurement of Dispersion in Short Single Mode Fibers,

M. J. Saunders, and W. B. Gardner. Oct 84, 4p

Included in Technical Digest - Symposium on Optical Fiber Measurements, p123-126 1984.

Keywords: *Fiber optics, *Optical dispersion, Near infrared radiation, Optical measurement, Interferometers, Precision, *Optical fibers.

Disadvantages of the conventional pulse delay method for measuring single mode fiber dispersion are the high cost of the equipment, the requirement for long (about km) lengths of fiber, and the eye hazard due to the high laser power levels. To overcome these disadvantages, interferometric methods for measuring dispersion in fibers using both the Michelson and Mach-Zehnder arrangements have been devised. The authors have used a 100 watt quartz halogen source, a monochromator, and a Mach-Zehnder interferometer with a motor-driven delay line to measure dispersion in fibers as short as 8.6 cm. This test set produces high visibility interference fringes at wavelengths up to 1.7 micrometers without the use of a reference fiber.

401,666

PB85-114999

(Order as PB85-114700, PC E07/MF E01)
Helsinki Univ. of Technology, Espoo (Finland).

Interferometric Dispersion Measurement in Single-Mode Fibers with a Numerical Method to Extract the Group Delays from the Measured Visibility Curves,

L. Oksanen, and S. J. Halme. Oct 84, 8p

Included in Technical Digest - Symposium on Optical Fiber Measurements, p127-134 1984.

Keywords: *Fiber optics, *Optical dispersion, Optical measurement, Interferometers, Automation, *Optical fibers.

In research and manufacture it is often desirable to be able to measure dispersion from a short piece, say a few meters, of the fiber. This can be done conveniently with the interferometric group delay measurement method, which gives the total dispersion of the fiber. The authors report on a simple numerical method to extract the group delays from the measured visibility curves. This method eliminates human bias and error inherent in visual inspection of the curves, enhances resolution, and facilitates automation of the measurement procedure.

401,667

PB85-118297

Not available NTIS

National Bureau of Standards, Washington, DC.

Vacuum Ultraviolet Spectral-Irradiance Calibrations: Method and Applications.

Final rept.,

W. R. Ott, J. M. Bridges, and J. Z. Klose. 1980, 3p

Pub. in Optics Letters 5, n6 p225-227 1980.

Keywords: *Far ultraviolet radiation, *Irradiance, *Standards, *Calibrating, Reprints, Light sources.

A method to determine the spectral irradiance of a radiation source in the vacuum ultraviolet through the use of a spectral radiance standard is described. The method has been applied, and the spectral irradiances of several different light sources have been measured on an absolute scale. Evidence for the reliability of the method is obtained by comparing the spectral irradiance calibrations in the near ultraviolet with those based upon a straightforward calibration using a tungsten quartz-halogen spectral irradiance standard.

401,668

PB85-118438

Not available NTIS

National Bureau of Standards, Washington, DC.

Compact Static Wavelength Meter for Both Pulsed and CW Lasers.

Final rept.,

J. J. Snyder. 1978, 5p

Pub. in Soviet Jnl. of Quantum Electronics 8, n8 p959-960 Aug 78.

Keywords: *Wavelengths, *Optical interferometers, Optical measurement, Reprints, *Laser radiation, Laser interferometry, Computer applications.

The author's Wavelength Meter is a self-contained instrument that measures the wavelength of radiation produced by lasers or other pulsed or cw sources of monochromatic light. The instrument is based on a Fizeau or 'optical wedge' interferometer. The fringe pattern produced by the interferometer is digitized and stored in a small computer which converts the fringe pattern into the wavelength (in the desired units) of the interfering light.

401,669

PB85-118446

Not available NTIS

National Bureau of Standards, Washington, DC.

Tomographic and 3-D Simulations Using NORA (Non-Overlapping Redundant Array).

Final rept.,

L. I. Yin, M. J. Bielefeld, S. M. Seltzer, and J. I.

Trombka. 15 Jul 84, 3p

Pub. in Applied Optics 23, n14 p2239-2241, 15 Jul 84.

Keywords: Computerized simulation, X rays, Analog systems, Reprints, *Tomography, Image reconstruction, Imaging techniques, Three dimensional.

The authors have demonstrated, with computer simulation, that it is possible to use NORA to reconstruct and view extended x-ray objects with low photon statistics in 3-D, using spherical lenses, as well as to obtain complete tomographic information free of out-of-focus artifacts. The added capability of analog 3-D

viewing may prove invaluable in the interpretation and selection of tomographic reconstructions.

401,670

PB85-130151

(Order as PB85-130078, PC A99/MF A01)

Max-Planck-Inst. fuer Quantenoptik, Garching (Germany, F.R.).

Measurement of Frequency Differences of Up to 170 GHz between Visible Laser Lines Using Metal-Insulator-Metal Point Contact Diodes,

H. U. Daniel, M. Steiner, and H. Walther. 1984, 3p

Included in Precision Measurement and Fundamental Constants II, p45-47 1984.

Keywords: *Frequency measurement, Microwave frequencies, Heterodyning, Laser radiation, MIM diodes, Krypton lasers, Dye lasers, Frequency difference.

Frequency differences of up to 170 GHz between the lines of a cw dye laser and a krypton laser at 568 nm were measured by mixing laser and microwave radiation in a metal-insulator-metal point contact diode. The beat signals exhibit good signal-to-noise ratio and no frequency 'roll-off' is observed when increasing the laser frequency difference from a few hundred MHz to 170 GHz. It follows that the point contact diode could be used at still much higher difference frequencies. Furthermore, these investigations show a diode response which is different at microwave and visible laser frequencies. Video detection experiments performed in the visible show the influence of thermal phenomena in the diode junction having a roll-off frequency of a few megahertz.

401,671

PB85-130235

(Order as PB85-130078, PC A99/MF A01)

Conservatoire National des Arts et Metiers, Paris (France).

Spatial Coherence and Optical Wavelength Metrology,

P. Bouchareine. 1984, 2p

Included in Precision Measurement and Fundamental Constants II, p81-82 1984.

Keywords: *Optical interferometers, *Diffraction, Laser beams, Coherent radiation, Wavelengths, Length, Metrology, Correction, Visible radiation.

The influence on precise measurements of optical wavelengths of spatial coherence of laser beams, or of classical sources when the 'etendue' of the interferometer is reduced by isolating the central fringe at high path differences is discussed. The interferometric observation of the phase angle at a fixed path difference is currently made with an uncertainty less than 0.001 of a fringe. With spatially coherent illumination, phase shifts of this order can be given by scratches or dust particles, or by mirror aberrations, and cannot be compensated by subtracting two phase angles at two path differences. If the spatial coherence of a laser beam is destroyed, these errors vanish, but only if the etendue of the interferometer is large enough. At very high path differences allowed by the good temporal coherence of lasers, compensated field interferometers may be useful to eliminate these spurious shifts and the uncertainty in diffraction corrections.

401,672

PB85-140655

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Minimization of Volume and Astigmatism in White Cells for Use with Circular Sources and Apertures.

Final rept.,

W. B. Olson. May 84, 6p

Pub. in Applied Optics 23, n10 p1580-1585, 15 May 84.

Keywords: Astigmatism, Apertures, Volume, Optimization, Reprints, *Imaging techniques.

Conditions are derived for minimum volume and astigmatism of White-type multiple reflection absorption cells, with multiple row and column image arrays, for the case of circular images and apertures.

401,673
PB85-141562 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Standardizing Test Conditions for Characterizing Fibers.
Final rept.,
D. L. Franzen, G. W. Day, and R. L. Gallawa. Aug 81, 3p
Pub. in Laser Focus, p103-105 Aug 81.

Keywords: *Fiber optics, Attenuation, Bandwidth, Tests, Reprints, *Optical fibers, Numerical aperture.

Standard launching conditions for the measurement of optical fiber attenuation, bandwidth, and numerical aperture are described. Usefulness of the launching conditions is demonstrated in an interlaboratory measurement comparison.

401,674
PB85-142180 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Linewidth Measurement by High-Pass Filtering - A New Look.
Final rept.,
M. Young. 1 Jul 83, 4p
Pub. in Applied Optics 22, n13 p2022-2025, 1 Jul 83.

Keywords: *Line width, Measurement, Diffraction, Fourier transformation, Microscopy, Reprints, Optical processing, Spatial filtering.

Earlier workers have noticed that high-pass filtering produces a sharp dark line in precisely the location of the geometrical image of an edge. They proposed using this fact as an aid in measuring linewidth in microscopy but found that the other edge of the line caused significant error. In this paper, the author examines that error as a function of normalized linewidth and normalized spatial-filter width and finds that it may be limited to + or - 5% or so, provided that the spatial filter subtends between 0.25 and 0.3X the numerical aperture of the objective and that the linewidth exceeds about twice the resolution limit.

401,675
PB85-142198 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Interlaboratory Measurement Comparison to Determine the Attenuation and Bandwidth of Graded-Index Optical Fibers.
Final rept.,
D. L. Franzen, G. W. Day, B. L. Danielson, G. E. Chamberlain, and E. M. Kim. 15 Jul 81, 8p
Pub. in Applied Optics 20, n4 p2412-2419, 15 Jul 1981.

Keywords: *Fiber optics, Attenuation, Bandwidth, Measurement, Comparison, Reprints, *Optical fibers.

An interlaboratory measurement comparison was conducted by the National Bureau of Standards in cooperation with the Electronic Industries Association. Participants included NBS and nine optical fiber and cable manufacturers. Four graded-index fibers having lengths of 2,2,2, and 0.9 km were used. Measurements of attenuation at 850 nm, using both beam optics and mode filter approaches to achieve a restricted launch, gave one standard deviation spreads for an overall average of 0.23 dB/km. Best measurement agreement was obtained for a fiber having little differential mode attenuation. Measurements of -3-dB bandwidth from time domain acquired data at 90 nm gave an average one standard deviation spread of 12% with poorer agreement on the higher frequency portion of the frequency response.

401,676
PB85-142271 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Simulating the Scratch Standards for Optical Surfaces - Theory.
Final rept.,
E. G. Johnson. Dec 83, 13p
Pub. in Jnl. of Applied Optics 22, n24 p4056-4068 Dec 83.

Keywords: *Optical equipment, *Surfaces, *Standards, Optical lenses, Light scattering, Simulation, Far field, Reprints, *Scratch standards.

The author shows how to simulate the scattering generated by a scratch on the surface of high-quality optics and their elements. This is accomplished by first describing how the present cosmetic scratch standards tend to be used in the optics industry. Second, the

author derives from first principles, using the scalar model for electromagnetic radiation, the first-order scattering coefficients for the far-field radiation due to a particular scratch pattern. There are approximations made to get these coefficients. The results allow construction of a set of secondary scratch standards. These are a pattern of rectangular grooves that can be made precisely reproducible during the manufacturing phase. Appropriate selection from this set can provide the same range of scattering power and character as is present in the current scratch standards, which are not easily reproducible. Because the method for construction of these new secondary standards is nonrandom, to guarantee the reproducible construction between these standards it is necessary to restrict the observation range 5-10 degrees from the direct beam.

401,677
PB85-144392 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Single Axis Photoelectronic Autocollimator.
Final rept.,
G. G. Luther, R. D. Deslattes, and W. R. Towler. May 84, 4p
Prepared in cooperation with Virginia Univ., Charlottesville. Dept. of Nuclear Engineering and Engineering Physics.
Pub. in Review of Scientific Instruments 55, n5 p747-750 May 84.

Keywords: *Collimators, Resolution, Performance, Design, Reprints.

Several single axis, diffraction limited, monolithic autocollimators, capable of resolving less than 0.001 arc s have been designed and built. Their features include small size, lightweight, ruggedness, and ease of operation. Construction features and performance levels are given.

401,678
PB85-144467 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Refractive Properties of Magnesium Fluoride.
Final rept.,
M. J. Dodge. 15 Jun 84, 6p
Pub. in Applied Optics 23, n12 p1980-1985, 15 Jun 84.

Keywords: *Magnesium fluorides, Optical materials, Single crystals, Optical measurement, Polarization(Waves), Birefringence, Infrared radiation, Ultraviolet radiation, Reprints, *Refractive index, Dispersion, Visible radiation.

The refractive indexes of a commercially available specimen of single crystal MgF₂ were determined for both the ordinary and extraordinary rays at selected wavelengths from 0.2026 to 7.04 micrometers. Measurements were made by means of the minimum-deviation method on a precision spectrometer near 19C. The experimentally determined index values for each polarization were fitted to a three-term Sellmeier-type dispersion equation. The birefringence was computed as a function of wavelength from the calculated index values obtained for the two polarizations. The dispersion coefficients were also determined for the O-ray and for the birefringence. The results of this study are compared with previously reported work on the refractive properties of MgF₂.

401,679
PB85-144921 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Intercomparison between Silicon and Blackbody Based Radiometry Using a Silicon Photodiode/Filter Radiometer.
Final rept.,
A. R. Schaefer, and R. D. Saunders. 15 Jun 84, 3p
Sponsored by National Research Council of Canada, Ottawa (Ontario).
Pub. in Applied Optics 23, n14 p2224-2226, 15 Jul 84.

Keywords: *Radiometry, *Radiometers, Blackbody radiation, Calibrating, Irradiance, Comparison, Silicon, Reprints, Storage rings, Intercomparison.

A radiometer composed of a silicon photodiode, interference filter, and integrating sphere was characterized and calibrated against an absolute silicon detector standard at 600 nm using a CW dye laser. This radiometer was then used to measure the irradiance at 600 nm from spectral irradiance lamps calibrated against a gold point blackbody, and also the irradiance from the NBS electron storage ring, SURF II. These results were intercompared with those independently derived from the other two sources, with overall agree-

ment of better than one percent. Various aspects of the measurements are discussed.

401,680
PB85-145472 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Two-Photon Absorption from a Phase Diffusing Laser Field.
Final rept.,
D. S. Elliott, M. W. Hamilton, K. Arnett, and S. J. Smith. Jul 84, 3p
Pub. in Physical Review Letters 53, n5 p439-441 Jul 84.

Keywords: Line width, Reprints, *Two photon absorption, Nonlinear optics, Laser radiation.

The authors report on the first quantitative measurements of the effect of a phase diffusing laser field on a nonlinear optical interaction. Using a nearly Lorentzian laser power spectrum, they have measured the spectral line width of an unsaturated two-photon absorption process. They found that the measured width scales as four times the laser width, in agreement with the theoretical predictions of Mollow.

401,681
PB85-148518 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Computer-Controlled System for Calibrating Detectors of TEA Laser Pulses.
Final rept.,
P. A. Simpsor. May 84, 11p
Pub. in Proceedings of Automatic RF Techniques Group (ARFTG) Fall 1983 Digest (22nd), Albuquerque, NM., November 3-4, 1983, p25-36 May 84.

Keywords: *Infrared detectors, *Optical detection, *Calibrating, Automation, *TEA lasers, Pulsed lasers, Computerized control systems, Laser radiation.

A computer-controlled system for calibrating detectors of TEA laser pulses is described. The types of detectors calibrated can be either energy detectors or waveform detectors. The operator inputs to the computer certain information pertinent to the measurements and the computer controls the run thereafter. Results are displayed on the screen, printed as hardcopy, and stored on cassette tape.

20H. Particle Physics

401,682
PB84-155290 PC A06/MF A01
National Bureau of Standards, Washington, DC.
Piece-Wise Analytic Evaluation of the Radiative Tail from Elastic and Inelastic Electron Scattering.
L. C. Maximon, and S. E. Williamson. Dec 83, 108p
NBSIR-83-2788
Prepared in cooperation with Illinois Univ. at Urbana-Champaign.

Keywords: *Electron scattering, *Scattering cross sections, Elastic scattering, Inelastic scattering, Differential cross sections, Numerical integration, Computer programs, MSPLTIM computer program.

The report discusses the calculation of the radiative tail from the elastic peak in medium and high energy electron scattering as well as from a discrete inelastic level of the recoiling nucleus. The authors examine the method generally used for this calculation, viz., a numerical integration of the differential cross section over the angles of the unobserved photon, and discuss the difficulties inherent in this numerical integration due to the sharp peaking of the integrand. They present an alternative method for calculating the radiative tail, in which the region of integration is divided into an arbitrary number of subintervals, the structure functions are fitted by cubic spline functions in each subinterval, and the integrations are then performed analytically in closed form. This method has the advantages of greatly increased accuracy and a reduction of the computation time by a factor which can vary between 10 and 1000, depending on the kinematics.

Field 20—PHYSICS

Group 20H—Particle Physics

401,683

PB84-218460 Not available NTIS
National Bureau of Standards, Washington, DC.
Photon Scattering from ^{12}C and ^{208}Pb in the Delta-Region.
Final rept.,
E. Hayward, and B. Ziegler. 1984, 14p
Prepared in cooperation with Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
Pub. in Nuclear Physics (Section) A414, p333-346 1984.

Keywords: *Photon cross sections, *Carbon 12, *Scattering cross sections, Dispersion relations, Bremsstrahlung, Inelastic scattering, Reprints, *Lead 208, *Cross sections, Delta resonances.

The photon scattering cross sections at 115 degrees for (^{12}C) and (^{208}Pb) have been measured using bremsstrahlung energies E , of 150, 200, 250, 300, 350, and 400 MeV. Scattered photons having energies in the range $0.9 E$ to E were accepted by the detector. The measured cross sections are much larger than the prediction of a simple model relating the scattering cross section at a large angle to the forward scattering cross section and the form factor for elastic electron scattering. This discrepancy is discussed in terms of collective effects, inelastic scattering, or exchange current distributions.

401,684

PB84-218825 Not available NTIS
National Bureau of Standards, Washington, DC.
Standard Model Constraints on Fermions.
Final rept.,
P. Fishbane, S. Meshkov, and P. Ramond. 5 Jan 84, 5p
Pub. in Physics Letters B, v134B n1-2 p81-85, 5 Jan 84.

Keywords: *Fermions, Nuclear models, Leptons, Quarks, Reprints, SU-3 groups, SU-2 groups, U-1 groups.

The authors present a catalog of fermions allowed by the standard model. These new fermions are restricted to sets which are anomaly free, vector-like with respect to electric charge and color, and have either $\delta(l \text{ sub } W) = 0$ (totally vector-like) or $\delta(l \text{ sub } W) = 1/2$ (chiral) masses. The authors list some simple examples where the anomalies of the leptons (quarks) cancel among themselves as well as against each other.

401,685

PB84-219963 Not available NTIS
National Bureau of Standards, Washington, DC.
Momentum-Space Solution of a Bound-State Nuclear Three-Body Problem with Two Charged Particles.
Final rept.,
L. C. Maximon, D. R. Lehman, A. Eskandarian, and B. F. Gibson. Apr 84, 11p
Sponsored in part by Department of Energy, Washington, DC.
Pub. in Physical Review C 29, n4 p1450-1460 Apr 84.

Keywords: *Three body problem, Nucleons, Wave functions, Charged particles, Perturbation theory, Reprints, *Bound state, Faddeev equations.

Momentum-space wave function equations are derived for the three-body system of one neutral and two charged particles where the separable interaction is spin and charge independent. The three-body wave function is decomposed so that the equations for the 'pure' nuclear components contain the two-nucleon t -matrix, as usual, but the equation for the additional Coulomb component is formulated in terms of the Coulomb potential rather than introducing the Coulomb t -matrix. The relationship of these equations to the scattering-amplitude equation of Veselova, in which the Coulomb t -matrix appears explicitly, as applied to the same problem by Kok et al., is given. The authors conclude that the Coulomb interaction can be incorporated easily into momentum-space three-nucleon, bound-state calculations.

401,686

PB84-220995 Not available NTIS
National Bureau of Standards, Washington, DC.
Scaling Variables for Coincident Electron Scattering.
Final rept.,
J. S. O'Connell. 16 Feb 84, 2p
Pub. in Physics Letters 135B, n5-6 p337-338, 16 Feb 84.

Keywords: *Electron scattering, Nucleons, Inelastic scattering, Cross sections, Reprints, *Knock-out reactions, Sum rules, Response functions.

The cross section for quasi-free nucleon knockout by inelastic electron scattering ($e, e'N$) is shown to depend on two scaling variables: y used in inclusive (e, e') reactions and $z = (p(f)/M) \sin(\theta \text{ sub } p)$, the transverse component of the initial and final nucleon velocity. It is shown that for given y and z the coincidence cross section is determined by a single spectral function of $(y \text{ squared}) + (z \text{ squared})$. A sum rule relates the spectral function to the nuclear response measured in inclusive reactions.

401,687

PB84-221001 Not available NTIS
National Bureau of Standards, Washington, DC.
Interpretation of Coincidence Form Factors in Electron-Nucleon Knockout Reactions.
Final rept.,
J. S. O'Connell. Apr 84, 6p
Pub. in Physical Review C 29, n4 p1544-1545 Apr 84.

Keywords: *Electron scattering, Nucleons, Cross sections, Reprints, *Knock-out reactions, Form factors.

The author points out that for two extreme reaction mechanisms describing nucleon ejection in the coincidence reaction $A(e, e'N)B$ (resonance or quasifree knockout) the interference form factors can be used to make a longitudinal-transverse separation of the inclusive cross section without change in electron scattering angle (resonance case), or a separation of the convection and spin currents in the transverse form factor (quasifree case).

401,688

PB84-221217 Not available NTIS
National Bureau of Standards, Washington, DC.
NBS (National Bureau of Standards) Measurements of the (^{235}U) Fission Cross Section.
Final rept.,
A. D. Carlson. Jul 83, 17p
Sponsored in part by International Atomic Energy Agency, Vienna (Austria).
Pub. in Proceedings of International Atomic Energy Agency Consultants' Meeting U-235 Fast-Neutron Fission Cross-Section, Cf-252 Fission Neutron Spectrum held at Smolenice, Czechoslovakia on March 28-April 1, 1983, p61-77 Jul 83.

Keywords: *Uranium 235, *Fission cross sections, *Cross sections, Nuclear fission, Standards, Neutron reactions.

The results of NBS measurements of the $(^{235}\text{U})(n, f)$ cross section made at the linac, Van de Graaff, and (^{252}Cf) facilities are reviewed.

401,689

PB84-221233 Not available NTIS
National Bureau of Standards, Washington, DC.
Glueballs.
Final rept.,
S. Meshkov. 1983, 31p
See also DE82-016963.
Pub. in Proceedings of Hadronic Session (18th) held at Recontre de Moriond, La Plange-Savoie, France on January 23-29, 1983, Gluons and Heavy Flavours 1, p427-440 1983.

Keywords: Mass, Reviews, *Glueballs.

The current status of various glueball properties such as level ordering and masses is reviewed. The leading glueball candidates currently are the $\phi\phi$ enhancements.

401,690

PB84-221332 Not available NTIS
National Bureau of Standards, Washington, DC.
Low Multipolarity Magnetic Transitions in (^{32}S) Excited by Electron Scattering.
Final rept.,
P. E. Burt, L. W. Fagg, H. Crannell, D. I. Sober, and W. Stapor. Mar 84, 9p
Grant NSF-PHY79-23968
Pub. in Physical Review C 29, n3 p713-721 Mar 84.

Keywords: *Electron scattering, *Scattering cross sections, *Cross sections, *Transition probabilities, Nuclear energy levels, Magnetic dipoles, Nuclear shell models, Reprints, *Sulfur 32, Form factors.

Electron scattering cross section measurements on (^{32}S) have been made at incident electron energies between 34 and 74 MeV and at scattering angles of 162.4 degrees and 180 degrees. Form factors were deduced for transitions to states at 8.11, 9.68, 10.05, 10.78, 11.12, and 11.63 MeV. Additional peaks at 7.12, 12.02, and 13.36 MeV were observed in some spectra. Comparisons of cross sections at different angles show that the above six transitions are transverse.

401,691

PB84-223874 Not available NTIS
National Bureau of Standards, Washington, DC.
Improved Bremsstrahlung Cross Sections for Transport Calculations.
Final rept.,
S. M. Seltzer, and M. J. Berger. Dec 83, 3p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science NS-30, n6 p4368-4370 Dec 83.

Keywords: *Bremsstrahlung, *Cross sections, Transport properties, Aluminum, Gold, Electrons, Reprints, KeV range 01-10, KeV range 10-100, KeV range 100-1000, MeV range 01-10, MeV range 10-100, MeV range 100-1000.

The cross section for the emission of bremsstrahlung by electrons in the field of the atomic nucleus has been evaluated by the synthesis of various theoretical results. The synthesis has been carried out for the cross section differential in emitted photon energy. Cross sections are presented here for the bremsstrahlung produced in aluminum and gold by electrons with energies from 1 keV to 1000 MeV.

401,692

PB84-224039 Not available NTIS
National Bureau of Standards, Washington, DC.
Applications of New Absolute Measurements of X-rays and Gamma-rays.
Final rept.,
R. D. Deslattes. 1983, 12p
Pub. in Proceedings of NATO Advanced Study Institute Quantum Metrology Fundamental Phys. Constants, Erice, Italy, November 16-28, 1981, p353-364 1983.

Keywords: *X rays, *Gamma rays, Quantum electrodynamics, Kaons, Muons, Pions, Measurement.

The technology described in the previous lecture has resulted in a new array of gamma-ray secondary standards and convenient, accurate procedures for re-measurement of X-ray lines. First use of the new gamma-ray reference lines has been in normalization of muonic and pionic atom spectra. Primary results so far have been in improved tests of QED using muonic spectra and in reconciliation of different routes to the pion mass. Additional work on X-ray absorption edges has led to a new value for the mass of $K(-)$ and will be used in an experiment on pionic deuterium. Re-study of especially mid- to high-Z spectra of normal atoms has been encouraged by newly available relativistic self-consistent field calculations. Detailed comparisons appear informative regarding systematic trends in the discrepancies.

401,693

PB84-224807 Not available NTIS
National Bureau of Standards, Washington, DC.
Inferred Fission Cross Sections in the MeV Range for the Transuranics.

Final rept.,
J. W. Behrens. 1983, 3p
Pub. in Transactions 45, p243-245 1983.

Keywords: *Fission cross sections, *Transuranium elements, *Cross sections, Neutron reactions, Reprints, MeV range.

Transuranics are produced in sufficient quantities in commercial nuclear reactors that it is logical to try to find marketable uses for these unique, manmade isotopes. Computer codes have been written which determine optimal conditions for the buildup (or burnout) of transuranic materials in nuclear fuel. These codes require accurate cross section data as input. There are many as yet unmeasured isotopes for which nuclear data are needed. As an alternative to direct measurement, the present approach uses measured data as a basis from which one infers fission cross sections for neighboring, short-lived isotopes. In its present form, this method is applicable in the MeV range.

401,694

PB84-224815 Not available NTIS
National Bureau of Standards, Washington, DC.
Nuclear Photon Scattering by ¹²C and ¹⁶O.

Final rept.,
W. R. Dodge, E. Hayward, R. G. Leicht, M. McCord, and R. Starr. Jul 83, 8p
Pub. in Physical Review C 28, n1 p8-15 Jul 83.

Keywords: *Carbon 12, *Scattering cross sections, *Absorption cross sections, *Cross sections, Photonuclear reactions, Elastic scattering, Reprints, *Oxygen 16, Form factors, Giant resonance, Quadrupoles.

The elastic scattering cross sections for (¹²C and (¹⁶O) have been measured in the energy ranges 23.5-39 and 25-39 MeV, respectively. These data have been compared with the Mainz total photonuclear absorption cross sections and interpreted in terms of a form factor applied to the gauge term of the Thomson amplitude as well as an E2 amplitude.

401,695

PB84-225002 Not available NTIS
National Bureau of Standards, Washington, DC.
Standard Cross-Section Data.

Final rept.,
A. D. Carlson. 1984, 49p
Pub. in Progress in Nuclear Energy, v13 n2/35 p79-127 1984.

Keywords: *Neutron cross sections, *Cross sections, *Standards, Reviews, Accuracy, Reprints.

A review is given of the neutron cross section standards. Comparisons are made between recent measurements and evaluations. Techniques for application of the standards are also reviewed. Estimates of the accuracy of the cross sections are given. Areas where more work needs to be done are discussed. The document includes a significant bibliography.

401,696

PB84-225457 Not available NTIS
National Bureau of Standards, Washington, DC.
Some Theoretical Considerations on the Sigma(Gamma,p)/Sigma(Gamma,n) Ratio in 4He.

Final rept.,
P. P. Delsanto, L. C. Biedenharn, M. Danos, and S. Tuan. 1983, 6p
Pub. in Nuovo Cimento Lettere, v37 n10 p369-374 1983.

Keywords: *Helium 4, *Neutron reactions, *Proton reactions, *Photonuclear reactions, Nuclear cross sections, Nuclear shell models, Gamma rays, Excitation, Reprints, MeV range 10-100, Isospin, Symmetry breaking.

Recent measurements have confirmed the value 1.7 + or - 0.3 for the ratio between (4)He (gamma,p) and (gamma,n) reaction cross sections in the excitation energy range 24 = or < (E sub x) = or < 30 MeV. This large deviation from unity implies isospin symmetry breaking an order of magnitude larger than that predicted from direct Coulomb effects using conventional shell model estimates. The authors present a phenomenological model search using continuum calculations,

undertaken to identify those features of the problem that more complete future treatments must yield to explain the experimental data. An indirect Coulomb mechanism, which may possibly account for the discrepancy, has been proposed.

401,697

PB84-226364 Not available NTIS
National Bureau of Standards, Washington, DC.

Precise Gamma-ray Multipole Mixing Ratios Using Nuclear Orientation.

Final rept.,
H. Marshak. 1983, 4p
Pub. in Hyperfine Interact., n15/16 p1043-1046 1983.

Keywords: *Gamma rays, Metastable state, Radioactive decay, Reprints, *Holmium 166, *Mixing ratio, Nuclear orientation.

Directional distribution measurements of gamma-rays from oriented nuclei, although not as universal as gamma-gamma angular correlation measurements, are capable of yielding more precise multipole mixing ratios since they require only singles measurements, whereas the latter require that the two gamma-rays be detected in coincidence. The higher counting rate of the singles measurement can result in a high accuracy if all the other parameters (sample temperature, gain stability of the detector, etc.) of the experiment can be held constant. When this is achieved, corrections often ignored must be applied to the data to obtain precise values for the mixing ratios. The importance of these corrections are discussed and applied to some of the transitions in the decay of (^{166m}Ho).

401,698

PB84-244748 Not available NTIS
National Bureau of Standards, Washington, DC.

Photon Attenuation Coefficients and Cross Section Data 100 eV to 100 GeV. Current Status and Prospects.

Final rept.,
J. H. Hubbell. 1984, 13p
Pub. in Proceedings of International Symposium on Radiation Physics (2nd), Universiti Saino Malaysia, Penang, May 25-29, 1982, p15-27 1984.

Keywords: *Photoelectric emission, Pair production cross sections, Incoherent scattering, Coherent scattering, Pair production, Gamma rays, X rays, Crystallography, *Photon-atom collisions, *Attenuation coefficients, IUCr project.

Recent advances in theoretical and experimental information on photon-atom collision processes (photoelectric absorption, coherent and incoherent scattering, and pair and triplet production) are discussed. Emphasis is on recent pair and triplet production cross section calculations 1 MeV-100 GeV, and also on an International union of Crystallography project to develop x-ray attenuation coefficient measurement standards in the 0.5 to 50 keV region and to coordinate measurements in progress aimed at resolving existing serious discrepancies in available data. Some preliminary results from the IUCr project are presented.

401,699

PB85-115517 Not available NTIS
National Bureau of Standards, Washington, DC.

New Kapitza Heat-Transfer Model for Liquid Helium Four.

Final rept.,
P. H. E. Meijer, and J. S. J. Peri. 1980, 11p
Pub. in Physical Review B: Condensed Matter 22, n1 p195-205, 1 Jul 80.

Keywords: *Helium 4, *Liquid helium, *Heat transfer, Quantum theory, Cryogenics, Reprints, *Kapitza resistance.

The Kapitza resistance between a solid and liquid helium 4 is explained by two parallel processes. One is the well-known Khalatnikov-acoustic-mismatch channel that has a frequency independent transmission coefficient. The other, we propose hereby, is the difference in quantum effects between the bulk liquid and the compressed surface layers. The crucial point is the presence of an 'optical branch', that is dispersion curve with (omega sub 0) not = 0 for k approaches 0.

401,700

PB85-118420 Not available NTIS
National Bureau of Standards, Washington, DC.

Nuclear Orientation.

Final rept.,
H. Marshak. 1982, 2p
Pub. in McGraw-Hill Encyclopedia of Science Technology, p307-308 1982.

Keywords: Temperature measurement, Polarization(Spin alignment), Nuclear magnetic moments, Nuclear quadrupole resonance, Nuclear spin, Cryogenics, Reprints, *Nuclear orientation, Nuclear orientation thermometry, Nuclear alignment, Polarized beams, Polarized targets.

Nuclear orientation is defined and definitions of nuclear polarization and alignment are given. The static method of nuclear orientation is briefly discussed, along with some general remarks about nuclear orientation and its usefulness in physics.

401,701

PB85-124071 Not available NTIS
National Bureau of Standards, Washington, DC.

Half Life of Plutonium-240.

Final rept.,
L. L. Lucas, and J. R. Noyce. 1984, 4p
Sponsored in part by Department of Energy, Germantown, MD.
Pub. in International Jnl. of Applied Radiation Isotopes 35, n3 p173-176 1984.

Keywords: *Half life, Nuclear materials management, Alpha decay, Reprints, *Plutonium 240, Safeguards.

The alpha-particle-emission rates of solutions of plutonium-240 oxide were determined from defined-solid-angle-counter measurements. These results were combined with composition data obtained from other laboratories, and the half life of plutonium-240 was calculated to be 6552.2 yr. Associated with this value is a standard deviation of the mean of plus or minus 2.0 yr. and a systematic uncertainty limit of plus or minus 13.8 yr.

401,702

PB85-130474
(Order as PB85-130078, PC A99/MF A01)
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Physics.

Sixth Order Contributions to g-2 of the Electron,

M. J. Levine, and F. Z. Roskies. 1984, 2p
Prepared in cooperation with Pittsburgh Univ., PA. Dept. of Physics and Astronomy.
Included in Precision Measurement and Fundamental Constants II, p201-202 1984.

Keywords: *Quantum electrodynamics, *Electron spin, *Magnetic moments, Abnormalities, *G factor, *Fine structure constant, Feynman diagram.

The contributions of 10 graphs to the anomalous magnetic moment of the electron in sixth order are presented to much greater accuracy than in previous evaluations. These results lead to a revised value for the entire sixth order contribution. When this is combined with the preliminary eighth order results, theory and experiment are again in reasonably good agreement.

401,703

PB85-130482
(Order as PB85-130078, PC A99/MF A01)

Cornell Univ., Ithaca, NY. Floyd R. Newman Lab. of Nuclear Studies.

Calculation of the Eighth Order Anomalous Magnetic Moment of the Electron,

T. Kinoshita, and W. B. Lindquist. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p203-205 1984.

Keywords: *Quantum electrodynamics, *Electron spin, *Magnetic moments, Abnormalities, *Fine structure constant, Feynman diagram.

The authors present a very preliminary result of their calculation of the eighth order QED contribution to the anomalous magnetic moment of the electron. Altogether 891 Feynman diagrams contribute to this term. By a method developed earlier, the authors have compressed them into about 100 integrals, which are evaluated using adaptive Monte Carlo integration routines. The difference between experiment and theory is now -251(154) X 10 to the -12th power.

Field 20—PHYSICS

Group 20H—Particle Physics

401,704

PB85-130490

(Order as PB85-130078, PC A99/MF A01)
Michigan Univ., Ann Arbor. Dept. of Physics.
Experimental Determinations of the Anomalous Magnetic Moments of the Free Leptons, R. Conti, D. Newman, A. Rich, and E. Sweetman. 1984, 8p
Included in Precision Measurement and Fundamental Constants II, p207-214 1984.

Keywords: *Quantum electrodynamics, *Magnetic moments, Electron spin, Positrons, Muons, Special relativity, Abnormalities, Dipole moments, *G factor.

The ten year period since the First International Conference on Precision Measurements and Fundamental Constants has seen an improvement of approximately one hundred fold in the experimental determination of the (e^-) , (e^+) and (μ^-) , (μ^+) anomalous magnetic moments. Similar progress has been made in theoretical QED $g-2$ calculations as well as in the experimental determination of α . The substance of this article will be a review of various experiments, a discussion of new work now in progress, and an attempt to predict future possibilities in measuring lepton anomalous moments. The non-QED tests are also discussed.

401,705

PB85-130508

(Order as PB85-130078, PC A99/MF A01)
Washington Univ., Seattle. Dept. of Physics.
Preliminary Comparison of the Positron and Electron Spin Anomalies, P. B. Schwinberg, R. S. Van Dyck, and H. G. Dehmelt. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p215-218 1984.

Keywords: *Electron spin, *Positrons, Fundamental constants, Abnormalities, Comparison, Precision, Ion traps, Geonium.

A new double Penning trap structure has been built using various techniques developed in our geonium experiment. Primary positrons are captured in a storage trap, centered, and then transferred into a well-compensated experiment trap where preliminary measurements have yielded the single positron g -factor anomaly $a(e^+) = (1159652222 \pm \text{or } -50) \times 10$ to the -12^{th} power. This value was obtained from four runs at a field of 50.8 kG with the $a(e^+)$ values extrapolated to zero spin flip power using the power dependence observed in the electron geonium experiment. The uncertainty is based on the resonance linewidths and an estimate of the remaining systematic errors. When compared to the electron spin anomaly, we obtain a positron/electron g -factor ratio of $1 + (22 \pm \text{or } -64) \times 10$ to the -12^{th} power.

401,706

PB85-130516

(Order as PB85-130078, PC A99/MF A01)
Washington Univ., Seattle. Dept. of Physics.
Geonium Without a Magnetic Bottle - A New Generation, G. Gabrielse, and H. Dehmelt. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p219-221 1984.

Keywords: *Electron spin, *Magnetic moments, Relativity, Mass, *Geonium, Ion traps, Magnetic bottles.

Work is now underway to improve the accuracy of the electron magnetic moment measurements by 10 to 100; that is, to an accuracy of 1 part per trillion. At this level of accuracy, the magnetic bottle so crucial to previous measurements must be removed. In fact, intrinsic bottles due to the paramagnetism of the trap electrodes must be carefully canceled. A promising replacement for the magnetic bottle is the relativistic mass increase which acts like a magnetic bottle 20 times smaller than the one previously used but with no distortion of the magnetic field. The relativistic mass increase has been observed for 0.5 eV electrons. The authors have also trapped electrons in a new style, compensated Penning trap (described here) which is simpler to construct, promises to be more reliable when cycled to liquid helium temperatures, and can be easily disassembled.

401,707

PB85-130524

(Order as PB85-130078, PC A99/MF A01)
Mainz Univ. (Germany, F.R.). Inst. fuer Physik.
Magnetic Moment of Positive Muons in Units of the Proton Magnetic Moment, E. Klempt, R. Schulze, H. Wolf, M. Camani, and F. N. Gygax. 1984, 5p
Prepared in cooperation with Eidgenossische Technische Hochschule, Villigen (Switzerland). Lab fuer Hochenergiephysik.
Included in Precision Measurement and Fundamental Constants II, p223-227 1984.

Keywords: *Nuclear magnetic moments, *Muons plus.

The magnetic moment of positive muons in units of the proton magnetic moment was determined. A value of $\mu(\mu)/\mu(p) = 3.1833441(17)$ was found.

401,708

PB85-130540

(Order as PB85-130078, PC A99/MF A01)
Harvard Univ., Cambridge, MA.
Determination of the Neutron Magnetic Moment, G. L. Greene, N. F. Ramsey, W. Mampe, J. M. Pendlebury, and W. B. Dress. 1984, 4p
Prepared in cooperation with Sussex Univ., Brighton (England), Institut Max von Laue - Paul Langevin, Grenoble (France), Oak Ridge National Lab., TN., and CEA Centre d'Etudes Nucleaires de Grenoble (France).
Included in Precision Measurement and Fundamental Constants II, p233-236 1984.

Keywords: *Neutrons, *Nuclear magnetic moments, Nuclear magnetic resonance.

The neutron magnetic moment has been measured with an improvement of a factor of 100 over the previous best measurement. Using a magnetic resonance spectrometer of the separated oscillatory field type capable of determining a resonance signal both for neutrons, and for protons in flowing H₂O, the authors find $\mu(n)/\mu(p) = 0.68497935(17)$ (0.25 ppm). The neutron magnetic moment can also be expressed without loss of accuracy in a variety of other units.

401,709

PB85-130565

(Order as PB85-130078, PC A99/MF A01)
Stanford Univ., CA.
Fundamental Tests and Measures of the Structure of Matter at Short Distances, S. J. Brodsky. 1984, 8p
Contract DE-AC03-76SF00515
Included in Precision Measurement and Fundamental Constants II, p249-256 1984.

Keywords: *Quantum electrodynamics, Strong interactions, Weak interactions, Field theory(Physics), *Quantum chromodynamics, Unified field theory.

Recent progress in gauge field theories has led to a new perspective on the structure of matter and basic interactions at short distances. It is clear that at very high energies, quantum electrodynamics, together with the weak and strong interactions, are part of a unified theory with new fundamental constants, new symmetries, and new conservation laws. A nontechnical introduction to these topics is given, with emphasis on fundamental tests and measurements.

401,710

PB85-130573

(Order as PB85-130078, PC A99/MF A01)
Bayreuth Univ. (Germany, F.R.).
Experimental Limit for the Charge of the Free Neutron, R. Gaehler, J. Kalus, and W. Mampe. 1984, 5p
Prepared in cooperation with Institut Max von Laue - Paul Langevin, Grenoble (France).
Included in Precision Measurement and Fundamental Constants II, p257-261 1984.

Keywords: *Neutrons, *Electric charge, Measurement, *Neutron charge.

The neutron charge has been measured to be $q(n) = \text{absolute value of } q(e) (-1.5 \pm \text{or } -2.2) \times 10$ to the -20^{th} power $q(e) = \text{electron charge}$ at a confidence level of 90%. This value brings down the known limit by two orders of magnitude. In the experiment slow neutrons of 20 Å wavelength passed a strong electric field of 10 m. length. The deflection of the neutron beam was

measured with respect to reversal of the field. For an increase in sensitivity the beam was focused by a neutron lens to a sharp image in the detector plane. Over a long run time the deflection of the neutron beam due to the electric field was less than 0.02 micrometer. The result on the neutron charge is in agreement with the commonly accepted neutrality of the neutron.

401,711

PB85-130680

(Order as PB85-130078, PC A99/MF A01)
Columbia Univ., New York.
High Precision Studies of Pionic X Rays: Some Past Results and Future Prospects, G. Dugan, L. Delker, C. S. Wu, and D. C. Lu. 1984, 5p
Prepared in cooperation with Yale Univ., New Haven, CT.
Included in Precision Measurement and Fundamental Constants II, p325-329 1984.

Keywords: *Pions, X ray spectrometers, Mass, Precision, *X-ray sources, Pions minus, Pionic atoms, Fine structure, Molybdenum 99.

The development of high intensity pionic x-ray sources has allowed a high precision crystal spectrometer measurement of certain pionic x-ray energies to be made. These energy measurements have resolved the relativistic fine structure and have been used to provide an improved determination of the negative pion mass (accuracy 6.4 ppm). Substantial further increases in pionic x-ray source intensity have been shown to be feasible at LAMPF. These increases will make possible the use of double flat crystals and can lead to advances in the study of electron screening in pionic atoms, further high precision pion mass and pionic atom fine structure studies, and possible also high precision muonic x-ray energy measurements.

401,712

PB85-130714

(Order as PB85-130078, PC A99/MF A01)
Auckland Univ. (New Zealand). Dept. of Physics.
Absolute Determination of the Threshold Energies of $(7)\text{Li}(p,n)$, $(10)\text{B}(p,n)$, and $(14)\text{N}(p,n)$, P. H. Barker, M. J. Lovelock, H. Naylor, R. M. Smythe, and R. E. White. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p345-347 1984.

Keywords: Neutron reactions, Proton reactions, Calibrating, Electric potential, Standards, *Proton-neutron interactions, *Threshold energy, Lithium 7, Boron 10, Nitrogen 14, Heavy ions.

The present status of the Heavy Ion Source System (HISS) for the measurement of nuclear reaction energies is discussed, and some results are presented. In particular, accurate values for the threshold energies of $(7)\text{Li}(p,n)$, $(10)\text{B}(p,n)$, and $(14)\text{N}(p,n)$ are given.

401,713

PB85-130722

(Order as PB85-130078, PC A99/MF A01)
Washington Univ., Seattle. Dept. of Physics.
Preliminary Proton/Electron Mass Ratio Using a Precision Mass-Ratio Spectrometer, R. S. Van Dyck, and P. B. Schwinberg. 1984, 4p
Grants NBS-G7-9023, NSF-PHY80-15328
Included in Precision Measurement and Fundamental Constants II, p349-352 1984.

Keywords: *Fundamental constants, Mass spectrometers, Measurement, Precision, Ratios, Proton, Electrons, Mass, *Proton-electron mass ratio, Ion traps, Ion cyclotron resonance spectroscopy, Penning traps.

A new type of compensated Penning trap has its ring electrode split into equal quadrants in order to synchronously detect ion cyclotron resonances. Using this device, the authors have observed intense unshifted resonances with very small relative linewidths ($< 2 \times 10$ to the -9^{th} power), comparable to that which is attainable in high resolution NMR studies. Thus, cyclotron frequencies of both protons and electrons have been measured in the same magnetic field (5 T) and been measured in the same trapping volume (< 10 to the -7^{th} power/cc). From the ratio of these frequencies, a preliminary value of $m(p)/m(e) = 1836.15300(25)$ is obtained with a relative uncertainty of 0.14 ppm. This value agrees well with previous direct measurements within their experimental uncertainties.

401,714
PB85-130730
 (Order as PB85-130078, PC A99/MF A01)
 Mainz Univ. (Germany, F.R.). Inst. fuer Physik.
Direct Determination of the Proton-Electron Mass Ratio.
 G. Graeff, H. Kalinowsky, and J. Traut. 1984, 4p
 Included in Precision Measurement and Fundamental Constants II, p353-356 1984.

Keywords: *Fundamental constants, Protons, Electrons, Mass, Ratios, *Proton-electron mass ratio, Ion traps, Penning traps.

The cyclotron frequencies of free protons and electrons have been measured in a magnetic field of 5.81 tesla with a superimposed electrostatic quadrupole field. The increase of energy connected with a transition at the cyclotron frequency is detected by the measurement of the time of flight through an inhomogeneous magnetic field. From the ratio of the measured cyclotron frequencies of both particles, the proton-electron mass ratio is deduced. The result, $m(p)/m(e) = 1836.1527(13)$, agrees within the limits of error (0.69 ppm) with the value of the indirect determination.

401,715
PB85-136273 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Improved Procedure for Calculating the Collision Stopping Power of Elements and Compounds for Electrons and Positrons.
 Final rept.,
 S. M. Seltzer, and M. J. Berger. 1984, 12p
 Pub. in International Jnl. of Applied Radiation and Isotopes 35, n7 p665-676 1984.

Keywords: Atoms, Molecules, Reprints, *Stopping power, *Electron collisions, *Positron collisions, *Electron-atom collisions, *Electron-molecule collisions, *Positron-atom collisions, *Positron-molecule collisions.

This paper is an addendum to an earlier paper which described a procedure and provided the data base for the quick-and-easy evaluation of electron and positron collision stopping powers. The procedure makes use of Bethe's stopping-power formula and Sternheimer's theory of the density effect, and involves a parametrization such that some parameters depend only on the particle energy and all others only on the properties of the stopping material. The data base for 278 materials has now been updated through an improved evaluation of the density effect within the framework of Sternheimer's theory. The use of the new instead of the old data base can result in stopping-power changes as large as 1 to 2 percent.

401,716
PB85-141513 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Electron Scattering in the Excitation Region of the Delta Resonance on Nuclei with $A = 1$ to 16.
 Final rept.,
 J. S. O'Connell, W. R. Dodge, J. W. Lightbody, X. K. Maruyama, and J. O. Adler. 22 Oct 84, 3p
 Pub. in Physical Review Letters 53, n17 p1627-1629, Oct 22, 1984.

Keywords: *Electron scattering, Inelastic scattering, Hydrogen, Helium, Beryllium, Carbon, Oxygen, Reprints, *Delta resonances, MeV range 100-1000.

The inelastic scattering sections of H, He, Be, C and O were measured for 730 MeV electrons scattered at 37.1 degrees for energy transfers to the nucleus up to 550 MeV. The nuclear response in the delta region is found to be quite similar for the $A > 1$ targets. Although the differential cross section per nucleon at the peak of the delta region (380 MeV) is suppressed compared to the free nucleon, the area in the 230 - 550 MeV region is enhanced for the $A > 1$ targets.

401,717
PB85-143907 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Glueballs.
 Final rept.,
 S. Meshkov. 1984, 31p
 Pub. in AIP Conference Proceedings, n113 p125-155 1984.

Keywords: Reviews, Reprints, *Glueballs.

The current status of various glueball properties such as level ordering, masses, production, and decay is re-

viewed. Glueball candidates $\iota(1440)$, $\theta(1670)$, (g sub T)(2160), (g sub T)(2320), and $0(2,3-3.4)$ are examined. A simple model which incorporates the mixing of the glueball candidate $\iota(1440)$ with quarkonium states $\eta(549)$ and η' (958), and of the $\theta(1670)$ with $f(1270)$ and $f(1515)$ is presented; neither the $\iota(1440)$ nor the $\theta(1670)$ can be consistently interpreted as a glueball in this framework. A 5 x 5 model of Palmer and Pinsky which also includes radial excitation of the η and η' yields two solutions for the pseudoscalar system, the preferred one of which has $\iota(1440)$ being mainly an $s(\bar{s})$ radial excitation, and a second solution in which the $\iota(1440)$ is mixed strongly with the $\iota(960)$ and is about half bare glueball. The current leading glueball candidates are the $(\phi)(\phi)$ enhancements at 2160 and 2320 MeV.

401,718
PB85-145571 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Experimental Verification of the D2O-Moderated ^{252}Cf Source Spectrum.
 Final rept.,
 R. B. Schwartz, C. M. Eisenhauer, and J. A. Grundl. 1984, 28p
 Sponsored by Nuclear Regulatory Commission, Washington, DC.
 Pub. in NUREG/CR-3399, p1-28 1984.

Keywords: *Neutron spectra, Neutron sources, Radiation dosage, Heavy water, Reprints, Californium 252.

The authors have experimentally verified the calculated spectrum for the 15 cm radius D2O-moderated (^{252}Cf) neutron source. Using NBS double fission chambers as threshold detectors, they found excellent agreement between their measurements and results derived from the calculated spectrum in the energy range below about 10 keV. The measurements do, however, suggest the existence of small, but significant, discrepancies above about 600 keV, but there is no significant net change in the fluence to dose equivalent conversion.

20I. Plasma Physics

401,719
PB85-142040 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Discussion of the Conditional Probability Function for Electric Fields in a Plasma.
 Final rept.,
 R. Stamm, and E. Smith. Jul 84, 14p
 Pub. in Physical Review A 30, n1 p454-467 Jul 84.

Keywords: *Plasmas(Physics), *Electric fields, Plasma dynamics, Autocorrelation, Reprints, Conditional probability functions.

The conditional-probability function plays a central role in the development of stochastic models for spectral line shapes in plasmas. The authors discuss some of the physical properties of this function, using various analytic models as well as the results of a computer simulation.

401,720
PB85-142156 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Computer Simulation Technique for Plasmas.
 Final rept.,
 E. W. Smith, and R. Stamm. Jul 84, 4p
 Pub. in Physical Review A 30, n1 p450-453 Jul 84.

Keywords: *Plasmas(Physics), *Computerized simulation, Electric fields, Autocorrelation, Reprints.

A computerized simulation, based on statistically independent, noninteracting, shielded ions, is developed. This simulation procedure differs from the usual molecular-dynamics approach in several respects and, for some problems, provides less-time-consuming and more-accurate results. Simulation results are compared with analytically known plasma functions, and the basic limitations of the method are discussed.

20J. Quantum Theory

401,721
PB84-239953 Not available NTIS
 National Bureau of Standards, Washington, DC.
Laser Gravitational Wave Experiment in Space.
 Final rept.,
 J. E. Faller, P. L. Bender, Y. M. Chan, J. L. Hall, and D. Hils. 1983, 3p
 Pub. in Proceedings of International Conference on General Relativity and Gravitation (10th), Padova, Italy, July 4-9 1983, 2, p960-962.

Keywords: *Relativity, *Gravitational radiation, Gravitational waves, Spaceborne experiments, Laser interferometry.

Detection of gravitational radiation is an important research goal in physics and astrophysics. At the Joint Institute for Laboratory Astrophysics, an investigation is being carried out of possible designs for a laser gravitational wave experiment using free masses and baseline lengths of 1,000,000 km or longer.

401,722
PB84-245224 PC A03/MF A01
 National Bureau of Standards (NML), Washington, DC.
 Center for Radiation Research.
Simple Model for the QCD Vacuum.
 M. Danos, D. Gogny, and D. Irakane. Jul 83, 29p
 NBSIR-83/2759
 Prepared in cooperation with CEA Centre d'Etudes de Bruyeres-le-Chatel, Montrouge (France).

Keywords: Quarks, Vacuum, *Quantum chromodynamics, Bag model, Color model, Gluons, Confinement.

By treating the high-momentum gluon and the quark sector as an in principle calculable effective Lagrangian, we obtain a non-perturbative vacuum state for QCD as an infrared gluon condensate. This vacuum is removed from the perturbative vacuum by an energy gap. It is unstable below a minimum size and it has dielectric and dia-magnetic character indicating expulsion of color-electric and -magnetic fields, i.e., it exhibits all the properties required for color confinement.

401,723
PB85-123396 Not available NTIS
 National Bureau of Standards, Washington, DC.
New Laboratory Test of the Equivalence Principle.
 Final rept.,
 P. T. Keyser, J. K. Hoskins, and J. E. Faller. 1983, 3p
 Grant NSF-PHY79-04928
 Pub. in Proceedings of International Conference on General Relativity and Gravitation (10th), Padova, Italy, July 4-9, 1983, 2, p993-995.

Keywords: *Relativity, *Gravitation, Lead(Metal), Copper, Mass, *Equivalence principle, *Eotvos experiment.

A test of the principle of equivalence using a large fluid (surrogate) fiber Eotvos apparatus is presently being undertaken at the Joint Institute for Laboratory Astrophysics. The authors have embarked on the construction of a 1.27 m diameter system employing approximately 500 kg of lead and 500 kg of copper as the test masses. The current status of their work will be described.

401,724
PB85-130086
 (Order as PB85-130078, PC A99/MF A01)
 Queen Mary Coll., London (England). Dept. of Applied Mathematics.
Laws and Constants of Nature.
 I. W. Roxburgh. 1984, 9p
 Included in Precision Measurement and Fundamental Constants II, p1-9 1984.

Keywords: *Fundamental constants, Gravitation, Plane geometry, Cosmology, Quantum theory, Anthropropic principle.

The paper concentrates on a few problems: geometry, mechanics, gravitation, and the large numbers (10 to the 40th power) that relate microphysics to the large scale structure of the universe. The author's purpose is not so much to describe what is known, but to question how well anything is known and to provoke the reader into asking questions and proposing experiments that probe the foundations of our understanding. Is geometry locally Euclidean. Do different clocks

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keep the same time. Does our existence depend on the exact form of the laws of nature and the exact values of the constants of nature. Do the constants of nature vary in time. Why are there laws at all. Readers can add questions of their own.

401,725

PB85-130458

(Order as PB85-130078, PC A99/MF A01)
Cornell Univ., Ithaca, NY. Floyd R. Newman Lab. of Nuclear Studies.

Implications of QED (Quantum Electrodynamics) Theory for the Fundamental Constants,
G. P. Lepage, and D. R. Yennie. 1984, 9p
Included in Precision Measurement and Fundamental Constants II, p185-193 1984.

Keywords: *Fundamental constants, *Quantum electrodynamics, Hyperfine structure, Hydrogen, Muonium, Positronium, Measurement, Precision, Fine structure, Lamb shift.

The authors review the current theoretical status of high precision measurements in quantum electrodynamics (QED). Theoretical predictions in QED fall into one of two general categories: perturbative, as for the magnetic moments of electrons and muons; and non-perturbative, as for the properties of atoms. We contrast these predictions and explore their implications for the fundamental constants of nature.

401,726

PB85-130755

(Order as PB85-130078, PC A99/MF A01)
Stanford Univ., CA. Dept. of Physics.

High Resolution Magnetic Measurement on Rotating Superconductors to Determine $h/m(e)$,
B. Cabrera, S. B. Felch, and J. T. Anderson. 1984, 6p
Contract NAS8-32355, Grant NBS-GB-9026
Sponsored in part by Grant NSF-DMR80-26007.
Included in Precision Measurement and Fundamental Constants II, p359-364 1984.

Keywords: *Fundamental constants, Magnetic measurement, Superconductors, Cryogenics, Ratios, Magnetometers, *Electron mass, *Plancks constant, SQUID devices.

The authors have begun a new experiment to determine $h/m(e)$ (Planck's constant divided by the free electron mass) to an accuracy of several parts per million using rotating superconducting rings. This resolution will allow for the first time investigation of recently predicted relativistic corrections at a level of 100 to 200 ppm. Here the authors present initial experimental measurements of $h/m(e)$. These include high precision measurements of the induced magnetic field from the rotating superconducting ring, showing an improvement in resolution by two orders of magnitude over previously reported observations, and a clear demonstration of flux quantization in the 50 mm diameter ring.

401,727

PB85-130763

(Order as PB85-130078, PC A99/MF A01)
National Physical Lab., Teddington (England). Div. of Quantum Metrology.

High Precision Measurement of the Electron Compton Wavelength ($h/m(e)$) Using Cryogenic Metrological Techniques,
J. C. Gallop, B. W. Petley, and W. J. Radcliffe. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p365-367 1984.

Keywords: *Fundamental constants, Ratios, Superconductors, Cryogenics, Helium 3, Liquid helium, Nuclear magnetic resonance, Magnetometers, *Electron mass, *Plancks constant, SQUID devices, Fluxoids.

The paper reports progress on the NPL measurement of the Compton wavelength of the electron, which relies on the unique properties obtainable in cryogenic environments. The method is to trap a magnetic field in a superconducting tube. The experimentally measured quantities are the spin precession frequency of the $(3)He$ nuclei in the trapped field, and the cross sectional area of the tube. Novel cryogenic metrology is used for both of these measurements.

401,728

PB85-130771

(Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

Preliminary Determination of $h/m(n)$,
E. Krueger, W. Nistler, and W. Weirauch. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p369-373 1984.

Keywords: *Fundamental constants, Ratios, Measurement, Precision, Neutron beams, *Plancks constant, *Neutron mass, Polarized beams.

A precisely measured value of the ratio $h/m(n)$ (Planck constant divided by the neutron mass) would be a new input parameter for the least-squares adjustment of the fundamental constants. $h/m(n)$ can be determined by measuring the wavelength and the velocity of reactor neutrons. It is expected that this measurement can be carried out with a relative uncertainty of about 1×10^{-6} to the -6 th power, using a method described in this paper. The method has been successfully tested in a preliminary determination of $h/m(n)$ and the results are reported.

401,729

PB85-131027

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Electrical Measurements and Standards Div.

Proton Gyromagnetic Ratio in H₂O - A Problem in Dimensional Metrology,
E. R. Williams, P. T. Qlsen, and W. D. Phillips. 1984, 7p

Sponsored by Department of Energy, Washington, DC.
Included in Precision Measurement and Fundamental Constants II, p497-503 1984.

Keywords: *Fundamental constants, *Protons, Quantum electrodynamics, Water, Dimensional measurement, *Gyromagnetic ratio, *Fine structure constant.

The last 10 years of work on the proton gyromagnetic ratio in H₂O, (γ prime, sub p), is reviewed. Results from both the low and high field methods are summarized along with short descriptions of several experiments. However, the emphasis is on the results from the low field method and the discrepancies among them. The values of the fine structure constant, α , obtained from the low field experiments are compared with several values of α obtained from various atomic physics experiments which to varying degrees require quantum electrodynamic theory (QED) for their interpretation.

401,730

PB85-131043

(Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

(γ sup p)-Experiment at PTB (Physikalisch-Technische Bundesanstalt),
K. Weyand. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p509-514 1984.

Keywords: *Fundamental constants, *Protons, Nuclear magnetic resonance, Magnetometers, Magnetic measurement, Precision, *Gyromagnetic ratio, SQUID devices.

This paper will give a brief summary of the mechanical apparatus and the electronic set-up which have been constructed to determine the gyromagnetic ratio of the proton by observing free precession in a low magnetic field. A novel scheme is used to determine the coil constant of a multilayer field coil system consisting of four winding packages by measuring a quantity proportional to the magnetic flux density at a number of points on the axis of the set of coils carrying a stabilized current.

401,731

PB85-131050

(Order as PB85-130078, PC A99/MF A01)
Yale Univ., New Haven, CT. Dept. of Physics.

New Method for the Determination of the Proton Gyromagnetic Ratio,
G. L. Greene. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p515-517 1984.

Keywords: *Fundamental constants, *Protons, Magnetic resonance, Magnetic measurement, Water, *Gyromagnetic ratio, Ramsey technique.

A method for the determination of (γ prime, sub p) is proposed which involves the separated oscillatory field magnetic resonance technique with flowing water. An association between the volume integral of a magnetic field in a cylinder (determined by a resonance frequency) and the line integral along its axis (determined by Ampere's law) is made. An accuracy of a few parts in $(10$ to the 8 th power) may be attainable with this technique.

401,732

PB85-131142

(Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

Gravity and Relativity: Experiments Relating to the Newtonian Gravitational Constant,
H. de Boer. 1984, 12p
Included in Precision Measurement and Fundamental Constants II, p561-572 1984.

Keywords: *Fundamental constants, Measurement, Surveys, *Gravitational constant, Uncertainty.

The Newtonian gravitational constant G is one of the natural constants, the exact knowledge of which might give us important answers to cosmological questions and contribute to the support of a theory of gravitation. In a survey, the problems are set forth which are related to the gravitational constant, appertaining measurements are described, and the uncertainties of measurements obtained so far are compiled.

401,733

PB85-131159

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Center for Absolute Physical Quantities.

Redetermination of the Newtonian Gravitational Constant 'G',
G. G. Luther, and W. R. Towler. 1984, 4p
Prepared in cooperation with Virginia Univ., Charlottesville. Dept. of Nuclear Engineering and Engineering Physics.

Included in Precision Measurement and Fundamental Constants II, p573-576 1984.

Keywords: *Fundamental constants, Experimental data, Measurement, *Gravitational constant, Uncertainty.

The universal Newtonian gravitational constant, G , has been redetermined at the National Bureau of Standards using the time-of-swing method, in which the period of a torsion pendulum in the form of a dumbbell weighing approximately 5 g is modified by the presence of two 10.5 kg tungsten balls. The difference in the squared frequencies with and without the balls is proportional to G . In this experiment the difference was approximately 3%. The apparatus used, albeit with extensive modification, is the same as used in the previous redetermination done at the National Bureau of Standards, using the method of constant angular acceleration. The apparatus is described, improvements are discussed, data is presented and evaluated. The resulting value of G is in agreement with the generally accepted CODATA value but with significantly smaller uncertainty.

401,734

PB85-131167

(Order as PB85-130078, PC A99/MF A01)
Cambridge Univ. (England). Cavendish Lab.

Design of a Beam Balance for a Determination of 'G',
C. C. Speake, and A. J. F. Metherell. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p577-579 1984.

Keywords: *Fundamental constants, Precision, Measurement, Design, *Gravitational constant, Balances, Beam balances.

The authors are currently engaged in the design and construction of a beam balance which will be used for a precision determination of G . The balance is designed to give a value of G to about one part in 100,000. In place of a knife edges the balance employs a cross-strip pivot for its fulcrum and flexure pivots are used to suspend the test masses from the ends of its arms. The balance is servo-controlled so that it maintains its position in the horizontal plane to an angle of about 10 to the -9 th power rad. The attracting masses are in the form of rectangular slabs with rectangular holes at their centers. This shape ensures

that the test masses suspended from the arms of the balance lie in regions of space where the gravitational field due to the slabs is highly uniform. A precise knowledge of the center-of-mass to center-of-mass distances is therefore unnecessary for a precision determination of G with this device.

401,735
PB85-131175

(Order as PB85-130078, PC A99/MF A01)
Cambridge Univ. (England). Cavendish Lab.
Optimizing the Shape of the Attracting Mass in Precision Measurements of 'G',
A. J. F. Metherell, C. C. Speake, Y. T. Chen, and J. E. Faller. 1984, 5p
Prepared in cooperation with Joint Inst. for Lab. Astrophysics, Boulder, CO.
Included in Precision Measurement and Fundamental Constants II, p581-585 1984.

Keywords: *Fundamental constants, *Shape, Measurement, Mass, Precision, Slabs, *Gravitational constant, Circular cylinders, Parallelepipeds.

It is now recognized that the sphere is not necessarily the best shape to use for an attracting mass in a precision measurement of G . Two shapes which minimize the effect of errors in the center-of-mass to center-of-mass distance between the attracting mass and the test mass are (a) the right-circular hollow cylinder and (b) a pair of rectangular parallelepiped slabs with rectangular holes at their centers. The kinematic factors influencing the design of these mass distributions are considered and the optimum design parameters that should be employed with attracting masses of these shapes are determined.

401,736
PB85-131183

(Order as PB85-130078, PC A99/MF A01)
Eastern Washington Univ., Cheney. Dept. of Physics.
Vacuum Polarization and Recent Measurements of the Gravitational Constant as a Function of Mass Separation,
D. R. Long. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p587-589 1984.

Keywords: *Fundamental constants, Measurement, Mass, Separation, Failure, Correction, *Gravitational constant, *Vacuum polarization, Inverse square laws.

The author notes that the coulomb inverse square law has long been known to fail at small charge separations due to a vacuum polarization effect. He points out that gravitational inverse square law data should be analyzed for a vacuum polarization effect and presents the QED result for the mass density shift of the vacuum due to an inducing mass. He points out that care must be used in analyzing the data because the point mass situation is very different from the case where one of the masses is quite extensive. He analyzes the current data for the value of the vacuum polarization parameter λ . Much of that data has errors too large to give definite results although it tends to agree with the authors earlier result of $\lambda = 0.002$. Of the more precise results, Stacey and Tuck are in agreement with the authors value while Spero et al. disagree. It is pointed out that the vacuum polarization analysis of the Spero et al. result is ambiguous.

401,737
PB85-131191

(Order as PB85-130078, PC A99/MF A01)
California Univ., Irvine. Dept. of Physics.
Tests of the Gravitational Inverse Square Law Using Torsion Balances,
J. K. Hoskins, R. Newman, J. Schultz, and R. Spero. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p591-594 1984.

Keywords: *Fundamental constants, Gravitation, Torsion balances, Measurement, Tests, *Gravitational constant, *Inverse square laws.

The authors describe experiments at U.C. Irvine to test the inverse square distance dependence of the gravitational force at laboratory distances. One experiment has tested a distance range of approximately 2 to 5 cm, using a test mass suspended from a torsion balance to prove the gravitational field inside a mass tube. Results of this experiment support an inverse square law. A second experiment, now in progress, tests a distance range from 5 cm to 20 m. We discuss the feasibility of an experiment to test the inverse square law at

distances less than 1 mm. Methods are discussed for reducing the effect of seismic noise on a torsion balance by damping pendulum oscillation modes of the balance.

401,738
PB85-131209

(Order as PB85-130078, PC A99/MF A01)
National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Physics.
Measurement of Gravitational Forces at Separations Around 10 Meters,
H. T. Yu, W. T. Ni, C. C. Hu, F. H. Liu, and C. H. Yang. 1984, 2p
Prepared in cooperation with Chinese Petroleum Corp., Miaoli (Taiwan).
Included in Precision Measurement and Fundamental Constants II, p595-596 1984.

Keywords: *Fundamental constants, Gravimeters, Gravitation, Separation, Mass, Tanks(Containers), Tests, *Gravitational constant, Inverse square laws, Oil tanks.

The authors used a Worden gravimeter to measure the gravitational forces at fixed positions when a large oil tank was full and when it was empty. The results are reported here.

401,739
PB85-131217

(Order as PB85-130078, PC A99/MF A01)
Queensland Univ., Brisbane (Australia). Dept. of Physics.
Non-Newtonian Gravity: Geophysical Evidence,
F. D. Stacey, and G. J. Tuck. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p597-600 1984.

Keywords: *Fundamental constants, Geophysics, Estimates, Gravitation, Measurement, *Gravitational constant, Inverse square laws.

Six independent geophysical data sets have been used to estimate the value of the Newtonian gravitational constant G , yielding results that are consistently higher than the accepted laboratory-determined value G by 0.5% to 1.5%. Possibilities of unrecognized systematic errors preclude a definite conclusion, so that new large scale measurements of G are needed to clarify the matter. Two such experiments, using masses distributed on quite different scales, both much larger than any laboratory measurement of G , are under development. One determines the gravitational attraction by a 3.5 km layer of sea water by measurements of gravity in a bathyscaphe. The other makes use of frequent level changes of a hydroelectric pumped-storage lake, involving a 10 m layer of water.

401,740
PB85-131225

(Order as PB85-130078, PC A99/MF A01)
Maryland Univ., College Park. Dept. of Physics and Astronomy.
Experimental Test of a Spatial Variation of the Newtonian Gravitational Constant at Large Distances,
H. A. Chan, and H. J. Paik. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p601-606 1984.

Keywords: *Fundamental constants, Superconductors, Measurement, Tests, *Gravitational constant, Inverse square laws, Poisson equation, Gravity gradiometers.

The Poisson equation of Newtonian gravitational potential provides a source-independent null test of the Inverse Square Law. A convenient Laplacian detector consists of superconducting gravity gradiometers in three orthogonal directions. Matching and stability of the cryogenic detector are achieved by utilizing superconducting circuits. Since the Laplacian of the gravitational potential produced by an arbitrary source is zero outside the source in the Inverse Square Law, this experiment becomes a source-independent null test for the constancy of the gravitational constant. This characteristic allows a precision test of the Inverse Square Law at geological distances using natural objects like an ocean or the earth. The authors discuss experimental procedures and expected sensitivities of the null experiment for three different sources: a swinging pendulum, an ocean tide, and the earth itself. It appears that the empirical limits in the Inverse Square Law could be improved by three to six orders of magnitude in the range between 1 m and 10 to the 7th power km by this new null experiment.

401,741

PB85-131233

(Order as PB85-130078, PC A99/MF A01)
University of Central Florida, Orlando. Dept. of Physics.
Measurement of 'G' for Small Inter-Mass Spacings,
W. C. Oelfke. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p607-609 1984.

Keywords: *Fundamental constants, Torsion balances, Measurement, Mass, Design, Operation, Experimental design, Disks(Shapes), *Gravitational constant, Inverse square laws.

An experimental project is currently under way at the University of Central Florida to measure the Newtonian gravitational constant G for inter-mass spacings r in the range $0.3 \text{ cm} > r > 3 \text{ cm}$. A Cavendish balance for measuring the gravitational attraction between disk-shaped masses has been constructed. This balance functions as a fully automated electrobalance with the incorporation of a microcomputer for the monitoring and recording of data and the manipulation of the balance. A complete description of the design and operation of this Cavendish balance is presented.

401,742

PB85-131241

(Order as PB85-130078, PC A99/MF A01)
Smithsonian Astrophysical Observatory, Cambridge, MA.
Tests of Gravitation and Relativity,
R. F. C. Vessot. 1984, 14p
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Included in Precision Measurement and Fundamental Constants II, p611-624 1984.

Keywords: *General relativity, *Gravitation, *Relativity, *Fundamental constants, Tests, Reviews, *Gravitational constant, Gravitational radiation.

The weak but all pervasive force of gravity governs the overall behavior of the universe. The dramatic discoveries in astrophysics place gravitation in the forefront of interest and raise questions about the range of validity of Einstein's General Theory of Relativity and at what level it may prove to be a classical limit to a quantum theory. At present, after more than seventy years, the General Theory continues to be the most acceptable description of space-time despite continuing tests to challenge it by searching for contradictions to predictions based on this theory. The chief purpose of this paper is to review the results of recent tests and assess the status of experimental gravitation. The status is applicable present technology and developments for future measurements will be discussed.

401,743

PB85-131258

(Order as PB85-130078, PC A99/MF A01)
Naval Observatory, Washington, DC.
Is the Gravitational Constant Changing,
T. C. Van Flandern. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p625-627 1984.

Keywords: *Fundamental constants, *Cosmology, Gravitation, Universe, *Gravitational constant, Lunar occultation, Lunar orbits, Lunar ranging.

Forty-four years after Dirac's original conjecture, experiments have become accurate enough to test for a time variation of the Universal Gravitational Constant. Present results use the lunar orbit, and do give a non-zero result. Interpreting the observed quantities with the Canuto-Hsieh scalar covariant cosmology, $(\dot{G}/G) = (-6.4 \pm \text{or } -2.2) \times 10^{-11}$ to the -11th power per year. The implications for relativity and cosmology are briefly discussed.

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401,744
PB85-131266

(Order as PB85-130078, PC A99/MF A01)
Virginia Univ., Charlottesville. Dept. of Physics.
Experiments on Variation of the Gravitational Constant Using Precision Rotations,
G. T. Gillies, and R. C. Ritter. 1984, 6p
Included in Precision Measurement and Fundamental Constants II, p629-634 1984.

Keywords: *Fundamental constants, Rotation, Precision, *Gravitational constant, Magnetic suspension, Matter.

The classical rotor for gravitational studies, the earth, has a varying decay time of about 3×10 to the 9th power years and a rotational roughness about 3×10 to the -8th power per day. A more rigid, highly protected, laboratory rotor might be made more suitable for gravitational measurements such as tests for the temporal variation of Newton's G and for cosmological matter creation. In this paper past tests for variation of G with other parameters are reviewed and the first room-temperature tests of precision rotors for such 'laboratory cosmology' experiments are discussed. The design of two such experiments at Virginia and the early results are presented for one protected rotor aimed at ultimately testing for matter creation at rates below (\dot{m} dot)/m approx. = 10 to the -10 power/year.

401,745
PB85-131274

(Order as PB85-130078, PC A99/MF A01)
Otago Univ., Dunedin (New Zealand).
Interpreting Dirac's Large Numbers Hypothesis,
W. Davidson. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p635-637 1984.

Keywords: *Fundamental constants, *Electromagnetic interactions, Cosmology, *Gravitational constant.

Dirac's large numbers hypothesis (LNH) and its implications are reviewed. Recent work shows that if the LNH is correct then not only does the Newtonian gravitational constant decrease on an atomic time scale (G proportional to $1/t$), as inferred by Dirac, but the electrical force between two charged particles becomes stronger relative to their mutual gravitational force regardless of which of Dirac's two space-time scales, atomic or gravitational, is used. This is made explicit by introducing a Coulomb constant gamma analogous to G. The derivation of the two metrics directly from the LNH is demonstrated. Some observational implications of the LNH are listed.

401,746
PB85-131282

(Order as PB85-130078, PC A99/MF A01)
Joint Inst. for Lab. Astrophysics, Boulder, CO.
New Laboratory Test of the Equivalence Principle,
P. T. Keyser, J. E. Faller, and K. H. McLagan. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p639-641 1984.

Keywords: *General relativity, *Gravitation, Mass, Tests, Lead(Metal), Copper, *Equivalence principle, Eotvos experiment.

A test of the principle of equivalence using a large fluid (surrogate) fiber Eotvos apparatus is presently being undertaken at the Joint Institute for Laboratory Astrophysics. Preliminary measurements using a 0.25 m diameter fluid system were sufficiently encouraging that the authors have embarked on the construction of a five times larger (1.27 m diameter) system employing approximately 500 kg of lead and 500 kg of copper as the test masses. The first experimental results on the equivalence of gravitational and inertial mass with this new large apparatus are expected in 1983 or 1984.

401,747
PB85-131290

(Order as PB85-130078, PC A99/MF A01)
Colorado Univ. at Boulder. Dept. of Physics and Astrophysics.
What Test Masses Are Best for an Eotvos Experiment,
D. F. Bartlett, J. Shepard, and C. D. Zafiratos. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p643-645 1984.

Keywords: *Gravitation, *Mass, Solidified gases, Aluminum, Hydrogen, *Eotvos experiment, *Equivalence principle, Solid hydrogen.

No element lighter than aluminum has been used as a comparison mass in the recent precise tests of the equivalence of gravitational and inertial mass. The authors discuss how the substitution of solid hydrogen for aluminum as the light mass could increase the sensitivity of an Eotvos experiment by a factor between 10 and 100.

401,748
PB85-131308

(Order as PB85-130078, PC A99/MF A01)
National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Physics.
Equivalence Principles and Precision Experiments,
W. T. Ni. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p647-651 1984.

Keywords: *Gravitation, Cosmology, Red shift, Torsion, Tests, *Equivalence principle, Symmetry breaking, Pulsars, Grand unified theory.

The authors use a general framework--the chi-g framework--to study the empirical foundations of the Einstein Equivalence Principle (EEP), and to analyze the theoretical significance of various precision experiments and observations such as timing observations of pulsar signal propagation through galactic gravitational field, the Hughes-Drever experiments, the Eotvos-Dicke-Braginsky experiments, and the Vessot-Levine experiment. These experiments constrain various linear combinations of the components of chi to be metric to various degrees of accuracy, leaving only one component out of 21 not constrained. The theory with this component different from zero can be reformulated as a torsion theory. To test EEP and this theory, experiments on polarized test bodies are suggested.

401,749
PB85-131316

(Order as PB85-130078, PC A99/MF A01)
Virginia Univ., Charlottesville. Dept. of Physics.
Inertial Clock to Test the Non-Metricity of Gravity,
W. S. Cheung, and R. C. Ritter. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p653-657 1984.

Keywords: *Gravitation, *Gravity, Clocks, Rotors, Tests, Corotation, Magnetic suspension.

A certain class of non-metric gravitation theories implies that clocks of different electromagnetic nature will interact with local gravity differently and result in slightly different gravitational redshift measurements. As ideal rotating body would have its moment of inertia, hence timekeeping, depend on the rotor dimensions, so that it would act as an 'electrostatic clock.' In the past, precision high speed rotations of small spheres have exhibited long decay times, about 10 to the 10th power/s, and high Q. Simple extrapolation indicates that larger rotors should have much longer decay times. A double magnetic suspension of two rotors--an inner 'proof' rotor and an outer 'shroud' rotor--has been built and is under test as a method for reducing bearing and gas drags. This paper presents a description of a non-metricity test, analysis of the corotation scheme, and details of construction of the first, room-temperature inertial clock.

401,750
PB85-131324

(Order as PB85-130078, PC A99/MF A01)
Stanford Univ., CA. Dept. of Aeronautics and Astronautics.
Assessment of the Prospects for a Measurement of Relativistic Frame Dragging by 1990,
R. A. Van Patten. 1984, 8p
Contract NAS8-32355
Included in Precision Measurement and Fundamental Constants II, p659-666 1984.

Keywords: *General relativity, Tests, *Relativistic frame dragging, Gyro experiment, Twin satellite experiment.

Relativistic frame dragging, i.e., the Schiff motional effect or the Lense-Thirring effect, has never been measured. Just two experiments proposed to date promise measurement accuracies of a few percent. The two are the gyro experiment and the twin satellite experiment. These two experiments, although very different, have a common element, a 'gyroscope' in a rotating gravity field. With the gyro experiment, a small cryogenic gyro is placed in orbit and its spin axis history is compared with a star to 0.001 arc sec/yr accuracy.

With the twin satellite experiment, two drag-free satellites are placed in reverse polar orbits and used as orbit-sized gyros. The sum of the nodal motion is checked to 30 cm against that predicted from earth oblateness using polar satellite-to-satellite Doppler data. This paper compares the errors and risks involved in carrying out each of these very demanding scientific space missions.

401,751
PB85-131332

(Order as PB85-130078, PC A99/MF A01)
Ohio Univ., Athens. Dept. of Physics.
Status of the Velocity of Light in Special Relativity,
E. Breitenberger. 1984, 4p
Included in Precision Measurement and Fundamental Constants II, p667-670 1984.

Keywords: *Special relativity, *Photons, *Fundamental constants, *Light speed, *Rest mass.

The special theory of relativity is shown to be independent of the assumption that the velocity of light, c, is a universal constant. No more than an intuitively obvious monotonicity postulate of velocity addition is needed to prove the existence of a universal, kinematic limit velocity (c sub 0), and the existence of a universal dispersion relation for vacuum waves. The best empirical support for the signal postulate (c sub 0) = c still comes from uncorroborated observations of the Crab Nebula pulsar which admit a photon rest frequency of up to 7 MHz, far above the limit inferred from the consistency of quantum electrodynamics (QED). Existing theory-dependent arguments purporting to demonstrate the constancy of c are shown to be inadequate. Further experimental work on the variability of c with frequency and with source conditions is desirable.

401,752
PB85-131340

(Order as PB85-130078, PC A99/MF A01)
Joint Inst. for Lab. Astrophysics, Boulder, CO.
Relativistic Time Dilation: A Latter-Day Ives-Stillwell Experiment,
P. Nachman, M. D. Rayman, and J. L. Hall. 1984, 3p
Included in Precision Measurement and Fundamental Constants II, p671-673 1984.

Keywords: *Special relativity, Atomic beams, Atomic spectra, Anisotropy, Experimentation, *Time dilation, Two photon spectroscopy, Helium atoms, Light speed.

Two-photon spectroscopy on a fast atomic beam offers the possibility of a dramatically improved test of the special relativistic time dilation. The authors experimental arrangement will allow direct measurement of He atom resonance frequencies displaced from their rest-frame values by time dilation alone. The atomic beam velocity will be determined optically via the Doppler shift. The longitudinal interaction geometry will also permit them to test with increased precision for a possible vector anisotropy in the speed of light, a possibility raising renewed interest because of recent astrophysical discoveries. Further, the authors expect to refine experimental values for the energies of the Rydberg terms in He.

401,753
PB85-131357

(Order as PB85-130078, PC A99/MF A01)
Utah State Univ., Logan. Dept. of Physics.
Experiment to Measure Relative Variations in the One-Way Velocity of Light,
D. G. Torr, and P. Kolen. 1984, 5p
Included in Precision Measurement and Fundamental Constants II, p675-679 1984.

Keywords: *Fundamental constants, *Special relativity, Rubidium frequency standards, Precision, Measurement, Anisotropy, *Light speed.

In this experiment two rubidium vapor frequency standards were placed approximately 500 m apart and the phase of their signals compared as a function of time. The diurnal rotation of the earth was used to introduce a change in the direction of propagation of the signal, thereby providing a test of the assumption of isotropy of propagation of electromagnetic radiation. The relative phase difference between clocks was also compared for negligible separation of the clocks. The drift rate changed detectably for the separated clocks, while the round-trip velocity remained constant to within 0.0001% c. Typical variations observed in the one-way velocity imply a diurnal modulation of the order of + or - 0.1% to 1.0% c. The relative precision

of the measurements amounted to 1 part in 5×10 to the 13th power.

401,754
PB85-131365
 (Order as PB85-130078, PC A99/MF A01)
 Tokyo Univ. (Japan).
High-Energy Gamma Rays Might Be Faster than Visible Light,
 K. Fujiwara. 1984, 4p
 Included in Precision Measurement and Fundamental Constants II, p681-684 1984.

Keywords: *Special relativity, *Gamma rays, De Broglie wavelengths, *Light speed, *Visible radiation.

Our possible confusion between the wave and particle pictures arising from the linearity of the de Broglie relation might be the cause of the divergence in field theories. When we assume that every line segment in three-dimensional space has a quantum structure analogous to the atomic chain of atomic distance $2(l \text{ sub } 0)$, the de Broglie relation is exponentially nonlinearized at sufficiently high momenta, and the symmetry between the two pictures is broken. It has been shown that, under such situations, the field theories automatically become finite without changing their conventional form. The present theory predicts that high-energy gamma-rays would be faster than visible light, though the detectability of the effect depends on the value of the unknown constant ($l \text{ sub } 0$).

401,755
PB85-131373
 (Order as PB85-130078, PC A99/MF A01)
 Indian Inst. of Tech., New Delhi. Dept. of Physics.
Fiber Optic Ring as a Gravitational Wave Detector,
 C. L. Mehta, D. Ranganathan, and G. Bose. 1984, 3p
 Included in Precision Measurement and Fundamental Constants II, p685-687 1984.

Keywords: *Optical interferometers, *Fiber optics, *Detectors, *Gyroscopes, Helium neon lasers, *Gravitational waves, *Sagnac effect, *Laser gyroscopes.

The authors suggest the use of a Sagnac interferometer made of a fiber optic ring for detecting gravitational waves. Any distortion in the geometry of the ring on account of a gravitational wave is detectable as a phase shift between the counter propagating optical signals. In order to discriminate against angular velocity variations and any other local fluctuations, a pair of orthogonal coils is to be used and the system rotated about an axis lying symmetrically between the two coils. It is estimated that a stabilized He-Ne laser used as the source and fiber coils of 1 m diameter with 100 turns rotating with an angular velocity of about 1000 rad/sec will provide adequate sensitivity.

401,756
PB85-131381
 (Order as PB85-130078, PC A99/MF A01)
 Joint Inst. for Lab. Astrophysics, Boulder, CO.
Possible Laser Gravitational Wave Experiment in Space,
 J. E. Faller, and P. L. Bender. 1984, 2p
 Included in Precision Measurement and Fundamental Constants II, p689-690 1984.

Keywords: Binary stars, Experimental design, Spacecraft, *Gravitational waves, Signal detection, Laser applications.

An investigation has been started of possible designs for a laser gravitational wave experiment with baseline lengths of roughly 1,000,000 km or longer. The objectives of the experiment are to search for narrow-band signals with periods of seconds to hours, for pulses of gravitational waves, and for broadband background radiation. One of the main goals is to detect signals from known rotating binary stars, such as Am CVn, WZ Sge, and i Boo. The corresponding gravitational wave periods are 8.76, 40.5, and 193 minutes. The expected strain amplitudes are roughly 0.4, 0.5, and 6×10 to the -21st power, respectively, which correspond to equivalent accelerations of 50, 4, and 2×10 to the -19th power g for a 1,000,000 km baseline. The main uncertainty in the expected signal strengths comes from the uncertainty in the distances. In view of the extremely tiny equivalent accelerations, care will be needed in designing the experiment in order to minimize spurious accelerations due to forces other than the gravitational attraction of the sun and planetary bodies.

20K. Solid Mechanics

401,757
PB84-218940 Not available NTIS
 National Bureau of Standards, Washington, DC.
Energy-Release Rate Associated with Diffusional Crack Growth.
 Final rept.,
 T. J. Chuang. 1983, 14p
 Sponsored in part by Department of Energy, Washington, DC. See also DE83-165076.
 Pub. in International Jnl. of Fracture 23, p229-242 1983.

Keywords: *Crack propagation, Diffusion, Fracture(Materials), Reaction kinetics, Thermodynamics, Energy, Reprints, J integrals.

A general expression for the energy release rate (G) that arise during steady state crack propagation by diffusion is derived from the standpoint of irreversible thermodynamics. Three contributing components of G are identified: (1) the Griffith energy (GGr); (2) heat generated in the process of surface diffusion; and (3) grain-boundary diffusion. Further, the total G is shown to be directly related to the well-known J-integral if the strain energy effects can be ignored. This expression for G is valid in general even if the response of the material is not linear and the mass transport kinetics does not follow Fick's law. Quantitative evaluations of each component are made for the linear case where field solutions are available.

401,758
PB84-242494 Not available NTIS
 National Bureau of Standards, Washington, DC.
Application of an Elastic-Plastic Model to the Use of Small Specimen Strength Ratio for Measuring Fracture Toughness.
 Final rept.,
 R. deWit, and C. G. Interrante. 1984, 8p
 Pub. in Jnl. of Engineering Fracture Mechanics 19, n6 p1151-1159 1984.

Keywords: *Fractures(Materials), Toughness, Fracture properties, Cracks, Stresses, Mechanical properties, Mathematical models, Reprints.

Data reported by Server and Wullaert correlating specimen strength ratio with fracture toughness were analyzed with the D-BSC-HSW model. This model is based on the Dugdale model, elaborated by Bilby, Cottrell and Swinden, and extended by Heald, Spink and Worthington. The data included instrumented pre-cracked Charpy results on HSST plate 02, as well as static, intermediate, and dynamic tests of 1 - T compact and bend specimens of SA533B-1 steel. The model relates the fracture toughness to the crack length, specimen shape and size, applied failure stress and effective flow strength. The only parameter not provided by the data is the constraint factor, M, the ratio of the effective flow strength to the yield strength. The model was fitted to the data by non-linear least squares methods by which M was determined to be approx. 2.5 for the Charpy data, and from 2.1 to 2.6 for the other specimen data. The fit is considered to be reasonably good throughout the range from linear-elastic fracture mechanics through to plastic collapse. The result for the Charpy data is considered to be as good as that for the other specimens. The determination of only one parameter is needed to establish the relationship between specimen strength ratio and fracture toughness. This relationship then applies to the entire range of fracture regimes.

401,759
PB85-115533 Not available NTIS
 National Bureau of Standards, Washington, DC.
Elastic Field of an Inhomogeneous System.
 Final rept.,
 W. C. Johnson, and J. K. Lee. 1982, 5p
 Pub. in Proceedings of Solid to Solid Phase Transformations, Pittsburgh, PA., August 10-14, 1981, p151-155 1982.

Keywords: *Elasticity, Heterogeneity, Integral equations, Phase transformations, Strains, Stresses.

An integral equation is derived for the strain field in a general infinite system subjected to arbitrary applied strains and stress-free transformation strains (eigenstrains) when the elastic constants of the material are a function of position. The approach is based upon establishing a reference frame free from strain but not necessarily free from stress. As an illustration, the

technique is applied to the case of two misfitting coherent precipitates embedded in a matrix of uniform elastic constants.

401,760
PB85-129344 Not available NTIS
 National Bureau of Standards, Washington, DC.
Feynman's Disk Paradox.
 Final rept.,
 G. G. Lombardi. 1983, 2p
 Pub. in American Jnl. of Physics 51, n3 p213-214 Mar 83.

Keywords: *Angular momentum, *Electrodynamics, Electromagnetic induction, Reprints, *Feynman disk, Paradoxes.

A paradox involving the apparent violation of angular momentum conservation is discussed. Electromagnetic induction is used to impart angular momentum to a disk of charges. The paradox is resolved by finding the origin of the angular momentum.

401,761
PB85-135515 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Theory of Chemically Assisted Fracture.
 Final rept.,
 E. R. Fuller, and R. M. Thomson. 1980, 10p
 Pub. in Proceedings of International Conference on Mechanical Behavior of Materials (3rd), Cambridge, England, August 20-24, 1979, p485-494 1980.

Keywords: *Brittle fracturing, Brittleness, Activation energy, Chemisorption, Reaction kinetics, Stress corrosion, Crack propagation, Theory, Fracture(Mechanics).

A general theoretical framework is developed for chemically assisted fracture in brittle materials. Using the theory of absolute reaction rates, an expression is developed for the subcritical growth of a brittle crack in contact with a reactive gas. The activation energy of the process is analyzed in qualitative terms. Although analytical results can be obtained for certain simplified models, the description presented here was in terms of general arguments that are expected to have wide validity. A distinction is drawn between quantities which have thermodynamic validity, and hence are related to the Griffith criterion for a stable crack, or the K sub ISCC of fracture mechanics, and those quantities which are kinetic in nature and are related to crack growth by thermal fluctuations. The theory is seen to rely heavily on earlier concepts developed for the lattice trapping of crack in brittle solids.

401,762
PB85-141935 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Finite Element and Experimental Evaluation of the J-Integral for Short Cracks.
 Final rept.,
 R. H. Dodds, D. T. Read, and G. W. Wellman. 1983, 23p
 Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
 Pub. in American Society for Testing and Materials STP 791, pI-520-I-542 1983.

Keywords: *Cracks, *Finite element analysis, Evaluation, Reprints, *J integrals, Fracture toughness.

Fitness-for-service assessments of critical metal structures such as piping systems, pressure vessels, and ships require accurate predictive methods for fracture of parts containing small flaws or short cracks. Flaw size, geometry, applied loads, fabricator and material characteristics often combine to produce large scale plastic zones inappropriate for evaluation by linear elastic fracture mechanics. The J-integral is widely advocated as a suitable parameter to characterize both material fracture toughness and the driving force in elastic-plastic fracture. Procedures have been proposed to measure the material fracture toughness, J sub lc, for standard test specimen geometries containing large crack lengths. However, there are no generally accepted methods to predict or experimentally measure the applied J-integral within a structural element containing a small crack (defined here by a crack length to remaining ligament ratio, a/W , < 0.25).

401,763
PB85-145241 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.

Physics of Fracture.

Final rept.,

R. M. Thomson. 1983, 41p

See also PB83-234658. Sponsored by Army Research Office, Research Triangle Park, NC., Office of Naval Research, Arlington, VA., and North Atlantic Treaty Organization, Brussels (Belgium).

Pub. in *Atomistics of Fracture*, Calcatoggio, Corsica, France, May 22-31, 1981, NATO (North Atlantic Treaty Organization) Conference Series 6: Materials Science 5, p167-207 1983.

Keywords: *Fractures(Materials), Cracks, Crystal lattices, Crack propagation, Computations, Reprints, *Fracture(Mechanics).

The title of the conference in its focus on atomistics certainly hints at the physical dimension, and it gives us our point of departure. However, before diving directly into a full-scale discussion of discrete lattices, I will first provide in the next section a very succinct background statement of the elastic description of a brittle crack. In the third section, discrete lattice theories are addressed directly, but first in one dimension for the purpose of emphasizing the kinds of phenomena for which an atomistic theory is important. This discussion points to the application of discrete lattice theories to the rates of atomic and chemical processes at the crack tip. In the fourth section we lay out the statistical mechanical framework for the thermal equilibrium of a crack and for thermally activated crack growth both for intrinsic lattices, and including interactions with external chemical environments. Then follows in section five a more detailed presentation and critique of the theoretical techniques for calculating the structure of lattices containing cracks in two and three dimensions. A short statement of the current status of the quantum theory of binding as it relates to defects will be included. Finally, in the sixth section, the question of stability of the crack in the lattice with respect to the emission of dislocations is discussed. A concluding short section summarizes the crucial points where future progress looks most promising.

20L. Solid-State Physics

401,764
PB83-110296 PC A06/MF A01
 National Bureau of Standards, Washington, DC.

Development of Standards for Superconductors.

Interim rept. Oct 80-Jan 82,

A. F. Clark, L. F. Goodrich, F. R. Fickett, and J. V. Minervini. Jul 82, 120p NBSIR-82-1678

Contract DE-AI01-76PR06010

See also PB81-176141. Sponsored in part by Massachusetts Inst. of Tech, Cambridge.

Keywords: *Superconductors, *Standards, *Critical current.

A cooperative program with the Department of Energy, the National Bureau of Standards, and private industry is in progress to develop standard measurement practices for use in large scale applications of superconductivity. The goal is the adoption of voluntary standards for the critical parameters and other characterizations of practical superconductors. Progress for the period October 1980 through January 1982 is reported. The major effort was the development of a standard test method for critical current, the necessary back-up research, and the coordination of the adoption of the test method and a standard terminology through the subcommittee level in ASTM.

401,765
PB84-179282 PC A10/MF A01
 National Bureau of Standards, Washington, DC. National Measurement Lab.

NBS (National Bureau of Standards) Reactor: Summary of Activities July 1982 through June 1983,
 F. J. Shorten. Apr 84, 206p NBS-TN-1190

Also available from Supt. of Docs. as SN003-003-02566-6. See also PB83-218636.

Keywords: *Neutron beams, *Nuclear research and test reactors, Neutron irradiation, Neutron activation analysis, Neutron diffraction, Neutron radiography, Materials tests, Crystal structure, Nondestructive tests.

This report summarizes all those programs which depend on the NBS reactor. It covers the period from July 1982 through June 1983. The programs range from the use of neutron beams to study the structure and dynamics of materials through nuclear physics and neutron standards to sample irradiations for activation analysis, isotope production, radiation effects studies, neutron radiography, and nondestructive evaluation.

401,766
PB84-216498 PC A04/MF A01
 National Bureau of Standards (NEL), Washington, DC. Semiconductor Materials and Processes Div.

Measurement Techniques for High-Power Semiconductor Materials and Devices: Annual Report, January 1, 1982 to March 31, 1983.

Final rept.,

W. R. Thurber, J. R. Lowney, and W. E. Phillips. Apr 84, 52p NBSIR-84-2838

See also DE-82-021026. Sponsored in part by Department of Energy, Washington, DC. Div. of Electric Energy Systems.

Keywords: *Silicon, *Semiconductor devices, *Measurement, Defects, Computer programs, Charge carriers.

This annual report is the final one in a series which describes NBS research to develop procedures for the effective utilization of deep-level measurements to detect and characterize defects which reduce lifetime or contribute to leakage current in power-device-grade silicon. During this reporting period the previously written computer program for predicting excess-carrier lifetime was revised to calculate more accurately lifetimes for high or low injection conditions and in space-charge regions. Comparisons were made between lifetime measurements on platinum-doped silicon diodes and the predictions of the computer model. As part of the effort to extend the procedures to analyze data from nonexponential transient capacitance measurements, the time dependence of the capacitance-voltage relationship of a heavily platinum-doped silicon diode was measured as a function of bias voltage. Included as appendices are three recent publications resulting from the work. A listing of the lifetime-predicting computer program is also an appendix.

401,767
PB84-218023 Not available NTIS
 National Bureau of Standards, Washington, DC.

Thermoelectric Effect in a Weakly Disordered Inversion Layer Subject to a Quantizing Magnetic Field.

Final rept.,

M. Johnson, and S. M. Girvin. 15 Feb 84, 8p

Pub. in *Physical Review B* 29, n4 p1939-1946, 15 Feb 84.

Keywords: *Thermoelectricity, Magnetic fields, Electron gas, Correction, Reprints, Two dimensional, Inversions.

The authors demonstrate that the usual Kubo formula for thermal response functions is invalid if a magnetic field is present. There exists a fundamental correction due to lack of time reversal symmetry. In addition to being of general importance in the theory of transport, the authors show in particular that this leads to a novel thermoelectric effect in a weakly disordered two-dimensional electron gas subject to a strong magnetic field. The thermopower tensor is calculated within the self-consistent Born approximation using a generalized Mott formula which is derived.

401,768
PB84-218478 Not available NTIS
 National Bureau of Standards, Washington, DC.

Magnetic and Crystallographic Structure of Y6Mn23D23.

Final rept.,

K. Hardman-Rhyne, J. J. Rhyne, E. Prince, C.

Crowder, and W. J. James. 1 Jan 84, 7p

Sponsored in part by Department of the Army, Washington, DC.

Pub. in *Physical Review B* 29, n1 p416-422, 1 Jan 84.

Keywords: *Crystal structure, *Antiferromagnetism, Yttrium compounds, Deuterium compounds, Face centered cubic lattices, Tetragonal lattices, Neutron diffraction, Cryogenics, Reprints, *Manganese yttrium hydrides, Manganese compounds, Magnetic ordering.

The magnetic behavior of Y6Mn23 is dramatically altered upon hydrogenation (or deuteration). In this

study, it has been found by means of high resolution powder diffraction and Rietveld refinement techniques, that the crystallographic structure is distorted from face-centered cubic (Fm3m) at 295K to a primitive tetragonal structure at 4K in which deuterium atoms are automatically ordered. Y6Mn23 is a ferromagnetic compound with T_c = 486K, and bulk magnetization of 13.2 (μ_B/f.u. (formula unit)). After deuteration of Y6Mn23 to the composition of Y6Mn23D23 low temperature scattering data (T < 175K) show that the b and (f sub 2) sites are antiferromagnetic and the d and (f sub 1) sites have no spontaneous magnetic moment.

401,769
PB84-218700 Not available NTIS
 National Bureau of Standards, Washington, DC.

Magnetic and Crystallographic Structure of Th6Mn23D(x).

Final rept.,

K. Hardman-Rhyne, H. K. Smith, and W. E. Wallace.

1984, 11p

Pub. in *Jnl. of the Less-Common Metals* 96, p201-211 *1984.

Keywords: *Crystal structure, Deuterium compounds, Face centered cubic lattices, Tetragonal lattices, Neutron diffraction, Magnetic moments, Cryogenics, Reprints, *Manganese thorium hydrides, *Magnetic ordering, Manganese compounds, Thorium compounds.

Th6Mn23D16 and Th6Mn23D30 were studied by neutron diffraction profile refinement methods. At low temperatures, below 78 K, Th6Mn23D16 undergoes a crystallographic change from face centered cubic, Fm3m, to primitive tetragonal, P4/mmm. This compound has no long range magnetic ordering down to temperatures of 4 K. Th6Mn23D30 retains face centered cubic symmetry even at 4 K but exhibits ferromagnetism with a Curie temperature of 329 K. All moments are coupled parallel except the b site which has one Mn moment and is coupled antiparallel to the other 22 Mn moments in the d, (f sub 1) and (f sub 2) sites. The Mn magnetic moments are much less than those of Y6Mn23.

401,770
PB84-218726 Not available NTIS
 National Bureau of Standards, Washington, DC.

Interacting Electrons in Two-Dimensional Landau Levels. Results for Small Clusters.

Final rept.,

S. M. Girvin, and T. Jach. 15 Oct 83, 4p

Pub. in *Physical Review B: Solid State*, v28 n8 p4506-4509, 15 Oct 83.

Keywords: *Electron gas, Magnetic fields, Wave functions, Interactions, Hall effect, Quantum theory, Reprints, *Landau levels, Two dimensional.

The authors study the two-dimensional electron gas in a quantizing magnetic field for the cases of Coulomb and harmonic interactions among the electrons. Numerical solutions for the quantum states of clusters of up to five electrons show that the strength of the excitation gap is a strongly oscillating function of the density not unlike what is observed in the anomalous quantum Hall effect. The authors present analytic results for the case of harmonic interactions and show that the variational wave function recently proposed by Laughlin for the Coulomb problem is in fact an exact eigenstate of the harmonic problem.

401,771
PB84-218742 Not available NTIS
 National Bureau of Standards, Washington, DC.

Short and Long-Range Magnetic Ordering of Y6(Fe(1-x)Mn(x))23 Compounds Using Neutron Scattering Techniques.

Final rept.,

K. Hardman-Rhyne, and J. J. Rhyne. 1983, 14p

Pub. in *Jnl. of the Less-Common Metals* 94, p23-36 1983.

Keywords: Antiferromagnetism, Yttrium alloys, Iron alloys, Manganese alloys, Neutron diffraction, Magnetic moments, Crystal lattices, Reprints, *Magnetic ordering.

Neutron diffraction studies of the Y6(Fe(1-x)Mn(x))23 system reveal the presence of substantial preferential atomic ordering of Fe and Mn atoms on the four transition metal crystallographic sites. Throughout the entire compositional range, Mn atoms prefer to occupy the (f sub 2) site and Fe atoms the (f sub 1) site. Neutron

diffraction profile refinements show no long range magnetic ordering occurring in the compositional range from $x = 0.35$ to 0.75 . The average Fe moments on each of the sites are reduced in the Fe-rich ternaries and remain ferromagnetically coupled. The manganese atoms are nonmagnetic.

401,772

PB84-218833 Not available NTIS
National Bureau of Standards, Washington, DC.

Electrical Properties.

Final rept.,

F. R. Fickett. Jul 83, 39p

Pub. in *Materials at Low Temperatures*, p163-201 Jul 83.

Keywords: *Electrical properties, *Metals, *Alloys, *Cryogenics, Materials, Polymers, Electrical resistance, Electrical resistivity, Electrical conductivity.

This chapter gives a review of the electrical properties of materials at cryogenic temperatures. Measurement techniques, the data base, and uses of the data are presented. The emphasis is on metals and alloys of technological importance; a topic which covers a large range of materials. The treatment of theory and of measurement techniques is primarily for the user interested in the more practical aspects. In every instance, however, extensive references are given that allow the reader to pursue the subject further. The text is essentially that of NBS TN 1053 with minor modifications.

401,773

PB84-218932 Not available NTIS
National Bureau of Standards, Washington, DC.

Low Energy Excitations in (KBr)_{1-x}(KCN)_x in the Orientational Glass State.

Final rept.,

J. J. DeYoreo, M. Meissner, R. O. Pohl, J. M. Rowe, and J. J. Rush. 19 Sep 83, 4p

Pub. in *Physical Review Letters*, v51 n12 p1050-1053, 19 Sep 83.

Keywords: *Thermal conductivity, *Potassium bromide, *Potassium cyanides, *Excitation, Specific heat, Cryogenics, Reprints, Amorphous materials, Spin glasses.

The thermal conductivity of single crystal (KBr)_{1-x}(KCN)_x, $0.05 \leq x \leq 0.5$, in the temperature range 0.08 - 100 K shows behavior characteristic of amorphous solids. Furthermore, for $x = 0.25$, an abrupt change in the conductivity is seen in the vicinity of 70 K. The low temperature specific heats ($T < 2.5$ K), measured on long (about 50s) and on short (about ≤ 0.2 ms) time scales also are identical to those found in amorphous solids. The authors propose that the KBr-KCN system provides a connecting link between the low energy excitations in amorphous solids and in spin glasses.

401,774

PB84-219039 Not available NTIS
National Bureau of Standards, Washington, DC.

Dissipation and Dynamic Non-Linear Behavior in the Quantum Hall Regime.

Final rept.,

M. E. Cage, R. F. Dziuba, B. F. Field, E. R. Williams, and S. M. Girvin. 10 Oct 84, 4p

Pub. in *Physical Review Letters*, v51 n15 p1374-1377, 10 Oct 84.

Keywords: *Hall effect, Nonlinear systems, Gallium arsenides, Quantum theory, Reprints, Heterostructures, Critical current, Transients.

Dynamic nonlinear behavior is reported at high currents in the Quantum Hall regime of GaAs heterostructures, resulting from breakdown of the dissipationless current flow. It is demonstrated that this breakdown is spatially localized and transient switching is observed on microsecond time scales among a set of distinct dissipative states. A simple macroscopic picture is proposed to account for these novel phenomena.

401,775

PB84-219997 Not available NTIS
National Bureau of Standards, Washington, DC.

Temperature-Dependent Sinusoidal Magnetic Order in the Superconductor HoMo₆Se₈.

Final rept.,

J. W. Lynn, J. A. Gotaas, R. W. Erwin, R. A. Ferrell, and J. K. Bhattacharjee. 9 Jan 84, 4p

Pub. in *Physical Review Letters* 52, n2 p133-136, 9 Jan 84.

Keywords: *Superconductors, *Phase transformations, Holmium compounds, Selenides, Cryogenics, Neutron scattering, Reprints, *Holmium molybdenum selenides, *Magnetic ordering, Temperature dependence, Molybdenum compounds, Order parameters.

A magnetic phase transition ($T_M = 0.53$ K) to a long-period (about 100Å) magnetic state has been observed via neutron scattering in the superconductor ($T_{sub c} = 5.6$ K) HoMo₆Se₈. The characteristic wave vector ($q_{sub c}$) is strongly temperature dependent even though no higher-order satellites are observed. With use of a Ginzburg-Landau model it is found that the temperature dependence of ($q_{sub c}$) can be explained as due to a renormalization of the superconducting order parameter caused by the coupling to the local magnetization density.

401,776

PB84-222611 Not available NTIS
National Bureau of Standards, Washington, DC.

Spin-Polarized Electron Scattering Studies of the Ferromagnetic Glass Fe_{81.5}B_{14.5}Si₄.

Final rept.,

J. Unguris, D. T. Pierce, and R. J. Celotta. 1 Feb 84, 6p

Sponsored in part by Office of Naval Research, Arlington, VA.

Pub. in *Physical Review B* 29, n3 p1381-1386, 1 Feb 84.

Keywords: *Ferromagnetic materials, Electron beams, Polarization (Spin alignment), Silicides, Electron scattering, Elastic scattering, Inelastic scattering, Surface properties, Magnetic hysteresis, Glass, Reprints, *Electron spin polarization, *Boron iron silicides, Polarized beams, Boron compounds, Iron compounds, Low energy electron diffraction.

Low-energy (20-500)-eV spin-polarized electrons were used to probe the magnetic surface properties of the ferromagnetic metallic glass Fe_{81.5}B_{14.5}Si₄. The spin-independent intensity and the spin-dependent asymmetry of the elastic scattering were measured as a function of applied magnetic field, electron energy, scattering angle, and angle of incidence. The scattering is liquidlike with no crystalline diffraction effects. Comparisons are made with scattering from the magnetic glass Fe₄₀Ni₄₀B₂₀ and an iron single crystal. Surface hysteresis curves as measured by the spin-dependent elastic scattering are very sensitive to ion-sputtering damage and to subsequent annealing. The asymmetry of the inelastic scattering was also measured for various primary energies and was found to closely resemble the elastic scattering asymmetry.

401,777

PB84-223791 Not available NTIS
National Bureau of Standards, Washington, DC.

Intrinsic Brittle/Ductile Criterion.

Final rept.,

I. H. Lin. 1983, 1p

Pub. in *Jnl. of Materials Science Letters* 2, p295 1983.

Keywords: *Brittle fracturing, *Fracture properties, *Ductility, Fractures (Materials), Dislocations, Cracks, Reprints.

This note reviews two intrinsic brittle/ductile criteria developed by Kelly, Tyson, and Cotrell (KTC), and Rice and Thomson (RT). The KTC criterion in terms of theoretical strengths is shown to be physically equivalent to the dislocation emission approach of RT.

401,778

PB84-226299 Not available NTIS
National Bureau of Standards, Washington, DC.

Comparison of Models of the Built-In Electric Field in Silicon at High Donor Densities.

Final rept.,

J. R. Lowney, and J. C. Geist. May 84, 4p

Pub. in *Jnl. of Applied Physics* 55, n10 p3624-3627 May 84.

Keywords: *Semiconductors (Materials), *Silicon, *Electric fields, *Photodiodes, *Energy gap, Holes (Electron deficiencies), Semiconductor doping, Quantum efficiency, Reprints.

The built-in electric field for holes due to donor-density gradients in n-type silicon is calculated at 300 K for donor densities between 1×10^{18} to the 18th power and 1×10^{19} to the 20th power/cc. The calculation is based upon a recent model of band-gap narrowing that includes the effects of ionized impurities, many-body interactions, and an estimate of spatial fluctuations of the band-gap edge caused by the random distribution of donor atoms in the silicon crystal. This model of band-gap narrowing differs significantly from a number of other band-gap narrowing models currently in use in that it agrees with the band-gap narrowing measured optically at 35 and 300 K rather than that inferred from electrical measurements. The built-in electric field based on this model, which also differs significantly from the results of most previous models, decreases significantly above a donor density of 1×10^{18} to the 19th power/cc with a reversal of the field above 7×10^{19} to the 19th power/cc. The implications of this work for photodiodes are discussed.

401,779

PB84-226315 Not available NTIS
National Bureau of Standards, Washington, DC.

Statistical Comparisons of Data on Band-Gap Narrowing in Heavily Doped Silicon: Electrical and Optical Measurements.

Final rept.,

H. S. Bennett, and C. L. Wilson. 15 May 84, 6p

Pub. in *Jnl. of Applied Physics* 55, n10 p3582-3587, 15 May 84.

Keywords: *Semiconductors (Materials), *Energy gap, *Silicon, Semiconductor doping, Photoluminescence, Cryogenics, Comparison, Reprints, Computer applications.

A system of subroutines for iteratively reweighted least squares (IRLS) computations has been applied to the published measured and theoretical data on band-gap narrowing in heavily doped silicon. The data include electrical and optical measurements at room temperature, photoluminescence and optical measurements for temperatures below 35 K, and theoretical calculations at 300 and 0 K. The IRLS procedure allows a clear graphical comparison of the various experimental and theoretical data in band-gap narrowing to be made. The results are (1) band-gap changes determined by the optical absorption are consistent at both 300 K and at temperatures below 35 K with recent theoretical calculations, (2) the electrical and optical measurements are not consistent with each other, and (3) the low temperature optical absorption data and the photoluminescence data are not consistent with each other.

401,780

PB84-239938 Not available NTIS
National Bureau of Standards, Washington, DC.

Inelastic Scattering of Electrons in Solids.

Final rept.,

C. J. Powell. 1983, 23p

Pub. in *Electron Beam Interactions With Solids*, p19-31 1983.

Keywords: *Electron scattering, Inelastic scattering, Ionization, Mean free path, Radiation damage, Cross sections, Microanalysis, Photoelectrons, Auger electrons, Solids, Reviews, Reprints, Auger electron spectroscopy, Electron probe microanalysis, X ray photoelectron spectroscopy, Electron energy loss spectroscopy.

The principal mechanisms and available data for the inelastic scattering of electrons in solids are reviewed. The processes relevant for electron-probe microanalysis, electron energy-loss spectroscopy, Auger-electron spectroscopy, and x-ray photoelectron spectroscopy are described, and examples of relevant electron

energy-loss data are shown. The discussion is based on the dielectric description of inelastic scattering and treats processes important in the excitation of both core electrons and valence electrons. Information is given on the cross sections for excitations of valence electrons, cross sections for ionization of core levels, inelastic mean free paths of Auger electrons and photoelectrons in solids, and radiation damage.

401,781
PB84-244235 Not available NTIS
 National Bureau of Standards, Washington, DC.
Surface Electronic Structure and Screening of 3d-Band Holes in Cu(100).
 Final rept.,
 W. F. Egelhoff, Jr. 15 Apr 84, 3p
 Pub. in Phys. Rev. B 29, n8 p4769-4771, 15 Apr 84.

Keywords: *Copper, Band structure of solids, Surfaces, Reprints, *Electronic structure.

Analysis of the Cu(100) surface electronic structure demonstrates that in Cu holes in the 3d-band are screened by 4s and 4p electrons as effectively as deep core holes. It is concluded that although 3d holes are mobile, the 4s-4p screening charge is even more mobile so that in photoemission the final state should be viewed as a 3d hole and its screening charge propagating through the lattice together.

401,782
PB84-244789 Not available NTIS
 National Bureau of Standards, Washington, DC.
Thermodynamic Properties of BCC Crystals at High Temperatures. 1. The Alkali Metals.
 Final rept.,
 R. A. MacDonald, R. C. Shukla, and D. K. Kananer.
 15 Jun 84, 11p
 Pub. in Physical Review B 29, n12 p6489-6499, 15 Jun 84.

Keywords: *Alkali metals, *Lithium, *Sodium, *Potassium, *Rubidium, *Cesium, *Thermodynamic properties, Body centered cubic lattices, Bulk modulus, Thermal expansion, Helmholtz free energy, Specific heat, Reprints.

The authors have calculated the thermodynamic properties of monatomic bcc crystals at high temperatures from the Helmholtz free energy, $F(V,T)$, for a second-neighbor, central-force model of the bcc lattice. $F(V,T)$ includes cubic and quartic anharmonic terms in perturbation theory evaluated in the high temperature limit. Numerical results have been obtained for the alkali metals, Li, Na, K, Rb and Cs.

401,783
PB84-244888 Not available NTIS
 National Bureau of Standards, Washington, DC.
Particle-Hole Symmetry in the Anomalous Quantum Hall Effect.
 Final rept.,
 S. M. Girvin. 15 May 84, 3p
 Pub. in Physical Review B 29, n10 p6012-6014, 15 May 84.

Keywords: *Hall effect, Gallium arsenides, Quantum theory, Abnormalities, Holes(Electron deficiencies), Reprints, *Quantum Hall effect.

This paper explores the uses of particle-hole symmetry in the study of the anomalous quantum Hall effect. A rigorous algorithm is presented for generating the particle-hole dual of any state. This is used to derive Laughlin's quasi-hole state from first principles and to show that this state is exact in the limit ν approaches 1, where ν is the Landau level filling. It is also rigorously demonstrated that the creation of m quasi-holes in Laughlin's state with $\nu = 1/m$ is precisely equivalent to creation of one true hole. The charge-conjugation procedure is also generalized to obtain an algorithm for the generation of a hierarchy of states of arbitrary rational filling factor.

401,784
PB84-244904 Not available NTIS
 National Bureau of Standards, Washington, DC.
Formalism for the Quantum Hall Effect: Hilbert Space of Analytic Functions.
 Final rept.,
 S. M. Girvin, and T. Jach. 15 May 84, 9p
 Pub. in Physical Review B 29, n10 p5617-5625, 15 May 84.

Keywords: *Hall effect, Quantum theory, Hilbert space, Analytic functions, Electron gas, Reprints, *Quantum Hall effect, Two dimensional.

The authors develop a general formulation of quantum mechanics within the lowest Landau level in two dimensions. Making use of Bargmann's Hilbert space of analytic functions, they obtain a simple algorithm for the projection of any quantum operator onto the subspace of the lowest Landau level. With this scheme, they obtain the Schroedinger equation in both real space and coherent state representations. A Gaussian interaction among the particles leads to a particularly simple form in which the eigenvalue condition reduces to a purely algebraic property of the polynomial wave function. Finally, the authors formulate path integration within the lowest Landau level using the coherent state representation. The techniques developed here should prove convenient for the study of the anomalous quantum Hall effect and other phenomena involving electron-electron interactions.

401,785
PB84-246081 Not available NTIS
 National Bureau of Standards, Washington, DC.
Order-Disorder Phenomena.
 Final rept.,
 S. C. Greer. 1981, 33p
 Pub. in Encyclopedia of Physics, p720-722 1981.

Keywords: *Order disorder transformations, *Phase transformations, Critical phenomena, Ising model, Superlattices.

The terminology of order-disorder phenomena is described, examples are given, and the theories of such phenomena are briefly presented.

401,786
PB85-104826 Not available NTIS
 National Bureau of Standards, Washington, DC.
Interaction of Intense Picosecond Pulses of 2.7 Micrometer Photons with Germanium.
 Final rept.,
 G. W. Bryant, P. Kelley, D. Ritchie, P. Braunlich, and A. Schmid. 1982, 16p
 Pub. in Physical Review B 25, n4 p2587-2602, 15 Feb 82.

Keywords: *Germanium, *Charge carriers, Laser beams, Light pulses, Near infrared radiation, Reprints, Picosecond pulses, Solid state plasmas.

Computer simulations of the propagation of intense picosecond laser pulses of 2.7 micrometer photons through germanium have been performed to determine the extent of carrier creation and carrier heating that occurs for a variety of pulse widths and intensities.

401,787
PB85-118404 Not available NTIS
 National Bureau of Standards, Washington, DC.
Analysis of High Resistivity Semiconductor Specimens in an Energy-Compensated Time-of-Flight Atom Probe.
 Final rept.,
 A. J. Melmed, M. Martinka, T. Sakurai, Y. Kuk, and S. M. Girvin. 1981, 2p
 Pub. in Applied Physics Letters 39, n5 p416-417, 1 Sep 81.

Keywords: *Semiconductors(Materials), *Silicon, Reprints, Atom probe field ion microscopy, Time-of-flight method, High resistivity, Field ion microscopy.

It is shown that high resistivity semiconductor specimens (at least up to 8600, and probably up to 24000 ohm cm) can be analyzed in a conventional energy-compensated ToF atom probe by using pulses of longer than usual duration, and that the necessary pulse width increases, with specimen resistance.

401,788
PB85-118461 Not available NTIS
 National Bureau of Standards, Washington, DC.
Superconducting Tunnel-Junction Refrigerator.
 Final rept.,
 R. G. Melton, J. L. Paterson, and S. B. Kaplan. 1980, 10p
 Pub. in Physical Review B 21, n5 p1858-1867, 1 Mar 80.

Keywords: *Refrigerators, *Electron tunneling, *Superconductors, Elementary excitations, Phonons, Electrons, Cryogenics, Aluminum, Lead(Metal), Tin, Aluminum oxide, Reprints, *Cryogenic refrigerators.

The dc current through an S(1)-S(2) tunnel junction, with $\delta(2)$ greater than $\delta(1)$, when biased with $eV < \delta(1) + \delta(2)$ will lower the energy in S(1).

This energy reduction will be shared by the phonons and electrons. This device is shown to be analogous to a thermoelectric refrigerator with an effective Peltier coefficient π approximately $= \delta(1)/e$. Tunneling calculations yield the cooling power, the electrical power supplied by the bias supply, and the cooling efficiency.

401,789
PB85-120681 Not available NTIS
 National Bureau of Standards, Washington, DC.
Polarized LEED Study of Surface Magnetism.
 Final rept.,
 D. T. Pierce, R. J. Celotta, G. C. Wang, G. P. Felcher, and S. D. Bader. 1980, 2p
 See also CONF79-090915.
 Pub. in Jnl. of Magnetism and Magnetic Materials 15, n8 p1583-1584 Jan 80.

Keywords: *Magnetization, *Nickel, Ferromagnetic materials, Surface properties, Electron beams, Electron spin, Magnetic fields, Reprints, Low energy electron diffraction, Polarized beams, Temperature dependence.

The surface magnetization of ferromagnetic Ni(110) has been observed via the use of a spin polarized electron beam. The spin dependence of the scattered electron intensity was measured as a function of external magnetic field strength and temperature.

401,790
PB85-131068
 (Order as PB85-130078, PC A99/MF A01)
 Technische Univ. Muenchen, Garching (Germany, F.R.), Physik-Dept.
Quantized Hall Resistance in Two-Dimensional Systems.
 K. von Klitzing, H. Obloh, G. Ebert, J. Knecht, and K. Ploog. 1984, 10p
 Prepared in cooperation with Max-Planck-Inst. fuer Festkoerperforschung, Stuttgart (Germany, F.R.).
 Included in Precision Measurement and Fundamental Constants II, p519-528 1984.

Keywords: *Fundamental constants, *Hall effect, Metal oxide transistors, Electron gas, Gallium arsenides, Field effect transistors, *Quantum Hall effect, Fine structure constant, Heterostructures, Two dimensional, Metal oxide semiconductors, Aluminium gallium arsenides.

After the Josephson effect, a second solid state quantum effect--the quantized Hall resistance--seems to be useful to determine fundamental constants. The authors will demonstrate that electrons at the interface between two semiconductors or at a semi-conductor-insulator interface may form at low temperatures a degenerate two-dimensional electron gas with discrete energy levels (Landau levels), if a strong magnetic field is applied perpendicular to the interface. Under experimental conditions where an integer number i of Landau levels is fully occupied with electrons, the value of the Hall resistance $R(H)$ (ratio between Hall voltage and current through the sample) becomes quantized with values which depend only on fundamental constants: $R(H) = h(e \text{ squared})^i$ ($h =$ Planck constant, $e =$ elementary charge). The authors experiments on (100) silicon MOSFETs (Metal-Oxide-Semiconductor Field-Effect-Transistors) and GaAs-Al(x)Ga(1-x) As heterostructures show that the measured value of the quantized Hall resistance is independent of device parameters.

401,791
PB85-131076
 (Order as PB85-130078, PC A99/MF A01)
 Electrotechnical Lab., Sakura (Japan).
Hall Effect in Silicon MOS Inversion Layers for $h/(e \text{ squared})$ Determination.
 C. Yamanouchi, K. Yoshihiro, J. Kinoshita, K. Inagaki, and J. Moriyama. 1984, 6p
 Prepared in cooperation with Gakushuin Univ., Tokyo (Japan).
 Included in Precision Measurement and Fundamental Constants II, p529-534 1984.

Keywords: *Hall effect, Metal oxide transistors, Field effect transistors, Measurement, Silicon, Cryogenics, Precision, *Quantum Hall effect, High magnetic field research, Metal oxide semiconductors.

The quantized Hall conductivity has been measured in n-channel inversion layers of silicon metal-oxide-semiconductor field effect transistor devices at tempera-

tures below 1.4 K using magnetic fields up to 15 T with improved accuracy and resolution. This work aimed to reexamine a new method for $h^2/(e \text{ squared})$ determination proposed by von Klitzing, Dorda, and Pepper. The result, which corresponds to $h^2/4(e \text{ squared})$, and its one standard deviation uncertainty are $-1/(\sigma \text{ sub } xy) = (6453.1969 + \text{ or } - 0.0046) \Omega(\text{ETL})$ or $(6453.1969 + \text{ or } - 0.0045) \Omega(\text{ABS})$. This result agrees with that obtained by other methods to 1 ppm.

401,792

PB85-131084

(Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

Cryogenic Method for the Determination of the Fine-Structure Constant by the Quantized Hall Resistance,

E. Braun, P. Gutmann, G. Hein, F. Melchert, and P. Warnecke. 1984, 3p

Prepared in cooperation with Technische Univ. Muenchen, Garching (Germany, F.R.). Physik-Dept.

Included in Precision Measurement and Fundamental Constants II, p535-537 1984.

Keywords: *Fundamental constants, *Hall effect, Cryogenics, *Quantum Hall effect, *Fine structure constant, SQUID devices.

Recently a determination of the fine-structure constant with a relative uncertainty of 1.3 parts in one million has been carried out. Since then attempts have been made to construct an experimental setup based on a potentiometric method using modern cryogenic measurement techniques, which should lead to a significant decrease of the uncertainty.

401,793

PB85-131092

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Electrical Measurements and Standards Div.

Status of the NBS-NRL (National Bureau of Standards-National Research Lab.) Determination of the Fine-Structure Constant Using the Quantized Hall Resistance Effect,

M. E. Cage, R. F. Dziuba, B. F. Field, C. F. Lavine, and R. J. Wagner. 1984, 3p

Prepared in cooperation with Naval Research Lab., Washington, DC. Electronics Technology Div.

Included in Precision Measurement and Fundamental Constants II, p539-541 1984.

Keywords: *Fundamental constants, *Hall effect, Metal oxide transistors, Field effect transistors, Silicon, Measurement, Precision, Superconducting magnets, *Quantum Hall effect, High magnetic field research.

Measurements of quantized Hall steps have been made on (100) Si MOSFET devices using a potentiometric method. In this approach, the quantized Hall resistance at a step is compared to a nominally equal room temperature reference resistor. The standard deviation of a single observation is 2 parts in 10 million at 10 microamps source-drain current. The measurement system is described, along with a report on some of the problems encountered.

401,794

PB85-131100

(Order as PB85-130078, PC A99/MF A01)
National Physical Lab., Teddington (England). Div. of Electrical Science.

Use of a Cryogenic Current Comparator to Determine the Quantized Hall Resistance in a Silicon MOSFET,

A. Hartland. 1984, 6p

Included in Precision Measurement and Fundamental Constants II, p543-548 1984.

Keywords: *Hall effect, Metal oxide transistors, Field effect transistors, Comparators, Electric bridges, Measurement, Cryogenics, Silicon, *Quantum Hall effect, SQUID devices.

A measurement system based on a cryogenic current comparator bridge is described. The system has the capability of being able to determine the ratio of a 6.453 kilohm and 100 ohm resistors, at 295 K, with an uncertainty (1 sigma) of 2 parts in 10 million when the larger resistor is energized with a current of 10 microamps. The suggested application of this technique to the determination of the quantized Hall resistance in silicon MOSFETs is described, and sources of possible error are assessed.

401,795

PB85-131118

(Order as PB85-130078, PC A99/MF A01)
Bell Labs., Murray Hill, NJ.

Resistance Standard Using the Quantized Hall Resistance of GaAs-Al(x)Ga(1-x)As Heterostructures,

A. C. Gossard, and D. C. Tsui. 1984, 3p

Included in Precision Measurement and Fundamental Constants II, p549-551 1984.

Keywords: *Electrical resistance, *Hall effect, *Standards, Superconducting magnets, Gallium arsenides, Electron gas, Cryogenics, *Resistance standards, *Quantum Hall effect, Aluminum gallium arsenides, Heterostructures, Two dimensional, High magnetic field research, Fine structure constant.

The authors have observed quantization of the Hall resistance of the two-dimensional electron gas in GaAs-Al(x)Ga(1-x)As heterostructures. The quantized Hall resistance is given by $\rho_{xy} = h^2/(e \text{ squared})(N + 1/2)$ where N is the quantum number of the Landau level immediately below E(F). The authors results show that the quantized ρ_{xy} as given by this relation does not depend on temperature T, magnetic field B, and the electron mobility μ of the sample, which in this experiment is varied from $\mu = 1.8 \text{ (m squared)/V.s}$ to $6.9 \text{ (m squared)/V.s}$. In other words, B, T, and μ must suffice to reach the quantum regime, which is evidenced by the vanishing of the parallel resistance ρ_{xx} , but the value of quantized ρ_{xy} is independent of them. In the authors samples, this quantum regime is reached for $B \text{ approx } = \text{ or } > 3 \text{ T}$ at $T = 1.2 \text{ K}$ and for $B \text{ approx } = \text{ or } > 4 \text{ T}$ at $T = 4.2 \text{ K}$. This modestly low magnetic field requirement makes this system a practical primary resistance standard.

401,796

PB85-131126

(Order as PB85-130078, PC A99/MF A01)
Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

Quantitative Theory for the Determination of $h/(e \text{ squared})$ from the Hall Effect in Two-Dimensional Conductors,

L. Bliiek, and G. Hein. 1984, 4p

Included in Precision Measurement and Fundamental Constants II, p553-556 1984.

Keywords: *Fundamental constants, *Hall effect, Magnetoresistivity, *Fine structure constant, *Quantum Hall effect, Two dimensional.

In experiments on two-dimensional conductors, steps proportional to $(e \text{ squared})/h$ have been observed in the quotient of the electric current and the Hall voltage. They can be explained on the basis of the well-established theory of the Shubnikov-De Haas effect, provided the dependence of the scattering lifetime on the density of states is consistently taken into account. Results of numerical calculations of the Hall voltage and of the electrical resistance agree closely with published experimental data.

401,797

PB85-131134

(Order as PB85-130078, PC A99/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Quantum Hall Effect: Role of Inversion Layer Geometry and Random Impurity Potential,

R. W. Rendell, and S. M. Girvin. 1984, 4p

Included in Precision Measurement and Fundamental Constants II, p557-560 1984.

Keywords: *Hall effect, Fundamental constants, Electrical resistance, Standards, Impurities, Measurement, Scattering, Errors, *Quantum Hall effect, Fine structure constant, Resistance standards, Density of states.

The recently discovered quantum Hall effect offers the potential for a new precision determination of the fine-structure constant and establishment of a quantum standard of resistance. The authors present here a discussion of possible sources of error associated with finite sample size. In addition, they present a preliminary report on an investigation of the density of states between Landau levels in the presence of a model impurity potential which is based on a non-perturbative variational calculation using recently developed field theoretic techniques.

401,798

PB85-135424

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Monte Carlo Calculation of Order on the Triangular Ising Lattice with Next-Nearest-Neighbour Interactions.

Final rept.,

P. H. E. Meijer, and G. W. Cunningham. 1977, 6p

Pub. in Physical Review B 15, n7 p3436-3441, 1 Apr 77.

Keywords: *Ferromagnetism, *Antiferromagnetism, *Phase transformations, Magnetic moments, Monte Carlo method, Interactions, Reprints, *Ising model, *Magnetic ordering, Two dimensional.

This paper deals with a Monte Carlo calculation of a two-dimensional spin system on a triangular lattice. The interactions considered are: (1) Ferromagnetic nearest neighbor, (2) Antiferromagnetic nearest neighbor and (3) Antiferromagnetic nearest neighbor coupling with ferromagnetic next nearest neighbor coupling. The results of 1 and 2 are compared with the Onsager calculations of Houtappel and Wannier. The authors found minor discrepancies in both calculations. For the third model they found a new low temperature transition, not predicted by the Bethe-Peierls calculations. The new phase is displayed. The authors propose a modification of the Monte Carlo procedure, using the conditional probability and found faster convergence with this method. The results described above were obtained using either method.

401,799

PB85-136257

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Strain Effects in Superconducting Compounds - An Overview and Synthesis.

Final rept.,

J. W. Ekin. Jul 84, 14p

Pub. in Advances in Cryogenic Engineering 30, p823-836 Jul 84.

Keywords: *Superconductors, *Strain, *Intermetallics, Critical field, Sensitivity, Crystal structure, Reviews, Niobium inorganic compounds, Vanadium inorganic compounds, Niobium intermetallics, Tin intermetallics, Gallium intermetallics, Vanadium intermetallics, Cyanides, Nitrides, Silicides, Cryogenics, Reprints, Critical current, Critical temperature, Niobium cyanides, Niobium nitrides, Niobium aluminum, Niobium germanium, Niobium tin, Gallium vanadium, Vanadium silicides.

An overview of the effect of strain on the critical current, critical field, and critical temperature of A15, B1, and C15 superconductors is presented. Reversible elastic strain effects in many A15 superconductors have been measured, analyzed, and compared in terms of simple strain scaling parameters. In addition, a new critical parameter -- critical strain ($\epsilon_{\text{sub } c}$) -- is described and used to characterize the strain sensitivity of these materials. The elastic strain effect is shown to be strongly dependent on crystal structure; it is nonexistent in all superconductors with the B1 and C15 crystal structure tested thus far. Possible mechanisms for explaining the elastic strain effect are briefly described.

401,800

PB85-141471

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Strongly Coupled Non-Neutral Ion Plasma.

Final rept.,

J. J. Bollinger, and D. J. Wineland. 23 Jul 84, 4p

Pub. in Physical Review Letters 53, n4 p348-351, 23 Jul 84.

Keywords: *Ions, Radiation pressure, Plasmas(Physics), Reprints, Laser cooling, Beryllium 9, Ion traps.

Radiation pressure from a laser has been used to cool and compress small non-neutral plasmas of (9)Be(+) ions confined by static electric and magnetic fields. A second laser has been used as a probe to measure ion densities of 20 million/cc and ion temperatures below 100 mK. A coupling, gamma, as large as 10 has been obtained indicating that the plasma is strongly coupled. In the future, couplings large enough to observe a liquid-solid phase transition should be accessible.

401,801
PB85-142412 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Surface-Residual-Stress Evaluation Using Horizontally Polarized Shear Waves.
 Final rept.,
 R. B. King, and C. M. Fortunko. 1 Jun 84, 7p
 Pub. in Jnl. of Applied Physics 55, n11 p3978-3983, 1 Jun 84.

Keywords: *Residual stress, *Stresses, *Surfaces, Elastic waves, Anisotropy, Nondestructive tests, Polarization, Reprints, Secondary waves, S waves.

In this paper a new theory and experimental method are described for evaluation of surface residual stresses in inhomogeneous, anisotropic materials. The method is based on the use of horizontally polarized shear waves (SH-waves) that propagate at a grazing angle with respect to the surface of a sample. In addition, a new theory is presented for grazing SH-waves propagating through a body in which the stress distribution varies with depth. It is shown that, to first order, the average velocity of the grazing SH-waves is dependent only on the surface values of residual stress. Based on the use of electromagnetic-acoustic transducers (EMATs) to generate and detect grazing SH-waves, preliminary experimental verification of the theory is presented.

401,802
PB85-142537 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Applications of Polarized Electron Sources Utilizing Optical Orientation in Solids.
 Final rept.,
 D. T. Pierce, and R. J. Celotta. 1984, 6p
 Sponsored by Office of Naval Research, Arlington, VA. Pub. in Optical Orientation, p259-264 1984.

Keywords: *Electron scattering, *Polarization (Spin alignment), Optical pumping, Parity, Surfaces, Gallium arsenides, Semiconductors, Band structure of solids, Sources, Reprints, *Electron spin polarization, *Magnetism, Electron-atom collisions, Exchange interactions.

The optical orientation of electron spin in semiconductors provides the basis for the most intense and well controlled source of spin polarized electrons. The method of polarized electron production, the characteristics of the source, and possible ways to increase the polarization are reviewed. Polarized electron sources using optical orientation in GaAs have been applied to a variety of experiments in atomic, condensed matter, and particle physics and a few illustrative examples are presented. A 'perfect' polarized electron-atom scattering experiment is discussed in which the quantum amplitudes and phases which are spin dependent owing to the spin-orbit interaction are determined. Surface magnetism of ferromagnetic solids is investigated by polarized electron scattering, where the spin dependence is due to the exchange interaction; surface hysteresis curves, the deviations of the surface magnetization from the bulk at low temperatures, the critical exponent of the surface magnetization, and spin dependent electronic band structure can be determined. Finally in elementary particle physics, high energy deep inelastic scattering of polarized electrons has given evidence of parity violation attributable to weak neutral currents as predicted in the Weinberg-Salam unified gauge theory.

401,803
PB85-142842 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Solid-Solid Phase Transformations. Where Do We Go from Here,
 J. W. Cahn. 1982, 5p
 Sponsored by American Society for Metals, Metals Park, OH., Carnegie-Mellon Univ., Pittsburgh, PA., National Science Foundation, Washington, DC., and Metallurgical Society of AIME, Warrendale, PA.
 Pub. in Proceedings of International Conference Solid-Solid Phase Transformations, Carnegie-Mellon University, Pittsburgh, PA., August 10-14, 1981, p1586-1590 1982.

Keywords: *Phase transformations, *Elastic properties, *Plastic properties, Solids, Reviews.

The last session of a week-long international conference on phase transformation at Carnegie-Mellon University August 10-14, 1981 was to be a panel discussion entitled 'Where do we go from here.' The panel

discussion did not take place, but became six separate discussions. The reports of these sessions together with a summary are published in the conference proceedings. The summary, prepared by J. W. Cahn, discusses the current issues, and the expected impact of new techniques and theoretical developments on the field. The report of one of the discussion sessions, chaired by William C. Johnson, concerns elasticity and plasticity in solid to solid phase transformations.

401,804
PB85-143485 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Crack as a Crystal Defect with Implications for the Fracture Resistance.
 Final rept.,
 R. M. Thomson, and E. R. Fuller. 1983, 24p
 Sponsored by Army Research Office, Arlington, VA., National Science Foundation, Washington, DC., and Office of Naval Research, Washington, DC.
 Pub. in Proceedings of International Symposium (3rd) on Fracture Mechanics of Ceramics, University Park, PA, July 15-17, 1981. Paper in Fracture Mechanics of Ceramics, V5, p253-276 1983.

Keywords: *Crack propagation, *Crystal defects, *Fracture properties, Activation energy, Greens function, Stress intensity factor.

In previous work on a one-dimensional lattice model of a crack, the authors have shown how the discrete nature of bond rupture exhibits energy barriers to brittle crack propagation, and how these barriers resisting thermally activated crack propagation are related to idealized interatomic force laws for a material. The authors have now generalized results to two-dimensional, and to some extent three-dimensional crack configurations. In the paper they demonstrate this generalization, and draw a number of conclusions regarding how real cracks should behave. The authors also are able from their general results, to answer in the negative way an intriguing question, which has appeared at several points in the previous literature, as to whether force laws exist which allow the discrete atomistic barriers to subcritical crack propagation to vanish altogether. Finally, the authors discuss how their general formalism applies to chemically assisted bond rupture at the crack tip.

401,805
PB85-143998 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Liquid-Solid Transition and the Fractional Quantum Hall Effect.
 Final rept.,
 P. K. Lam, and S. M. Girvin. 1 Jul 84, 3p
 Pub. in Physical Review B: Condensed Matter 30, n1 p473-475, 1 Jul 84.

Keywords: Phase transformations, Solids, Liquids, Reprints, *Fractional quantum Hall effect, *Quantum Hall effect, Wigner crystals.

The critical Landau level filling factor (ν sub c) for the transition from Laughlin's liquid state to a Wigner crystal is determined by comparing the energies of these states. The Wigner crystal energy is substantially improved over the Hartree-Fock result by using a variational wave function which includes particle correlations. The liquid state energy is obtained from the Monte Carlo calculation of Levesque, et al. The authors found (ν sub c) to be slightly larger than $1/7$ which is consistent with the experimental observation by Mendez, et al. that the fractional quantum Hall effect does not occur for $\nu =$ or $< 1/7$. The improvement in the crystal energy by correlation is essential to this agreement since without correlations, (ν sub c) is about $1/10$. In addition, the crystal correlation energy explains the very low temperatures required to see the $\nu = 1/5$ liquid state.

401,806
PB85-144012 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Anomalous Quantum Hall Effect and Two-Dimensional Plasmas: Analytic Approximations for Correlation Functions and Ground State Energies.
 Final rept.,
 S. M. Girvin. 15 Jul 84, 3p
 Pub. in Physical Review B: Condensed Matter 30, n2 p558-560, 15 Jul 84.

Keywords: *Hall effect, Wave functions, Ground state, Plasmas (Physics), Electron gas, Reprints, *Quantum Hall effect, Two dimensional, High magnetic field research, Correlation functions.

A simple analytic scheme is presented for the estimation of the two-point correlation function and the ground state energy of a class of variational wave functions of interest in the study of the anomalous quantum Hall effect. The technique is illustrated by application to the wave function recently proposed by Laughlin and to a generalization of this wave function developed by Chui and Ma. The technique also yields information about the classical two-dimensional plasma problems associated with these wave functions.

401,807
PB85-144442 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Fast Ion Transport in the NASICON Analog Na3Sc2(PO4)3: Structure and Conductivity.
 Final rept.,
 S. Susman, C. J. Delbecq, T. O. Brun, and E. Prince. Dec 83, 6p
 Pub. in Solid State Ionics, v9-10 pt2 p839-844 Dec 83.

Keywords: *Phase transformations, Sodium phosphates, Hexagonal lattices, Reprints, *Sodium scandium phosphates, *Electrical conductivity, *Ionic conductivity, Superionic conductors, Temperature dependence.

The room temperature modification of stoichiometric NASICON(Sc) is monoclinic Cc. At 64C there is a first order transition to a normal-conducting rhombohedral form R($\bar{3}c$). Na(1) sites are fully occupied whereas Na(2) sites are partially occupied. At 167C there is a transition to a superionic phase, but the structure remains rhombohedral R($\bar{3}c$). Vacancies are now shared equally by Na(1) and Na(2) sites. Fast Na-ion motion in stoichiometric Na3Sc2(PO4)3 arises from vacancy motion in a 'dogleg' path between Na(1) and Na(2) sites.

401,808
PB85-144970 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Temperature Dependence of the Quantum Hall Resistance.
 Final rept.,
 M. E. Cage, B. F. Field, R. F. Dziuba, S. M. Girvin, and A. C. Gossard. 15 Aug 84, 3p
 Pub. in Physical Review B 30, n4 p2286-2288, 15 Aug 84.

Keywords: *Hall effect, Gallium arsenides, Magnetic fields, Precision, Electron gas, Reprints, *Quantum Hall effect, Fine structure constant, Resistance standards, Temperature dependence, Two dimensional, Heterostructures.

The authors report high precision measurements of the temperature dependence of the quantum Hall resistance for two GaAs heterostructures. The Hall resistivity (ρ sub xy)(T) is found to vary linearly with the minimum resistivity along the device (ρ sub xx, sup min)(T) and to depend upon the sample, Hall probe set, and magnetic field direction, but to approach a sample-independent value as T approaches 0. The temperature dependent shift of (ρ sub xy)(T) from (ρ sub xy)(0) can be significant even for very flat Hall steps and is inconsistent with standard mechanisms.

401,809
PB85-147916 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Determination of the Superconductive Transition Temperatures of Cd, Zn, and Al Using a Josephson Junction Noise Thermometer.
 Final rept.,
 W. E. Fogle, J. H. Colwell, and R. J. Soulen. 1984, 2p
 Pub. in Proceedings of International Conference on Low Temperature Physics (17th), Karlsruhe, Germany, August 15-22, 1984, p1149-1150.

Keywords: *Superconductors, *Transition temperature, *Temperature measurement, Aluminum, Cadmium, Zinc, Josephson junctions, Cryogenics, Noise thermometers, Ultralow temperature.

In order to evaluate the accuracy of the EPT-76 temperature scale, the authors measured three fixed points defined on that scale (the superconductive transition temperatures of Cd, Zn, and Al) using a Josephson junction noise thermometer.

401,810
PB85-151595 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Electron-Phonon Interactions and the Breakdown of the Dissipationless Quantum Hall Effect.
 Final rept.,
 O. Heinonen, P. L. Taylor, and S. M. Girvin. 15 Sep 84, 4p
 Pub. in *Physical Review B: Condensed Matter* 30, n6 p3016-3019, 15 Sep 84.

Keywords: *Hall effect, *Electron phonon interactions, Electron gas, Magnetic fields, Reprints, *Quantum Hall effect, Two dimensional, Electrical conductivity.

The Quantum Hall Effect is manifested by plateaus in the Hall conductivity at which the current flows without loss. Recently it has been observed that as the current is increased to a critical value, corresponding to a carrier drift velocity of the order of the speed of sound, there is a dramatic onset of dissipation. The authors investigated the role in the breakdown of phonon-assisted transitions between Landau levels and calculated the steady-state power absorption. As the drift velocity of the carriers is increased there is a sudden onset of dissipation, and an upper limit for the critical current is obtained.

20M. Thermodynamics

401,811
PB85-107423 Not available NTIS
 National Bureau of Standards, Washington, DC.
Modeling of Turbulent Diffusion Flames and Fire Plumes for the Analysis of Fire Growth.
 Final rept.,
 Y. Hasemi, and T. Tokunaga. 1983, 9p
 Pub. in *Proceedings of National Heat Transfer Conference (21st), Fire Dynamics and Heat Transfer*, Seattle, WA., July 24-28, 1983, p37-45.

Keywords: *Flames, *Fires, Diffusion flames, Plumes, Heat transfer, Velocity measurement, Model tests, Fire tests.

Measurements of temperature, velocity and irradiance, and observation of flame height were made in the near field of the turbulent diffusion flames from a porous burner with propane as fuel located in a large area simulating semi-infinite space, on a thermally thick wall and in a wall-corner. The data on the upward currents in the semi-infinite space were compared with an integral model of turbulent diffusion flames derived without assuming the entrainment hypothesis. The nature of diffusion flame as an external radiation source is also studied based on the model.

401,812
PB85-118339 Not available NTIS
 National Bureau of Standards, Washington, DC.
Gas Thermometry.
 Final rept.,
 L. A. Guildner. 1982, 2p
 Pub. in *McGraw-Hill Encyclopedia of Science Technology*, p74-75 1982.

Keywords: *Temperature measurement, Thermodynamics, Reprints, *Gas thermometry.

Gas thermometry is defined, and its application to the determination of thermodynamic temperature is given. The types of gas thermometers are discussed in idealized form, and some of the departures from ideal, as encountered in the laboratory, are cited.

401,813
PB85-129625
 (Order as PB85-129591, PC A03/MF A01)
 Los Alamos National Lab., NM.
Thermal Expansion of Liquid Normal Hydrogen between 18.8 and 22.2 K,
 L. A. Schwalbe, and E. R. Grilly. 7 Jun 84, 7p
 Included in *Jnl. of Research of the National Bureau of Standards*, v89 n4 p317-323 Jul-Aug 84.

Keywords: *Hydrogen, *Thermal expansion, Liquefied gases, Cryogenics, *Liquid hydrogen, Temperature dependence, Pressure dependence.

The thermal expansion coefficient alpha of liquid normal hydrogen (n-H₂) was measured between 18.8 and 22.2 K in the presence range 5 to 70 bar. The results are compared with those derived from PVT meas-

urements by others on both normal and para (p-H₂) hydrogen. Our analysis of the earlier normal data includes fitting an empirical equation of state, and expansion coefficients are derived from this equation by differentiation. We discuss the effects on alpha and the compressibility beta from molecular quadrupole interactions; both theoretical and empirical results suggest these to be on the order of 2% or less for the normal spin mixture. We conclude that our thermal expansion data are consistent with earlier results on both n-H₂ and p-H₂ in this range of pressures and temperatures.

401,814
PB85-130623
 (Order as PB85-130078, PC A99/MF A01)
 Bureau International des Poids et Mesures, Sevres (France).
Radiometric Determination of the Stefan-Boltzmann Constant,
 T. J. Quinn, and J. E. Martin. 1984, 7p
 Prepared in cooperation with National Physical Lab., Teddington (England).
 Included in *Precision Measurement and Fundamental Constants II*, p291-297 1984.

Keywords: *Thermal radiation, Blackbody radiation, Radiometers, Calorimeters, Cryogenics, *Stefan-Boltzmann constant.

A new determination of the Stefan-Boltzmann constant is being made using a blackbody source of thermal radiation at 273.16 K and a detector in the form of a heat-flow calorimeter at 2 K. From a knowledge of the geometry of the aperture system and the thermodynamic temperature of the blackbody, the Stefan/Boltzmann constant may be deduced.

401,815
PB85-130631
 (Order as PB85-130078, PC A99/MF A01)
 National Research Lab. of Metrology, Sakura (Japan).
Radiometric Measurement of the Stefan-Boltzmann Constant at NRLM (National Research Lab. of Metrology),
 A. Ono. 1984, 4p
 Included in *Precision Measurement and Fundamental Constants II*, p299-302 1984.

Keywords: *Thermal radiation, Blackbody radiation, Radiometers, Emissivity, *Stefan-Boltzmann constant.

Progress at NRLM on the radiometric measurement of the Stefan-Boltzmann constant is described. In the method, the total radiant flux emitted from a blackbody source that is spatially defined by two limiting apertures is measured by an absolute radiometer. A newly developed absolute radiometer is described that has improved uniform responsivity over the surface of the receiver; the variation of responsivity is less than 0.2% over an area 15 mm in diameter. Emissivities of blackbody cavities are calculated by the Monte Carlo method taking into account partial specular reflection of radiation on the cavity walls. An approach to a perfect blackbody cavity is also presented. It is discussed how uncertainties of blackbody source temperature and of diffraction losses of radiant flux are to be minimized.

401,816
PB85-130938
 (Order as PB85-130078, PC A99/MF A01)
 National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Measurements and Standards Div.
Helium Melting Curve and the Linkage of Fundamental Constants, Pressure, Density, and Mass,
 C. R. Van Degrift. 1984, 3p
 Included in *Precision Measurement and Fundamental Constants II*, p457-459 1984.

Keywords: *Liquid helium, *Helium, *Melting, *Fundamental constants, Many body problem, Solidified gases, Density(Mass/volume), Pressure, Mass, Quantum theory, Helium 3, Helium 4, Cryogenics, *Solid helium.

Recent progress made toward the calculation of the ground states of liquid and solid helium from first principles suggests that a future pressure standard might be based on the calculated phase diagrams of (3)He and (4)He. The absolute reference pressures of the zero temperature intercepts and minima of the melting curves of these systems would be transferred to room temperature gages and provide a new connection between fundamental constants and density or mass. Al-

ready, present experiments suggest that the helium melting curves can provide pressure reference points which are precise within 1 ppm. A summary of the current state of theoretical work is given followed by a discussion of the practical difficulties in realizing the linkages between the melting curve and room temperature pressure, mass and density.

401,817
PB85-135531 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Status of Thermophysical Properties Data for Pure Fluids and Mixtures of Cryogenic Interest.
 Final rept.,
 W. M. Haynes, A. J. Kidnay, N. A. Olien, and M. J. Hiza. 1984, 32p
 Pub. in *Advances in Cryogenic Engineering* 27, p919-942 1984.

Keywords: *Thermophysical properties, *Cryogenics, *Fluids, Mixtures, Reprints.

This paper will discuss the importance of accurate thermophysical properties data for pure fluids and fluid mixtures encountered in cryogenic process technology. The most important properties will be identified, the status of data for these properties will be summarized, and recommendations for future work will be proposed. The integrated roles of experiment, basic theory, and correlation techniques in obtaining a fundamental understanding of fluid behavior for the development of techniques for the prediction of thermophysical properties will be discussed.

401,818
PB85-135564 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Transient Boiling Heat Transfer from Two Different Heat Sources: Small Diameter Wire and Thin Film Flat Surface on a Quartz Substrate.
 Final rept.,
 P. J. Giarratano. 1984, 8p
 Pub. in *International Jnl. of Heat and Mass Transfer* 27, n8 p1311-1318 1984.

Keywords: *Boiling, *Heat transfer, Platinum, Quartz, Substrates, Thin films, Wire, Reprints, Liquid nitrogen, Transients.

Transient boiling heat transfer data are reported for two different heater surface geometries submerged in liquid nitrogen. During the early part of the transient heat pulse, the heat transfer coefficient for both geometries generally agrees with values predicted from classical transient pure conduction equations. The agreement persists until the time for onset of convection which varies approximately as 1/(q squared) where q is the heat flux to the fluid.

401,819
PB85-143394 Not available NTIS
 National Bureau of Standards, Gaithersburg, MD.
Measurement of Thermal Radiation Properties of Materials.
 Final rept.,
 J. C. Richmond. 1984, 60p
 See also PB80-189186.
 Pub. in *Compendium of Thermophysical Property Measurements, Volume 1: Survey of Measurement Techniques*, p709-768 1984.

Keywords: *Thermal radiation, Heat transfer, Reflectance, Absorptance, Emittance, Transmittance, Photons, Reviews, Reprints.

The thermal radiation properties of materials are reflectance, absorptance, transmittance, and emittance. They are called thermal radiation properties because they control the rate of heat transfer by radiation between noncontacting bodies at different temperatures, and between a body and its surroundings. Radiant heat transfer is the only mode of heat transfer in a vacuum and becomes the dominant mode of heat transfer between noncontacting solids at high temperatures, such as exist in many industrial furnaces.

Field 20—PHYSICS

Group 20M—Thermodynamics

401,820

PB85-147932 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Superconductive Temperature Reference Points above 0.5 K.
Final rept.,
J. F. Schooley, and J. H. Colwell. 1984, 2p
Pub. in Proceedings of International Conference on Low Temperature Physics (17th), Karlsruhe, Germany, August 15-22, 1984, p409-410.

Keywords: *Temperature measurement, Transition temperature, Lead(Metal), Indium, Aluminum, Cadmium, Zinc, Cryogenics, Superconductivity, *Ultralow temperature, Standard reference materials.

Careful preparation and annealing of samples made from high-purity Pb, In, Al, Zn, and Cd have resulted in sample-to-sample ($T_{sub c}$) variations of less than 0.5 mK. Less-pure Nb samples, while more variable in T_c , still exhibit single-sample reproducibilities better than 0.2 mK. Temperature reference devices incorporating these six elements offer stable, high precision in situ calibration capability.

401,821

PB85-151728 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Very-Low-Temperature Cooling Systems.
Final rept.,
R. Radebaugh. 1983, 79p
Pub. in Cryocoolers, Part 2: Applications, Chapter 12, p177-255 1983.

Keywords: *Refrigerators, Adiabatic demagnetization, Helium 3, Helium 4, Copper, Liquid helium, Nuclear spin, Reprints, *Cryogenic refrigerators, *Cryocoolers, *Ultralow temperature, Magnetic refrigerators, Pomeranchuk cooling.

This paper is written as chapter 12 for the book Cryocoolers, by G. Walker. In this chapter the refrigeration principles and practical examples of the common techniques for reaching temperatures below 1 K are presented. The refrigeration techniques discussed are (3)He refrigerators, (3)He-(4)He dilution refrigerators, Pomeranchuk cooling, and magnetic refrigerators. Record low temperatures of 50 nK for copper nuclei, less than 50 micro K for copper electrons, and 0.21 micro K for liquid (3)He have been reached using adiabatic demagnetization of nuclear spins. Historical development, problem areas, and applications of these various cooling systems are discussed.

401,822

PB85-151736 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Fundamentals of Alternate Cooling Systems.
Final rept.,
R. Radebaugh. 1983, 47p
Pub. in Cryocoolers, Part 2: Applications, Chapter 11, p129-175 1983.

Keywords: *Refrigerators, *Thermodynamics, Electrochemical cells, Entropy, Electrons, Phonons, Magnetic dipoles, Mixtures, Photons, Phase transformations, Adsorption, Reprints, *Cryogenic refrigerators, *Cryocoolers, Electric dipoles.

This paper is written as chapter 11 for the book Cryocoolers, by G. Walker. In this chapter the thermodynamic fundamentals applicable to any refrigeration system are discussed. Emphasis is placed on systems other than the gas-liquid systems normally used in mechanical refrigerators in hopes of stimulating new ideas in refrigeration. Because refrigeration power is proportional to the available entropy of the system, entropy comparisons are used to evaluate the potential of new systems. The systems discussed here include such things as electrons, phonons, magnetic dipoles, electric dipoles, mixtures, electrochemical cells, photons, as well as some gas-liquid-solid systems. A description of how each of these systems can be used for refrigeration, along with the useful temperature range, is presented.

20N. Wave Propagation

401,823

PB84-226323 Not available NTIS
National Bureau of Standards, Washington, DC.
Integral Equation for Scattering by a Dielectric.
Final rept.
E. Marx. Feb 84, 7p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation AP-32, n2 p166-172 Feb 84.

Keywords: *Electromagnetic wave transmission, *Electromagnetic scattering, *Integral equations, *Dielectrics, Wave equations, Greens function, Monochromatic radiation, Reprints, Vector fields, Transients.

The determination of the scattered and transmitted transient electromagnetic waves produced by a uniform dielectric body is reduced to the solution of a singular integral equation of the first kind for one tangential vector field defined on the surface. All derivations are carried out within the heuristic approach to Green functions and delta functions. The electric and magnetic fields are expressed in terms of the sources, initial values, and the boundary values by means of the Green function for the scalar wave equation. The appropriate integral equation is derived, and the integrals for the scattered and transmitted fields are given. The simpler problem of scattering of scalar waves is developed first. Formulas for the scattering of monochromatic fields are also given in the scalar and electromagnetic cases when transmitted fields do not vanish.

401,825

PB84-154327 PC A07/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Intensity and Duration of Chimney Fires in Several Chimneys,
R. D. Peacock. Dec 83, 136p NBSIR-83-2771
Sponsored in part by Consumer Product Safety Commission, Bethesda, MD., and Department of Energy, Washington, DC.

Keywords: *Chimneys, *Fire safety, *Intensity, *Time, Surveys, Stoves, Accident prevention, Fire tests, Wood burning appliances.

A series of tests was conducted in five instrumented chimneys to study the intensity and duration of chimney fires due to the ignition and burning of combustible deposits accumulated on the chimney lining over a prolonged period of time. These tests were conducted (1) to establish typical conditions including temperatures in the chimneys and on combustible surfaces nearby, (2) to determine the duration of the burnout as evidenced by elevated temperatures within the chimneys, and (3) to compare these measured values with those obtained during overfire conditions - prolonged firing of the appliances at high rates. The results of these tests point out some areas where the codes and standards covering residential wood heating appliances should be modernized to better protect against failure due to chimney fires.

401,826

PB84-155340 PC A08/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Summaries of Center for Fire Research (of the National Bureau of Standards) Grants and In-House Programs - 1983.
Final rept.,
S. M. Cherry. Dec 83, 164p NBSIR-83-2800

Keywords: *Fire tests, Research projects, Toxicity, Combustion, Ignition, Mathematical models, Risks, Plastics, Fire safety, Soot, Smoke, Human behavior, Smoldering.

This report was prepared for distribution at the 7th Annual Conference on Fire Research, August 23-25, 1983. It contains extended abstracts of grants and contracts for fire research sponsored by the Center for Fire Research, National Bureau of Standards, as well as descriptions of the internal programs of the Center for Fire Research.

401,827

PB84-155787 PC A06/MF A01
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
Computer Fire Code VI. Volume 1,
J. B. Gahm. Dec 83, 117p HOME FIRE PROJECT TR-58, NBS-GCR-83-451-VOL-1
Contract NB82-NADA-3030
See also Volume 2, PB84-155795.

Keywords: *Fires, *Mathematical models, Computer programming, Fortran.

There is no definitive version of CFR VI yet, but this document will be valid for any version. The numerical 'package' used is described in general terms only. The physics inherent in the program is also omitted; however, most of those subroutines have been taken directly from Mark 5, although they have been broken up so that any subroutine has just one output. For the reader interested in the documentation of the physics, it is given in detail in Harvard Fire Project Technical Reports 34 and 45. There are four appendices, where in it is explained how to insert a new subroutine or a new physical variable. Following the report, a listing of the program appears; this is a version of CFC VI which compiles on both a VAX and a Perkin-Elmer computer. The program was written in ANSI 77 FORTRAN, and is fairly machine-independent. It consists of two independent parts: BINP is a program which produces an input file for the second (main) program, DBLE, to use. Two differences between CFC VI and Mark 5 not described in the Foreword are: first, the gas burner algorithm in Mark 5 has not been incorporated. Second, the gas concentrations are incorrectly computed.

21. PROPULSION AND FUELS

21B. Combustion and Ignition

401,824

PB84-153980 PC A05/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Estimating Effectiveness of State-of-the-Art Detectors and Automatic Sprinklers on Life Safety in Residential Occupancies.
Final rept.,
E. K. Budnick. 30 Jan 84, 82p NBSIR-84-2819

Keywords: *Residential buildings, *Fire detection systems, Sprinkler systems, Fire alarm systems, Safety, Assessments, State of the art.

The report provides a qualitative assessment of the life safety impact of early warning fire detection and automatic sprinkler technology in residential occupancies. This assessment is based on the results of full scale studies and statistics on residential fire fatalities from the NFIRS data base. Estimates of the impact of three alternatives, smoke detectors, standard automatic sprinklers, and residential sprinklers, are provided for major fire hazard scenarios in residential occupancies. A quantitative approach is outlined that can lead to a more accurate assessment of the impact of detectors and sprinklers. An initial framework is presented which identifies the key parameters for residential life safety. A mathematical expression is proposed as a success criterion. Work is underway to extend the framework to sufficient detail to permit formulation of appropriate analytical expressions necessary for quantitative evaluation of specific parameters and their interrelationships.

401,828
PB84-155795 PC A07/MF A01
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
Computer Fire Code VI. Volume 2,
J. B. Gahm. Dec 83, 150p NBS-GCR-83-451-VOL-2
Contract NB82-NADA-3030
See also Volume 1, PB84-155787.

Keywords: *Fires, *Mathematical models, Computer programs, Fortran.

There is no definitive version of CFR VI yet, but this document will be valid for any version. The numerical 'package' used is described in general terms only. The physics inherent in the program is also omitted; however, most of those subroutines have been taken directly from Mark 5, although they have been broken up so that any subroutine has just one output. For the reader interested in the documentation of the physics, it is given in detail in Harvard Fire Project Technical Reports 34 and 45. There are four appendices, where in it is explained how to insert a new subroutine or a new physical variable. One of the appendices is a dictionary of symbols, terms, and variables used in the program and in the text. Appendix D is in a separate volume. Following the report, a listing of the program appears; this is a version of CFC VI which compiles on both a VAX and a Perkin-Elmer computer. The program was written in ANSI 77 FORTRAN, and is fairly machine-independent. It consists of two independent parts: BINP is a program which produces an input file for the second (main) program, DBLE, to use. Two differences between CFC VI and Mark 5 not described in the Foreword are: first, the gas burner algorithm in Mark 5 has not been incorporated. Second, the gas concentrations are incorrectly computed.

401,829
PB84-176759 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.
Fire Induced Flows Through Room Openings - Flow Coefficients,
K. D. Steckler, H. R. Baum, and J. G. Quintiers. Mar 84, 60p NBSIR-83-2801
Sponsored in part by Armstrong World Industries, Lancaster, PA.

Keywords: *Air flow, *Fire tests, *Flow distribution, *Orifice coefficients, *Room fires.

A full-scale experimental and theoretical study was made of steady-state fire-induced flows through doorway and window openings. Measurements included two-dimensional temperature and pressure-difference profiles within the opening and vertical temperature profiles within the rooms connected by the openings. A floor-level gas burner served as the energy source. Mass flow rates through the openings were calculated from the opening data. A static-pressure flow model was used to establish ideal orifice flows from different combinations of the experimental temperature profiles. The opening and ideal flow results were combined to form room-opening flow coefficients as a function of fire energy release rate, opening geometry, and fire location. Two calculation procedures were used to compute the ideal flow. An irrotational jet model for the flow coefficients was developed and found to be in reasonable agreement with these and other measurements. Measured flow coefficient results show no significant dependence on fire strength, opening geometry, or fire location, as long as the ideal mass flow rate was based on measured gas temperatures. However, the theory indicates a significant variation in flow coefficient with opening widths larger than those used in the experiments.

401,830
PB84-218411 Not available NTIS
National Bureau of Standards, Washington, DC.
Flash Fire Hazards in Fire Experiments.
Final rept.,
C. Huggett. Oct 83, 3p
Pub. in Jnl. of Fire Sciences 1, p396-398 Oct 83.

Keywords: *Fire hazards, *Flammability test, *Flash point, Fire safety, Safety, Experiments, Reprints, Numerical solution.

The potential for encountering hazardous flash fire conditions in fire experiments can be estimated by a simple calculation. The limiting conditions for safe operation is: $C(h \text{ sup } c) < -1.8 \text{ kJ/l}$ where C is the fuel load in grams per liter and $h \text{ sup } c$ is the gross heat of

combustion of the fuel. The critical fuel load is small compared to that likely to be encountered in a real fire situation so the possibility of a flash fire under ventilation limited conditions must always be considered.

401,831
PB84-219500 PC A19/MF A01
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
Pyrolysis, Ignition and Fire Spread on Horizontal Surfaces of Wood.
Doctoral thesis,
A. Atreya. c1983, 439p NBS/GCR-83/449
Contract NB81-NADA-2026

Keywords: *Pyrolysis, *Ignition, *Wood, *Fire tests, Surfaces, Thesis, Heat transfer, Mass transfer, Thermochemistry, Temperature, Physical properties, Chemical properties, *Fire spread, Mass fractions.

In this work, experimental techniques and methods were developed to study the growth of fire from a point ignition to a burning area of two feet in diameter. Numerous experiments on ten different kinds of wood were conducted to determine the dominant mechanisms of fire spread and to obtain reliable chemical and physical data. Simultaneous measurements of fire diameter, weight loss, surface temperature, forward flame radiation, total convective and radiative energy, depletion of O₂, production of CO₂, CO, total unburned hydrocarbons, and water were made. The study also developed a theory to predict transient fire growth on the basis of the following observations: (1) that fire spread may be treated as a continuous ignition process, (2) forward gas-phase heat transfer is a local phenomenon independent of fire size, (3) forward radiative heat transfer is the primary accelerating mechanism, (4) energetics due to desorption of adsorbed moisture is far more important than heat of thermal decomposition of wood, (5) reradiation from wood and char is the primary heat loss mechanism, (6) conduction of the heat parallel to the spread surface does not contribute significantly to the fire spread process.

401,832
PB84-220979 Not available NTIS
National Bureau of Standards, Washington, DC.
Compatibility of Materials with Cryogenics.
Final rept.,
J. C. Moulder, and J. G. Hust. 1983, 28p
Pub. in Materials at Low Temperatures, Chapter 10, p343-370 1983.

Keywords: *Cryogenics, *Combustion, *Materials tests, *Ignition, Metals, Alloys, Hydrogen embrittlement, Liquid oxygen, Liquid fluorine, Liquid hydrogen, Reprints.

The compatibility of materials with liquid oxygen, liquid fluorine, and liquid hydrogen is reviewed. Special emphasis is given to the ignition and combustion of structural metals and alloys, but the behavior of many non-metals used with these cryogenics is also discussed. Ignition sources common to cryogenic systems are enumerated and the experimental methods used to objectively determine compatibility of materials with liquid oxygen and liquid fluorine are classified and described. The relative compatibility of materials with fluorine and oxygen as revealed by various compatibility tests is discussed. Several guidelines are suggested for choosing materials compatible with liquid oxygen or liquid fluorine. A brief discussion of hydrogen embrittlement of metals and alloys as it pertains to liquid hydrogen service concludes the review.

401,833
PB84-221399 Not available NTIS
National Bureau of Standards, Washington, DC.
Prediction of Heat and Smoke Movement in Enclosure Fires.
Final rept.,
H. R. Baum, R. G. Rehm, and G. W. Mulholland. 1983, 9p
Pub. in Fire Safety Jnl. 6, p193-201 1983.

Keywords: *Fire detection systems, *Fire safety, *Heat transfer, *Smoking, *Particle size distribution, *Aerosols, Sources, Mathematical models, Reprints, Numerical solution.

In order to understand the response of a detector to a given fire in an enclosure, it is necessary to relate the local thermal and aerosol characteristics actually sensed by the detector to the physical and geometrical properties of the fire and the enclosure. This paper presents computations designed to predict the evolu-

tion of the size distribution of smoke aerosol as it ages, as well as the large-scale air movement and temperature fields generated by an enclosure fire. The computations contain three main ingredients: first, a finite difference solution for the air movement and temperature generated by a prescribed source of heat used to represent a fire in a closed room; second, the computer evaluation of an exact solution to the ageing equation corresponding to the evolution of an experimentally observed size distribution; and third, a particle tracking scheme which permits the smoke aerosol to be followed in space and time as it gradually fills the room. No nonphysical empirical parameters (e.g. turbulence models) are employed in these calculations. The mathematical and physical models are summarized briefly, but most emphasis is placed on displaying results. Sample calculations are presented, comparisons are made with relevant experiments, and predictions of the local environment experienced by a detector due to the occurrence of an enclosure fire are shown.

401,834
PB84-224187 Not available NTIS
National Bureau of Standards, Washington, DC.
Some Examples of Application of Harvard V Fire Computer Code to Fire Investigation.
Final rept.,
T. Handa, M. Morita, J. A. Rockett, O. Sugawa, and K. Hayashi. 1983, 9p
Pub. in Fire Science Technology, v3 n1 p63-72 1983.

Keywords: *Fire tests, *Mathematical models, *Furniture, Residential buildings, Hotels, Reprints, Computer applications.

Full scale fire tests of a simulated Japanese style hotel guest room are described. Experimental results are compared with calculations using the Harvard Computer Fire Simulation, level 5.2. The computed results were in reasonable agreement with the experimental observations.

401,835
PB84-225556 Not available NTIS
National Bureau of Standards, Washington, DC.
Experimental Comparison of Forward and Reverse Smolder Propagation in Permeable Fuel Beds.
Final rept.,
T. Ohlemiller, and D. Lucca. 1983, 17p
Pub. in Combustion and Flame 54, p131-147 1983.

Keywords: *Combustion, *Foam, *Insulation, *Flammability testing, *Flame propagation, Wood, Cellulose, Polymers, Plastics, Oxidation, Pyrolysis, Sampling, Oxygen, Carbon monoxide, Carbon dioxide, Reprints, *Smoldering.

Forward and reverse smoldering combustion propagation, supported by forced air flow, have been studied in two types of permeable fuels, a cellulosic loose-fill insulation (wood fibers) and a particulated polymer foam (polyisocyanurate). Thermocouples and gas sampling (O₂, CO, CO₂) were used to probe the structure of the two types of smolder wave. There are marked qualitative and quantitative differences in the two smolder propagation modes. Reverse smolder quickly reaches a steady propagation rate determined largely by heat transfer processes; forward smolder propagation is unsteady and moves at a lower rate that appears limited by the stoichiometry of char oxidation. Both modes of propagation are ultimately limited by the rate of oxygen supply.

401,836
PB84-229517 Not available NTIS
National Bureau of Standards, Washington, DC.
Calculating Escape Time from Fires.
Final rept.,
L. Y. Cooper. 1980, 19p
Pub. in Proceedings of Engineering Applications Fire Technology Workshop, Gaithersburg, MD., April 16-18, 1980, p195-213.

Keywords: *Escape systems, *Fire safety, *Time measurement, *Mathematical models, Fire tests, Fire detection, Smoke, Safety, Reprints.

A general technique for calculating the time available for safe egress from a fire is presented. A definite model of hazard development is introduced, and the details of the technique are formulated for the room of fire origin problem. The inputs to the model are the area and ceiling height of the room, data from free burn tests of characteristic fuel assemblies likely to be found therein, the anticipated mode of fire detection

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and a criterion for hazard. The output is a definite estimate of the length of time between detection of a fire and the onset of hazardous conditions. Examples of applying the calculation technique are presented and discussed. In the course of developing these examples some universal working graphs are generated.

401,837
PB84-229525 Not available NTIS
National Bureau of Standards, Washington, DC.
Smoke Control by Stairwell Pressurization.
Final rept.,
J. Klote. 1980, 21p
Pub. in Proceedings of Engineering Applications Fire Technology, p137-157 1980.

Keywords: *Stairways, *Smoke, *Pressurizing, *Escape systems, *Air flow, Design criteria, Performance evaluation, Safety, *Smoke control, Numerical solution, Computer applications.

Pressurized stairwells have been used increasingly in the past few years to provide smoke free escape routes. However, generally accepted and proven design procedures for these systems are not available. This paper provides a discussion of several of the designs currently in use. In particular, single and multiple injection systems are discussed. The factors affecting the performance of pressurized stairwells are discussed. A method of analyzing pressurized stairwells is developed for a simple building model, and example calculations using this method are provided.

401,838
PB84-229814 PC A04/MF A01
National Bureau of Standards (NEL), Washington, DC.
Center for Fire Research.
Flame Spread on Combustible Solar Collector Glazing Materials.
Final rept.,
E. Braun, and P. J. Allen. Jul 84, 64p NBSIR-84/2887
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Fire tests, *Glazes, *Flame propagation, Performance evaluation, Buildings, Ignition, Reinforced plastics, Plastics, Fiberglass reinforced plastics, Polymethyl methacrylate, Polycarbonate resins, *ASTM D635 test, *Solar collectors, *Flame spread.

The use of ASTM D635 and associated criteria as an evaluation method for solar collector glazings was investigated. Four materials commonly used in solar collector applications were evaluated by ASTM D635. Four other test methods were used to characterize the glazing materials as to ignition, flame spread, and heat release rate. These results were compared to large scale fire tests of these materials. Based on the large scale tests, it was found that ASTM D635 produced test results that were not consistent with those obtained from the large scale tests. Good agreement was found between the rank ordering of the large scale tests and heat release rate and ignition properties as measured in the cone calorimeter and modified ISO test.

401,839
PB84-244615 Not available NTIS
National Bureau of Standards, Washington, DC.
Observation of Vapor Generation Preceding the Ignition of Liquid N-Decane and I-Decane by CO₂ Laser Radiation.
Final rept.,
T. Kashiwagi, and T. J. Ohlemiller. 1982, 21p
Pub. in Combust. Sci. Technol. 29, n1-2 p15-35 1982.

Keywords: *Ignition, *Fuels, *Decanes, Liquid phases, Vapor phases, Vaporization, Aviation fuels, Absorption, Drops(Liquids), Reprints, *Laser applications, Chemical reaction mechanisms.

As an aid to understanding the ignition mechanism of liquid fuels under high intensity radiation, the time sequence of behavior of a liquid fuel and of the fuel vapor near the liquid surface was observed by high speed schlieren and direct photography. A CW CO₂ laser with fluxes up to 1000 W/sq cm was used with beam incident angles of 30 and 90 degrees with respect to the liquid surface. Both n-decane and 1-decene were used as the liquid fuel. The pictures reveal, in time sequence, the formation of a radial wave, a central surface depression, bubble nucleation/growth/bursting followed by complex surface motion and further bubbling. Effects of laser flux level, incident laser angle and absorption coefficient of the liquid (16/cm and 50/

cm) on the formation of bubbles, the size of the bubbles, the frequency of bubble formation and the vaporization process were studied. A simple order of magnitude analysis is applied to ascertain the dominant process that underlies these phenomena.

401,840
PB84-245877 Not available NTIS
National Bureau of Standards, Washington, DC.
Measurement of the Protective Value of Fabrics in a Fire Environment.
Final rept.,
E. Braun, D. Cobb, V. B. Cobble, J. F. Krasny, and R. Peacock. Mar 80, 11p
Pub. in Jnl. of Consumer Product Flammability 7, n1 p15-25 Mar 80.

Keywords: *Fabrics, *Fire protection, *Fire tests, Insulation, Heat flux, Ignition, Industrial hygiene, Exposure, Reprints, *Consumer products, Occupational safety and health.

A method for measuring the protection provided by fabrics in a fire environment is described. Fabrics are subjected to a heat load, and the heat flux behind them is measured. The apparatus can be adjusted to simulate a variety of fire situations; the total incident heat flux can be varied, as well as the ratio of the radiative and convective components; the heat sensor can be in contact with the fabric, or at a distance simulating looseness of fit of various garments; resistance to ignition can be determined by exposing the heated specimen to a pilot flame; and the heat received by the fabric at which charring or melting occurs can be determined. Typical results on a variety of reasonably ignition resistant fabrics are shown and related to fabric construction parameters. The results are expressed in terms of time of exposure until an incipient second degree burn is likely to occur. This time to injury is estimated based on work of previous investigators. Optimum use of the method would involve study of the types of heat exposure to which workers in various industries, fire fighters, etc. are likely to be subjected and reproducing these conditions in the laboratory.

401,841
PB85-108470 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Environmental Cycling of Cellulosic Thermal Insulation and Its Influence on Fire Performance.
J. R. Lawson. Aug 84, 47p NBSIR-84/2917
Sponsored in part by Department of Energy, Washington, DC.

Keywords: *Environmental surveys, *Fire tests, *Insulation, *Cellulose, Performance evaluation, Humidity, Temperature, Exposure, Air pollution, *Indoor air pollution.

A study was conducted on climatological data for eleven cities located throughout the United States. Findings from this environmental study were used to develop conditioning cycles for a research project on the influence of environments on the fire performance of loose-fill cellulosic thermal insulation. Six cellulosic insulation materials containing 25 percent by weight of fire retardant chemical add-on of different compositions were specially manufactured for this study. These materials were tested to establish a baseline. After the materials were exposed to the various environmental cycles, they were tested for fire performance. Results from these tests show that environmental exposure can have a significant effect on the fire performance of cellulosic insulation materials and indicates that long term fire protection provided by fire retardant compounds may be limited.

401,842
PB85-115608 Not available NTIS
National Bureau of Standards, Washington, DC.
Flame Boundary Layer Effects Line-Of-Sight Optical Measurements.
Final rept.,
L. H. Grabner, and J. W. Hastie. 1982, 11p
Pub. in Combustion and Flame 44, n1-3 p15-25 Jan 82.

Keywords: *Flames, *Mathematical models, *Combustion, *Boundary layer, Concentration(Composition), Optical measurement, Absorption spectra, Reprints, *Hydroxyl radical.

A flame is approximated by a core surrounded by a boundary layer, both of uniform but different temperatures and species concentrations. For this model the

temperature measured by the line-reversal and ratio method is calculated as well as the OH concentration from the integrated absorption of an OH line.

401,843
PB85-115665 Not available NTIS
National Bureau of Standards, Washington, DC.
Mobility Measurements of Atomic Ions in Flames Using Laser-Enhanced Ionization.
Final rept.,
W. G. Mallard, and K. C. Smyth. 1982, 10p
Pub. in Combustion and Flame, v44 n1-3 p61-70 1982.

Keywords: *Combustion, *Flames, Ions, Excitation, Ionic mobility, Comparison, Reprints, *Laser enhanced ionization.

Atomic ion mobilities have been directly determined in C₂H₂/air and CO/O₂ flames using optical excitation to instantaneously create a pencil of ions and then measuring ion velocities in an applied electric field. The ions were chosen to provide a wide range of atomic weights (Li, Na, K, Ca, Sr, Ba, Fe, In, Tl, U), thus providing a good comparison with the Langevin theory of ion mobility under several flame conditions. In all cases the Langevin theory provides an upper limit and predicts the measured mobility to within 50%, with best agreement obtained in general for the smaller and less polarizable ions.

401,844
PB85-120731 Not available NTIS
National Bureau of Standards, Washington, DC.
Investigation of the Flammability Hazard of Apparel Fabrics.
Final rept.,
L. B. Miles. 1978, 37p
Sponsored in part by Cotton Foundation, Memphis, TN.
Pub. in Proc. Symp. on Textile Flammability (6th), 20 April 1978, p38-74.

Keywords: *Fabrics, *Flammability testing, Hazards, Comparison.

The flammability hazard of various apparel fabrics was examined on both the Apparel Fire Modeling Apparatus (AFMA) and the Mushroom Apparel Flammability Tester (MAFT). Potential hazard as measured on the AFMA generally decreased for the cellulosic fabrics under the following conditions: (1) contact with a copper surface, (2) surface (vs hole) ignition, and (3) addition of flame retardant (FR) chemicals. The untreated synthetics had lower potential hazard than most of the cellulose and appeared relatively unaffected by varying experimental conditions on the AFMA. On the Mushroom Apparel Flammability Tester most fabrics studied did not qualify for the safest class of fabrics according to the proposed apparel flammability standard. Ignition studies on the MAFT for further classification of the fabrics showed that classification for the cellulose could be improved by: (1) increasing fabric weight, (2) increasing level of FR treatment, and (3) blending with an inherently FR fiber, (modacrylic). Comparison of AFMA potential hazard measurements with MAFT values showed that four of the eighteen fabrics tested were less hazardous than MAFT classification indicated, i.e., they had AFMA hazard potentials comparable to fabrics with low MAFT heat values.

401,845
PB85-120772 Not available NTIS
National Bureau of Standards, Washington, DC.
Temperature Profiles of Inhibited Flames Using Raman Spectroscopy.
Final rept.,
M. C. Drake, and J. W. Hastie. 1981, 11p
Pub. in Jnl. of Combustion and Flame 40, n2 p201-211 1981.

Keywords: *Flames, *Raman spectroscopy, Temperature, Nitrogen, Hydrogen, Oxygen, Reprints.

Laser Raman scattering from vibrational and rotational states of N₂ and H₂ has been used to determine temperature profiles for several H₂/O₂/N₂ flames with and without HBr present. The inhibiting effect of HBr is clearly demonstrated and the derived properties of burning velocity and inhibition index are in good agreement with literature data.

401,846
PB85-124253 Not available NTIS
National Bureau of Standards, Washington, DC.
Multiphoton Ionization of Molecules in Flames.
Final rept.,
K. C. Smyth, W. G. Mallard, and J. H. Miller. 1984,
8p
Pub. in Society of Photo-Optical Instrumentation Engineers 482, p66-73 1984.

Keywords: *Ionization, *Molecules, *Flames, Trace elements, Pyrolysis, Fluorescence, Nitrogen oxide(NO), Butadiene, Potassium oxides, Diffusion, Reprints, Laser induced fluorescence.

Multiphoton ionization of molecules can be observed easily in both premixed and diffusion flame environments. Recent experiments on NO, PO, and butadiene show that this method is very sensitive for trace species detection and is well suited for making profile measurements. Multiphoton ionization complements laser-induced fluorescence techniques and now appears to be the best prospect for extending optical diagnostic studies to additional polyatomic molecules.

401,847
PB85-124295 Not available NTIS
National Bureau of Standards, Washington, DC.
Upholstered Furniture Room Fires - Measurements, Comparisons with Furniture Calorimeter Data, and Flashover Predictions.
Final rept.,
V. Babrauskas. Feb 84, 15p
Pub. in Jnl. of Fire Sciences 2, p5-19 Jan-Feb 84.

Keywords: *Fire tests, *Furniture, Heat measurement, Burning rates, Comparison, Flashover, Reprints.

This paper describes a series of room fire tests using upholstered furniture items for comparison with their open burning rates, previously determined in a furniture calorimeter. For the four tests conducted good agreement was seen in all periods of the room fires, including post-flashover, noting that only fuel-controlled room fires were considered. Difficulties in making accurate mass and heat flow measurements in the room's window opening were found, and it is suggested that with present day instrumentation only exhaust stack measurements are reliable. Finally, a number of simplified rules or theories for predicting room flashover based on room physical properties and open-burning heat release values were examined and compared. Broad agreement was generally found, with recommended ones selected on the basis of well controlled asymptotic behavior.

401,848
PB85-128114 PC A04/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Laser-Initiated Combustion Studies on Metallic Alloys in Pressurized Oxygen.
J. W. Bransford. Aug 84, 74p NBSIR-84/3013

Keywords: *Combustion, Ignition, Aluminum alloys, Steels, Stainless steels, Nickel alloys, Cobalt alloys, Oxygen, Compatibility.

The interim results of ignition and combustion studies on aluminum, cobalt, iron, and nickel based alloys are presented. It was found that aluminum alloys could be ignited below the melting point of the product alloy oxides. It was also found that the cobalt, iron, and nickel based alloys generally ignited slightly below to slightly above the melting range of the respective alloy. Unsupported combustion could not be achieved until the alloys and oxides were in the liquid state.

401,849
PB85-133973 PC A08/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
New Concepts for Measuring Flame Spread Properties.
J. G. Quintiere, and M. Harkleroad. Nov 84, 158p
NBSIR-84/2943
Sponsored in part by Federal Aviation Administration Technical Center, Atlantic City, NJ.

Keywords: *Flame propagation, *Ignition, *Materials tests, *Fire tests, Experimental design, Composite materials, Plastics, Wood, Carpets.

An experimental procedure is described which can be used to derive data relevant to the prediction of ignition

and flame spread on materials. The apparatus utilizes a radiant heat source capable of supplying up to 6.5 W/sq cm to a vertically oriented specimen. The test results pertain to piloted ignition of a vertical sample under constant and irradiation, and to lateral flame spread on a vertical surface due to an external applied radiant heat flux. The results can be used to display the maximum velocity and ignition time as a function of irradiance. Critical or minimum irradiances for spread and ignition are determined. An empirical correlation, based on heat conduction principles, is found to correlate the ignition data and also provides a more general interpretation for the flame spread results. Further analyses of the data yield effective values for the thermal inertia of the material (kpc), its ignition temperature, and a parameter related to flame temperature. These parameters appear to be phenomenological constants for each material, rather than factors dependent on the apparatus. Results are presented for a wide range of materials. Suggestions for extending the results to other flame spread conditions are presented.

401,850
PB85-136794 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Calculating Fire Plume Characteristics in a Two-Layer Environment.
Final rept.,
D. D. Evans. Aug 84, 25p
See also PB84-114578.
Pub. in Fire Technology 20, n3 p39-63 Aug 84.

Keywords: *Fires, *Plumes, Layers, Gas flow, Enclosures, Activation, Predictions, Sprinkler systems, Environments, Temperature.

Methods are developed to determine axial gas flow conditions within a weakly buoyant plume that passes from an ambient quiescent environment, in which the plume originates, to an upper layer at elevated temperatures. The methods are appropriate for inclusion in two-layer analysis of enclosure fire. In particular, they are first steps in developing a prediction of actuation time for thermally activated automatic sprinklers exposed to an enclosure fire. Results obtained with various methods are compared with measurements in a 1.22 m diameter cylindrical enclosure.

401,851
PB85-140432 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Will the Second Item Ignite.
Final rept.,
V. Babrauskas. 1982, 12p
See also PB81-214025.
Pub. in Fire Safety Jnl. 4, n4 p281-292 1982.

Keywords: *Combustion, *Burning rate, *Furniture, Flammability, Thermal radiation, Fires, Fire tests, Analyzing, Heat flux, Flash point, Reprints, *Room fires, *Fire spread.

The burning of more than a single fuel item in a room fire has not been well characterized. The first step in describing multiple item burning is to determine if, in fact, it will occur. This question has been experimentally explored from two aspects. (1) The radiant heat fluxes from burning first-to-ignite objects have been measured, along with their mass loss rates. (2) The ignitability of exposed objects has been determined using a bench-scale uniform flux ignitability test. It is then suggested that whether the second item will ignite can best be determined analytically from considering these two sets of results.

401,852
PB85-140457 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Alternative Derivation of Some Flame Spread Integral Equations.
Final rept.,
H. R. Baum. 1980, 4p
Pub. in Combustion Science and Technology 23, n1-2 p79-82 1980.

Keywords: *Flame propagation, Integral equations, Flames, Combustion, Analysis(Mathematics), Greens function, Heat, Phase, Reprints.

An alternate derivation of flame spread integral equations is presented. The method audits the use of transform techniques. The equations governing the evolution of the gas phase dependent variables are transformed into the heat conduction equation. The introduction of the Greens function corresponding to a one dimensional heat source then leads to the desired result.

401,853
PB85-140499 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Cellulosic Insulation Material. 3. Effects of Heat Flow Geometry on Smolder Initiation.
Final rept.,
T. J. Ohlemiller. 1981, 17p
Sponsored by Department of Energy, Washington, DC.
Pub. in Combustion Science and Technology 26, n3-4 p89-105 Aug 81.

Keywords: *Insulation, *Combustion, *Flammability testing, Cellulose, Thermal analysis, Tests, Heat transmission, Mathematical models, Fire protection, Reprints.

The variation with heat flow geometry of minimum heat source temperature which causes smolder initiation has been examined for eight configurations. These range from a wire-like source, to a flat planar source, to a corner formed by planar sources. They span the geometry range seen by insulation in practice. The ignition temperature for the same insulation varies from 235C (corner source) to 385 degrees (wire source). Other variables such as bulk density or the presence of smolder retardants have much less effect on ignitability. This behavior is predicted in an approximate manner by simple heat generation/heat flow arguments. It is predicted semi-quantitatively by a numerical model using reaction kinetics derived from thermal analysis. The results are used to suggest a smolder ignitability test design and procedure that should correspond closely to the real hazard situation.

401,854
PB85-141406 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Burning Behavior of Upholstered Furniture Mock-ups.
Final rept.,
J. F. Krasny, and V. Babrauskas. Jun 84, 31p
Pub. in Jnl. of Fire Sciences 2, p205-235 May-Jun 84.

Keywords: *Furniture, *Flammability testing, *Heat measurement, Ignition, Polyurethane resins, Foam, Chloroprene resins, Reprints.

Furniture mockups consisting of various arrangements of full-size cushions were tested in the NBS furniture calorimeter. Measurements included heat release, combustion product concentrations, and flame spread characteristics. Major variations in burning were observed: neoprene mockups only smoldered; flame retardant treated polyurethane mockups burned more slowly than untreated mockups but eventually reached similar maximum heat release rates. Fabrics ranked, in terms of maximum heat release rate and several other measured characteristics, from low to high; heavy cotton fabric; light cotton and heavy olefin; and light olefin. Flame spread rate measured on the mockups correlated with time to 100 kW heat release rate. Heat release rate and combustion product concentration generally increased with increasing number of cushions per mockup. Thinner cushions burned more rapidly than thicker ones.

401,855
PB85-141877 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Interpretation of Optical Measurements of Flame Generated Particles.
Final rept.,
R. A. Dobbins, and G. W. Mulholland. 1984, 17p
Pub. in Combustion Science and Technology 40, p175-191 1984.

Keywords: *Flames, *Particles, *Optical measurement, Aerosols, Soot, Coagulation, Agglomeration, Concentration(Composition), Reprints, *Particle volume distribution function.

The dynamic equation for an aerosol undergoing simultaneous particle formation and coagulation is solved by the moment method. Solutions are obtained that quantify the evolution of the particle volume distribution function (PVDF) for both a size independent and a free molecular collision function. The solutions show that an equilibrium is rapidly established between the source and the coagulation terms and that the particle number concentration N is then proportional to the square root of the source strength. During the interval of equilibrium there is a widening of the PVDF. These quantities may exceed the asymptotic values that apply in the absence of particle formation.

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401,856
PB85-143493 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Collection of Ions Produced by Continuous Wave Laser-Enhanced Ionization in a Hydrogen-Air Flame.
Final rept.,
P. K. Schenck, J. C. Travis, G. C. Turk, and T. C. O'Haver. 1981, 11p
Pub in Jnl. of Physical Chemistry 85, n17 p2547-2557 1981.

Keywords: *Flames, *Ionization, *Atomic spectroscopy, Excitation, Combustion, Sodium, Reaction kinetics, Reprints, *Laser enhanced ionization.

Laser enhanced ionization (LEI) -- or the optogalvanic effect in flames -- is known to result when a tunable laser is used to significantly populate an excited state of an atomic species in an atmospheric pressure flame. The perturbed ionization rate may be sensed with external electrodes, providing the opportunity for applications to trace metal analysis and combustion research. The present study correlates experimental studies of the spatial and temporal characteristics of the LEI signal with theoretical expectations. The experiments are performed with a cw dye laser exciting the D2 transition of sodium introduced in to H₂/air flame. Saturation currents with and without laser excitation are found to be consistent with expected ionization rate constants for the Na ground and excited states. Vertical spatial profiles -- using a unique imaging method -- show the physical size of the excess ion region generated by the laser, and the influence of external voltage, flame velocity, diffusion, and coulombic expansion on the excess ion region. Rise and fall times -- measured at different voltages with the laser switched by an acousto-optic modulator -- show the dependence on ion mobility, electric field, and excited state ionization rate constant. The relationships derived and illustrated would be of value for the improvement of precision and accuracy in analytical and diagnostic LEI.

401,857
PB85-159945 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Heat Release and Mass Loss Rate Measurements for Selected Materials,
W. D. Walton, and W. H. Twilley. Dec 84, 63p
NBSIR-84/2960
Sponsored by Federal Aviation Administration Technical Center, Atlantic City, NJ.

Keywords: *Flammability testing, *Heat of combustion, *Mass, *Construction materials, *Aircraft cabins, Experimental design, Plastics, Foam, Polymethyl methacrylate, Buildings.

The purpose of this study was to measure fire parameters for a selected group of materials. These parameters are to be used in a continuing study of flame spread. The parameters measured are rate of heat release, rate of mass loss, heat of gasification, effective heat of combustion, stoichiometric ratio and time to ignite. Heat release rates and mass loss rates are given as a function of time for several external heat flux levels. The rate of heat release is also given as a function of the total heat released. The experimental results and analysis are shown for six diverse materials representative of aircraft (interior panels, carpeting, and seat cushions) and buildings (particle board, polymethyl methacrylate (PMMA) and rigid foam).

21D. Fuels

401,858
PB82-241415 PC A03/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Review of Needs for Thermophysical Property Data on Solid Feedstocks: 1. Coal.
Final rept.,
Jane E. Callanan. May 82, 32p NBSIR-82-1666

Keywords: *Thermophysical properties, *Coal, Heat of combustion, Specific heat, Thermal conductivity, Thermal expansion, Thermal diffusivity, Sampling, Surveys, Heat of wetting, Energy conversion.

In January 1981, a comprehensive survey was undertaken to determine the need for thermophysical prop-

erties of the following solid feedstocks/fuels: coal, oil shale, tar sands, gas hydrates. This report deals with that portion of the survey which concerns coal and includes the results of broad consultation with industrial, government, and academic groups as indicated. This survey shows the need for experimental work on heat of combustion, heat capacity/enthalpy, thermal conductivity, and heat of wetting for both well-characterized premium coal samples and for samples of the type which will be used directly in conversion processes. Widely accepted, standardized measurement techniques do not exist for these properties, with the exception of heat of combustion, and must be developed; in addition, reliable data must be generated for efficient use of coal as a feedstock. Theoretical studies which will allow for modeling of properties should proceed along with the experimental investigations to allow for improvement in prediction of coal properties for process design.

401,859
PB83-161414 PC A03/MF A01
National Bureau of Standards, Boulder, CO.
Heat Capacity Measurements on Structure I and II Pure Hydrates at Low Pressures and Below Room Temperature.
Final rept. Oct 81-Sep 82,
J. E. Callanan, and E. D. Sloan. Sep 82, 35p NBSIR-83-1682, GRI-81/0102
Contract GRI-5081-360-0487

Keywords: *Natural gas, *Specific heat, *Hydrates, Ethylene oxide, Cyclopropane, Heat measurement, Furan/tetrahydro.

World resources of natural gas in hydrate form are on the order of trillions of cubic meters. Thermophysical property measurements are vital to the determination of the exploitability of this resource. The natural gas hydrates are clathrates; the hydrate lattice exists in one of two special structures (I and II), both of which are different from any of the known forms of ice. The hydrate lattice forms with cavities or cages in which molecules in specific size ranges can be trapped. Heat capacities as a function of temperature and, where appropriate, heats of dissociation have been measured for tetrahydrofuran (II), ethylene oxide (I), and cyclopropane (I and II) hydrates by differential scanning calorimetry. The heat capacities were found to vary both with structure and with guest. Scanning calorimetric techniques and sample handling techniques suitable for dealing with hydrates in the subambient region were developed.

401,860
PB83-259580 PC A09/MF A01
National Bureau of Standards, Boulder, CO. National Engineering Lab.
Compilation and Evaluation of Available Data on Phase Equilibria of Natural and Synthetic Gas Mixtures,
F. R. Williamson, and N. A. Olien. Jun 83, 182p
NBSIR-83-1692
Sponsored in part by Gas Research Inst., Chicago, IL, and Texas A and M Research Foundation, College Station.

Keywords: *Natural gas, *Chemical equilibrium, *Liquid phases, *Vapor phases, Binary system(Material), Tables(Data), *Synthetic fuels.

This report summarizes the results of a two-year effort to identify, compile, and evaluate the data available in the open literature for the liquid-vapor equilibria for binary and multicomponent mixtures of He, H sub 2, C sub 1 - C sub 5 alkanes, N sub 2, CO, CO sub 2, NH sub 3, H sub 2 S, H sub 2 O, CS sub 2, COS, binary systems relevant to the gas industry. The result of the evaluation is that there are: 46 systems for which data are imperative and 104 systems for which data are needed but not imperative. The report lists the data needs in temperature and pressure range for each system for both Priority 1 and 1. The report includes three appendices: A - a listing of the ranges and quality of all available data for binary systems; B - the same for all multicomponent systems; and C - a complete bibliography of the 543 citations identified in the project.

401,861
PB84-175470 PC A04/MF A01
National Bureau of Standards, Washington, DC. National Measurement Lab.
Assessing the Credibility of the Calorific Value of Municipal Solid Waste,
Interim rept. 1 Oct 80-30 Sep 83,
K. L. Churney, E. S. Domalski, A. E. Ledford, J. C. Colbert, and S. S. Bruce. Feb 84, 51p NBSIR-84-2825(DOE)
Contract DE-AI01-76PR06010

Keywords: *Calorific value, Assessments, Fuels, Calorimetry, Enthalpy, Thermodynamic properties, Samples, Combustion, Laboratories, *Municipal wastes, *Solid wastes, *Refuse derived fuels.

A study has been made at the National Bureau of Standards to establish the limits of reliability of the calorific value of municipal solid waste (MSW) by the bomb calorimetric procedure currently used in commercial test laboratories. This procedure involves using gram-size samples derived from MSW that has been processed down to a particle size of 2 mm or less. Critics of the procedure argue that gram-size samples are too small to be representative of such a heterogeneous material, and that processing MSW alters its composition. To test the bomb calorimetric procedure, a 2.5 kg capacity combustion flow calorimeter was designed and constructed for the determination of the enthalpies of combustion of kilogram-size samples of MSW in flowing oxygen near atmospheric pressure.

401,862
PB84-202647 PC A11/MF A01
National Bureau of Standards (NEL), Washington, DC. Chemical Engineering Science Div.
Liquefied Natural Gas Densities: Summary of Research Program at the National Bureau of Standards.
Final rept.,
W. M. Haynes, R. D. McCarty, and M. J. Hiza. Oct 83, 249p NBS/MONO-172
Also available from Supt. of Docs as SN003-003-02587-9. Library of Congress catalog card no. 83-600608.

Keywords: *Liquefied natural gas, *Density(Mass/volume), Mixtures, Binary systems(Materials), Research projects, Dielectric properties, Fuels, Mathematical models, Volume, Numerical solution.

This report summarizes the results of a project concerning the densities of liquefied natural gas (LNG) and its components. This project, initiated in the Properties of Fluids Section of the Cryogenics Division of the National Bureau of Standards in July 1972, was carried out under the sponsorship of a consortium of eighteen energy companies. The density data have been used to optimize, test, and compare several mathematical models as to their suitability for the calculation of LNG densities for custody transfer. Models selected for optimization and testing included an extended corresponding states method, a hard sphere model, a cell model, and an empirical model due to Klosek and McKinley. The ultimate goal of this project was to produce one or more mathematical models that could be used to predict the density of any LNG mixture to within an uncertainty of 0.1 percent from an input of pressure, temperature, and composition. After revisions based on the new experimental data from this project, each of the models investigated here satisfy this goal for typical LNG compositions. The limitations and ranges of validity of the various models are discussed. Also presented are techniques for predicting LNG densities from dielectric constant measurements and from excess volume calculations. The last section of this report consists of publications that provide a complete and detailed account of the results of this project.

401,863
PB85-102259 Not available NTIS
National Bureau of Standards, Washington, DC.
Measurement Techniques for Fuel Stability Characterization.
Final rept.,
A. L. Cummings, P. Pei, and S. M. Hsu. 1983, 16p
Pub. in American Society for Testing and Materials, Special Technical Publication 809, p335-350 1983.

Keywords: *Fuels, *Oxidation tests, *Chemical stabilization, *Chemical analysis, Comparison, Stability, Dis-

tillation, Chromatographic analysis, Reprints, Liquid chromatography, Differential scanning calorimetry.

A measurement technique has been developed to characterize the oxidation stability of liquid fuels under various conditions. The technique is based on high pressure differential scanning calorimetry. It is shown to be sensitive to the chemical compositions of some fuels, including shale-derived jet fuel and a marine diesel fuel. These fuels were subsequently fractionated according to molecular type using liquid chromatography. Using the procedure developed, the oxidation characterizations of the fuel fractions were examined. Results suggested that different amount of various molecular types present in different fuels may affect the overall stability of the fuels. Comparison of results from these tests with the results from commonly used stability tests (JFTOT and accelerated stability) suggests qualitative agreement. The technique offers many advantages in terms of precision, sample size requirement, as well as number of parameters measured.

401,864

PB85-102754

Not available NTIS

National Bureau of Standards, Washington, DC.

Semi-Quantitative Ion Microprobe Mass Analysis (IMMA) of Mineral-Rich Particles in the Upper Freeport Coal.

Final rept.,

R. B. Finkelman, F. T. Dulong, R. W. Stanton, D. S.

Simons, and E. B. Steel. 1984, 11p

Sponsored in part by Geological Survey, Reston, VA. Pub. in *International Jnl. of Coal Geology* 3, p279-289 1984.

Keywords: *Coal, *Chemical analysis, *Clay minerals, Trace elements, Electron microscope, Sampling, Reprints, *Ion microprobe mass analyzers.

An ion microprobe mass analyzer has been used to quantitatively analyze clay-rich particles from two facies in the Upper Freeport coal bed. Accuracy is estimated to be \pm or - 20 percent (one standard deviation) for those elements with abundances above 0.1 weight percent and \pm or - 50 percent (one standard deviation) for the remaining elements. Statistically significant differences between the two samples were found for six of the 25 elements detected. For some of these elements (Fe, Li, Mn), the differences seen in the clay-rich particles are similar to the differences found in whole-coal analyses. In other cases differences between the two samples are attributable to irregular distributions of an inorganic phase (Ce, La) or different modes of occurrence of an element (Ca). Differences between the clay-rich phases and bulk analysis are significant for only five elements (Fe, Ca, Na, Ti, K) and are attributable to irregular distributions and/or different modes of occurrence. The authors conclude that quantitative ion microprobe analysis can provide insight into the distribution and mode of occurrence of many trace elements in coal.

401,865

PB85-115541

Not available NTIS

National Bureau of Standards, Washington, DC.

Nuclear Magnetic Resonance Studies of Ancient Buried Wood 1. Observations on the Origin of Coal to the Brown Coal Stage.

Final rept.,

P. G. Hatcher, I. A. Breger, and W. L. Earl. 1981, 7p

Pub. in *Organic Geochemistry* 3, n1-2 p49-55 Jan-Apr 81.

Keywords: *Nuclear magnetic resonance, *Wood, *Anaerobic processes, *Geochemistry, Sediments, Reprints, *Coalification.

Various wood fragments buried in sediments under anaerobic conditions for 450 years to approximately 8 million years have been examined by solid-state nuclear magnetic resonance. Cellulose and other carbohydrates, the major components of Holocene wood, have been shown to be gradually hydrolyzed under the conditions of burial. Lignin structures, however, are preserved relatively unchanged and become concentrated by differences as the carbohydrates disappear. Thus, a fragment of coalified wood isolated from a Miocene brown coal was found to be still composed of approximately 75% lignin and 25% cellulose. On the basis of our observations, we suggest that coalification of woody tissue progresses directly from lignin to coal and that such coalification may not occur until most of the cellulose disappears.

401,866

PB85-143584

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Ignition of a Liquid Fuel Under High Intensity Radiation.

Final rept.,

T. Kashiwagi. 1980, 9p

Pub. in *Combustion Science and Technology* 21, n3-4 p131-139 1980.

Keywords: *Fuels, *Ignition, Reprints.

This describes an experimental study of the key process of the ignition. First, the effect of the container size on ignition was studied to determine the appropriate container size to avoid wall effects. Then, high speed photographs were taken to observe the events through the preheating period to ignition. Finally the effect on ignition of the incident angle of the laser beam with respect to the liquid surface was studied. Results obtained from these experiments are described.

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PB83-165068

400,129

Author name

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NTIS order number

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- PB85-159069**
Innovative Office Building Structures and Enclosures: A Survey of Experts.
PB85-159069 401,245 PC A06/MF A01
- PB85-159085**
Materials Selection Criteria for Crack Arrestor Strakes in Naval Vessels: Second Interim Progress Report.
PB85-159085 401,152 PC A04/MF A01
- PB85-159945**
Heat Release and Mass Loss Rate Measurements for Selected Materials.
PB85-159945 401,857 PC A04/MF A01
- PB85-159952**
Small Aperture Analysis of the Dual TEM (Transverse Electromagnetic) Cell and an Investigation of Test Object Scattering in a Single TEM Cell.
PB85-159952 401,477 PC A04/MF A01
- PB85-159960**
Implementation of Compressible Shoring Analysis for Multi-story Concrete Construction.
PB85-159960 401,246 PC A04/MF A01
- PB85-160133**
Prediction of the Long Term Stability of Polyester-Based Recording Media.
PB85-160133 401,024 PC A03/MF A01
- PB85-160695**
Calorimeter for Measuring High-Energy Optical Pulses.
PB85-160695 401,478 PC A08/MF A01
- PB85-161271**
Journal of Research of the National Bureau of Standards, Volume 89, Number 5, September-October 1984.
PB85-161271 401,479 PC A05/MF A01
- PB85-161289**
Evaluation of Some High-Temperature Platinum Resistance Thermometers.
PB85-161289 401,480
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- PB85-161297**
Automated High-Temperature PVT Apparatus with Data for Propane.
PB85-161297 401,481
(Order as PB85-161271, PC A05/MF A01)
- PB85-161305**
Radio Propagation in a Coal Seam and the Inverse Problem.
PB85-161305 400,662
(Order as PB85-161271, PC A05/MF A01)
- PB85-161313**
Report on the National Bureau of Standards pH Standards.
PB85-161313 400,639
(Order as PB85-161271, PC A05/MF A01)
- PB85-163376**
Thickness Effect in Low-Density Insulation.
PB85-163376 401,091 PC A03/MF A01
- PB85-163384**
Computer Generation of Latin Hypercube Sampling Plans.
PB85-163384 401,051 PC A02/MF A01
- PB85-163392**
Short Duration Winter-Time Performances of Different Passive Solar Systems.
PB85-163392 401,092 PC A04/MF A01
- PB85-164952**
Technical Activities 1984, Center for Analytical Chemistry.
PB85-164952 400,133 PC A08/MF A01
- PB85-165645**
Validation of Daylight Prediction with CEL-1.
PB85-165645 401,093 PC A02/MF A01
- PB85-165850**
Future Information Technology, 1984 Telecommunications.
PB85-165850 400,786 PC A15/MF A01
- PB85-165900**
Methods and Procedures Used at the National Bureau of Standards to Certify Sulfur in Coal SRM's (Standard Reference Materials) for Sulfur Content, Calorific Value, Ash Content.
PB85-165900 400,640 PC A04/MF A01
- PB85-166759**
Negative Exponential Solution to an Evacuation Problem.
PB85-166759 401,201 PC A02/MF A01
- PB85-170587**
Civil Engineering Standards for the Computer Age.
PB85-170587 400,787 Not available NTIS
- PB85-170645**
Fault-Tolerant Hierarchical Broadcast Network.
PB85-170645 401,501 Not available NTIS
- RR-84-36**
Negative Exponential Solution to an Evacuation Problem.
PB85-166759 401,201 PC A02/MF A01
- RR-174-VOL-1**
Technologies in the Service Sector. Volume 1. Economic and Technological Trends.
PB85-122471 400,076 PC A08/MF A01
- RR-174-VOL-2**
Technologies in the Service Sector. Volume 2. A Case Study of Videotex/Teletext.
PB85-122489 400,077 PC A06/MF A01
- RR-174-VOL-3**
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PB85-122497 400,078 PC A06/MF A01
- TT-76-52046**
Phase Diagrams of Uranium Alloys--Translation.
PB84-191311 400,898 PC A18/MF A01
- VPI-E-80-23**
Solar Collector Test Procedures: Development of a Method to Refer Measured Efficiencies to Standardized Test Conditions.
PB84-165299 400,832 PC A07/MF A01

APPENDIX A

List of Depository Libraries in the United States

ALABAMA

Alexander City

Alexander City State Junior College Thomas S. Russell Library (1967)*

Auburn

Auburn University Ralph Brown Draughon Library (1907)

Birmingham

Birmingham Public Library (1895)
Birmingham-Southern College Library (1932)
Jefferson State Junior College James B. Allen Library (1970)
Miles College C. A. Kirkendoll Learning Resource Center (1980)
Samford University Library (1884)

Enterprise

Enterprise State Junior College Learning Resources Center (1967)

Fayette

Brewer State Junior College Learning Resources Center Library (1979)

Florence

University of North Alabama Collier Library (1932)

Gadsden

Gadsden Public Library (1963)

Huntsville

University of Alabama in Huntsville Library (1964)

Jacksonville

Jacksonville State University Library (1929)

Mobile

Mobile Public Library (1963)
Spring Hill College Thomas Byrne Memorial Library (1937)
University of South Alabama Library (1968)

Montgomery

Alabama State Department of Archives and History Library (1884)
Alabama Supreme Court and State Law Library (1884)
Auburn University at Montgomery Library (1971) REGIONAL
Air University Library Maxwell Air Force Base (1963)

Normal

Alabama Agricultural and Mechanical University J. F. Drake Memorial Learning Resources Center (1963)

Troy

Troy State University Library (1963)

Tuskegee Institute

Tuskegee Institute Hollis Burke Frissell Library (1907)

University

University of Alabama Library (1860) REGIONAL
University of Alabama School of Law Library (1967)

ALASKA

Anchorage

Alaska Court Libraries (1973)
Anchorage Municipal Libraries Z. J. Loussac Public Library (1978)
University of Alaska at Anchorage Library (1961)
U.S. Department of Interior Alaska Resources Library (1981)
U.S. District Court Library (1983)

Fairbanks

University of Alaska Elmer E. Rasmuson Library (1922)

Juneau

Alaska State Library (1900)
University of Alaska-Juneau Library & Medical Services (1981)

Ketchikan

Ketchikan Community College Library (1970)

ARIZONA

Coolidge

Central Arizona College (1973)

Flagstaff

Northern Arizona University Library (1937)

Mesa

Mesa Public Library (1983)

Phoenix

Department of Library Archives, and Public Records (unknown) REGIONAL
Grand Canyon College Fleming Library (1978)

* Year designated.

Phoenix Public Library (1917)
U.S. Court of Appeals (1984)

Prescott

Yavapai College Library (1976)

Tempe

Arizona State University College of Law Library (1977)
Arizona State University Library (1944)

Tucson

Tucson Public Library (1970)
University of Arizona Library (1907) REGIONAL

Yuma

Yuma City-County Library (1963)

ARKANSAS

Arkadelphia

Ouachita Baptist University Riley Library (1963)

Batesville

Arkansas College Library (1963)

Clarksville

College of the Ozarks Dobson Memorial Library (1925)

Conway

Hendrix College Olin C. Bailey Library (1903)

Fayetteville

University of Arkansas University Libraries (1907)
University of Arkansas School of Law Library (1978)

Little Rock

Arkansas State Library (1978) REGIONAL
Arkansas Supreme Court Library (1962)
Little Rock Public Library (1953)
University of Arkansas at Little Rock Library (1973)
University of Arkansas at Little Rock, School of Law Library (1979)

Magnolia

Southern Arkansas University Magale Library (1956)

Monticello

University of Arkansas at Monticello Library (1956)

Pine Bluff

University of Arkansas at Pine Bluff Watson Memorial Library (1976)

Russellville

Arkansas Tech University Tomlinson Library (1925)

Searcy

Harding University Beaumont Memorial Library (1963)

State University

Arkansas State University Dean B. Ellis Library (1913)

Walnut Ridge

Southern Baptist College Felix Goodson Library (1967)

CALIFORNIA

Anaheim

Anaheim Public Library (1963)

Arcadia

Arcadia Public Library (1975)

Arcata

Humboldt State University Library (1963)

Bakersfield

California State College Bakersfield Library (1974)
Kern County, Beale Memorial Library (1943)

Berkeley

University of California General Library (1907)
University of California Law Library (1963)

Carson

California State University Dominguez Hills Educational Resources
Center (1973)
Carson Regional Library (1973)

Chico

California State University Merriam Library (1962)

Claremont

Claremont Colleges' Libraries Honnold Library (1913)

Coalinga

West Hills Community College Library (1978)

Compton

Compton Public Library (1972)

Culver City

Culver City Library (1966)

Davis

University of California Shields Library (1953)
University of California at Davis Law Library (1972)

Downey

Downey City Library (1963)

Fresno

California State University, Fresno, Henry Madden Library (1962)
Fresno County Free Library (1920)

Fullerton

California State University, at Fullerton Library (1963)
Western State University College of Law Library (1984)

Garden Grove

Garden Grove Regional Library (1963)

Gardena

Gardena Public Library (1966)

Hayward

California State University at Hayward Library (1963)

Huntington Park

Huntington Park Library (1970)

Inglewood

Inglewood Public Library (1963)

Irvine

University of California at Irvine General Library (1963)

La Jolla

University of California at San Deigo Central University Library (1963)

Lakewood

Angelo Iacoboni Public Library (1970)

Lancaster

Lancaster Library (1967)

La Verne

University of La Verne College of Law Library (1979)

Long Beach

California State University at Long Beach Library (1962)
Long Beach Public Library (1933)

Los Angeles

California State University at Los Angeles John F. Kennedy Memorial Library (1956)
Los Angeles County Law Library (1963)
Los Angeles Public Library (1891)
Loyola Marymount University Charles Von der Ahe Library (1933)
Loyola Law School Law Library (1979)
Occidental College Library (1941)
Southwestern University School of Law Library (1975)
University of California, University Research Library (1932)
University of California, Los Angeles Law Library (1958)
University of Southern California Doheny Memorial Library (1933)
University of Southern California Law Library (1978)
U.S. Court of Appeals 9th Circuit Library (1981)
Whittier College School of Law Library (1978)

Malibu

Pepperdine University Library (1963)

Menlo Park

Department of Interior Geological Survey Library (1962)

Montebello

Montebello Library (1966)

Monterey

U.S. Naval Postgraduate School Dudley Knox Library (1963)

Monterey Park

Bruggemeyer Memorial Library (1964)

Northridge

California State University at Northridge, Oviatt Library (1958)

Norwalk

Norwalk Public Library (1973)

Oakland

Mills College Library (1966)
Oakland Public Library (1923)

Ontario

Ontario City Library (1974)

Palm Springs

Palm Springs Public Library (1980)

Pasadena

California Institute of Technology Millikan Memorial Library (1933)
Pasadena Public Library (1963)

Pleasant Hill

Contra Costa County Library (1964)

Redding

Shasta County Library (1956)

Redlands

University of Redlands Armacost Library (1933)

Redwood City

Redwood City Public Library (1966)

Reseda

West Valley Regional Branch Library (1966)

Richmond

Richmond Public Library (1943)

Riverside

Riverside City and County Public Library (1947)
University of California at Riverside Library (1963)

Sacramento

California State Library (1895) REGIONAL
California State University at Sacramento Library (1963)
Sacramento County Law Library (1963)
Sacramento Public Library (1880)
University of the Pacific McGeorge School of Law Library (1978)

San Bernardino

San Bernardino County Law Library (1984)
San Bernardino County Library (1964)

San Diego

San Diego County Law Library (1973)
San Diego County Library (1966)
San Diego Public Library (1895)
San Diego State University Library (1962)
University of San Diego Kratter Law Library (1967)

San Francisco

Golden Gate University School of Law Library (1979)
Hastings College of Law Library (1972)
Mechanics' Institute Library (1889)
San Francisco Public Library (1889)
San Francisco State University J. Paul Leonard Library (1955)
Supreme Court of California Library (1979)
U.S. Court of Appeals Ninth Circuit Library (1971)
University of San Francisco Richard A. Gleeson Library (1963)

San Jose

San Jose State University Library (1962)

San Leandro

San Leandro Community Library Center (1961)

San Luis Obispo

California Polytechnic State University Robert E. Kennedy Library (1969)

San Rafael

Marin County Free Library (1975)

Santa Ana

Orange County Law Library (1975)
Santa Ana Public Library (1959)

Santa Barbara

University of California at Santa Barbara Library (1960)

Santa Clara

University of Santa Clara Orradre Library (1963)

Santa Cruz

University of California at Santa Cruz, McHenry Library (1963)

Santa Rosa

Sonoma County Library (1896)

Stanford

Stanford University Libraries (1895)
Stanford University Robert Crown Law Library (1978)

Stockton

Public Library of Stockton and San Joaquin County (1884)

Thousand Oaks

California Lutheran College Library (1964)

Torrance

Torrance Public Library (1969)

Turlock

California State College Stanislaus Library (1964)

Vallejo

Solano County Library, John F. Kennedy Library (1982)

Valencia

Valencia Regional Library (1972)

Ventura

Ventura County Library Services Agency (1975)

Visalia

Tulare County Free Library (1967)

Walnut

Mount San Antonio College Library (1966)

West Covina

West Covina Regional Library (1966)

Whittier

Whittier College Wardman Library (1963)

CANAL ZONE

Balboa Heights

Panama Canal Commission (1963)

COLORADO

Alamosa

Adams State College Learning Resources Center (1963)

Aurora

Aurora Public Library (1984)

Boulder

University of Colorado at Boulder Norlin Library (1879) REGIONAL

Colorado Springs

Colorado College Tutt Library (1880)
University of Colorado at Colorado Springs Library (1974)

Denver

Auraria Library (1978)
Colorado State Library (unknown)
Colorado Supreme Court Library (1978)
Denver Public Library (1884) REGIONAL
Department of the Interior Bureau of Reclamation Library (1962)
Regis College Dayton Memorial Library (1915)
U.S. Court of Appeals Tenth Circuit Library (1973)
University of Denver Penrose Library (1909)
University of Denver College of Law Westminster Law Library (1978)

Fort Collins

Colorado State University Libraries (1907)

Golden

Colorado School of Mines Arthur Lakes Library (1939)

Grand Junction

Mesa County Public Library (1975)

Greeley

University of Northern Colorado James A. Michener Library (1966)

Gunnison

Western State College Leslie J. Savage Library (1932)

La Junta

Otero Junior College Wheeler Library (1963)

Lakewood

Jefferson County Public Library Lakewood Library (1968)

Pueblo

Pueblo Library District (1893)
University of Southern Colorado Library (1965)

USAF Academy

U.S. Air Force Academy Academy Library—DFSEL-D (1956)

CONNECTICUT

Bridgeport

Bridgeport Public Library (1884)
University of Bridgeport School of Law Library Wahlstrom Library (1979)

Danbury

Western Connecticut State University Ruth A. Haas Library (1967)

Danielson

Quinebaug Valley Community College Audrey P. Beck Library (1975)

Enfield

Enfield Central Library (1967)

Hartford

Connecticut State Library (unknown) REGIONAL
Hartford Public Library (1945)
Trinity College Library (1895)
University of Connecticut School of Law Library (1978)

Middletown

Wesleyan University Olin Library (1906)

Mystic

Mystic Seaport Museum, Incorporated G. W. Blunt White Library (1964)

New Britain

Central Connecticut State University Elihu Burritt Library (1973)

New Haven

Southern Connecticut State University Hilton C. Buley Library (1968)
Yale Law Library (1981)
Yale University Seeley G. Mudd Library (1859)

New London

Connecticut College Library (1926)
U.S. Coast Guard Academy Library (1939)

Stamford

Ferguson Library Stamford's Public Library (1973)

Storrs

University of Connecticut University Library U-56P (1907)

Waterbury

Post College Traurig Library (1977)
Silas Bronson Public Library (1869)

West Haven

University of New Haven Peterson Library (1971)

DELAWARE

Dover

Delaware State College William C. Jason Library (1962)
State Law Library in Kent County (unknown)

Georgetown

Delaware Technical and Community College Library (1968)
Sussex County Law Library (1976)

Newark

University of Delaware Library (1907)

Wilmington

Delaware Law School Library (1976)
New Castle County Law Library (1974)

DISTRICT OF COLUMBIA

Washington

Administrative Conference of the United States Library (1977)
Advisory Commission on Intergovernmental Relations Library (1972)
American University Washington College of Law Library (1983)
Antioch School of Law Library (1982)
Catholic University of America Robert J. White Law Library (1979)
Civil Aeronautics Board Library (1974)
Department of the Army Pentagon Library ANRAL (1969)
Department of Commerce Library (1955)
Department of Energy, Energy Library (1963)
Department of Health and Human Services Library (1954)
Department of Housing and Urban Development Library (1969)
Department of the Interior Library Natural Resources Library (1895)
Department of Justice Main Library (1895)
Department of Labor Library (1976)
Department of the Navy Library (1895)
Department of State Library (1895)
Department of State Law Library (1966)
Department of Transportation Main Library (1982)
Department of Transportation, U.S. Coast Guard Law Library (1982)
Department of the Treasury Library (1895)
District of Columbia Court of Appeals Library (1981)
District of Columbia Public Library (1943)
Executive Office of the President, Office of Administration, Library & Information Service Division (1965)
Federal Deposit Insurance Corporation Library (1972)
Federal Election Commission Library (1975)
Federal Energy Regulatory Commission Library (1983)
Federal Labor Relations Authority Law Library (1982)
Federal Mine Safety & Health Review Commission Library (1979)
Federal Reserve System Board of Governors Research Library (1978)
Federal Reserve System Law Library (1976)
General Accounting Office Library (1974)
General Services Administration Library (1975)
Georgetown University Library (1969)
Georgetown University Law Center Fred O. Dennis Law Library (1978)
George Washington University Melvin Gelman Library (1983)
George Washington University National Law Center Jacob Burns Law Library (1978)
Library of Congress Congressional Research Service (1978)
Library of Congress Serial and Government Publications (1977)
Merit Systems Protection Board Library (1979)
National Defense University Library (1895)
U.S. Court of Appeals Judges' Library (1975)
U.S. Office of Personnel Management Library (1963)
U.S. Postal Service Library (1895)
U.S. Senate Library (1979)
U.S. Supreme Court Library (1978)
University of the District of Columbia Library (1970)
Veterans' Administration Central Office Library (1967)

FLORIDA

Boca Raton

Florida Atlantic University S. E. Wimberly Library (1963)

Clearwater

Clearwater Public Library (1972)

Coral Gables

University of Miami Library (1939)

Daytona Beach

Volusia County Library Center (1963)

De Land

Stetson University duPont-Ball Library (1887)

Fort Lauderdale

Broward County Main Library (1967)
Nova University, Center for Study of Law/Law Library (1967)

Fort Pierce

Indian River Community College Library (1975)

Gainesville

University of Florida College of Law Library (1978)
University of Florida Libraries (1907) REGIONAL

Jacksonville

Haydon Burns Public Library (1914)
Jacksonville University Swisher Library (1962)
University of North Florida Thomas G. Carpenter Library (1972)

Lakeland

Lakeland Public Library (1928)

Leesburg

Lake-Sumter Community College Library (1963)

Melbourne

Florida Institute of Technology Library (1963)

Miami

Florida International University Library (1970)
Miami-Dade Public Library (1952)

North Miami

Florida International University North Miami Campus Library (1977)

Opa Locka

Biscayne College Library (1966)

Orlando

University of Central Florida Library (1966)

Palatka

Saint Johns River Community College Library (1963)

Panama City

Bay County Public Library (1983)

Pensacola

University of West Florida John C. Pace Library (1966)

Port Charlotte

Charlotte County Library System (1973)

Saint Petersburg

Saint Petersburg Public Library (1965)
Stetson University College of Law Charles A. Dana Library (1975)

Sarasota

Selby Public Library (1970)

Tallahassee

Florida Agricultural and Mechanical University Coleman Learning Resources Center (1936)
Florida State University College of Law Library (1978)
Florida State University Documents Dept./Strozier Library (1941)
Florida Supreme Court Library (1974)
State Library of Florida (1929)

Tampa

Tampa-Hillsborough County Public Library (1965)
University of South Florida Library (1962)
University of Tampa Merl Kelce Library (1953)

Winter Park

Rollins College Mills Memorial Library (1909)

GEORGIA

Albany

Dougherty County Public Library (1964)

Americus

Georgia Southwestern College James Earl Carter Library (1966)

Athens

University of Georgia Libraries (1907) REGIONAL
University of Georgia School of Law Library (1979)

Atlanta

Atlanta Public Library (1880)
Atlanta University Center Robert W. Woodruff Library (1962)
Emory University School of Law Library (1968)
Emory University Woodruff Library (1928)
Georgia Institute of Technology Price Gilbert Memorial Library (1963)
Georgia State Library (unknown)
Georgia State University William Russell Pullen Library (1970)
Georgia State University College of Law Library (1983)
U.S. Court of Appeals 11th Circuit Library (1980)

Augusta

Augusta College Reese Library (1962)

Brunswick

Brunswick-Glynn County Regional Library (1965)

Carrollton

West Georgia College Irvine Sullivan Ingram Library (1962)

Columbus

Columbus College Simon Schwob Memorial Library (1975)

Dahlonega

North Georgia College Stewart Library (1939)

Dalton

Dalton Junior College Library Resource Center (1978)

Decatur

DeKalb Community College South Campus Learning Resources Center (1973)

Macon

Mercer University Stetson Memorial Library (1964)
Mercer University Walter F. George School of Law Library (1978)

Marietta

Kennesaw College Memorial Library (1968)

Milledgeville

Georgia College at Milledgeville Ina Dillard Russell Library (1950)

Mount Berry

Berry College Memorial Library (1970)

Savannah

Chatham-Effingham Liberty Regional Library (1857)

Statesboro

Georgia Southern College Liberty (1939)

Valdosta

Valdosta State College Library (1956)

GUAM

Agana

Nieves M. Flores Memorial Library (1962)

Mangilao

University of Guam Robert F. Kennedy Memorial Library (1978)

HAWAII

Hilo

University of Hawaii at Hilo Library (1962)

Honolulu

Hawaii Medical Library Incorporated (1968)
Hawaii State Library (1929)
Municipal Reference & Records Center (1965)
Supreme Court Law Library (1973)
University of Hawaii Hamilton Library (1907) REGIONAL
University of Hawaii William S. Richardson School of Law Library (1978)

Laie

Brigham Young University Hawaii Campus, Joseph F. Smith Library (1964)

Lihue

Kauai Regional Library (1967)

Pearl City

Leeward Community College Library (1967)

Wailuku

Maui County Library (1962)

IDAHO

Boise

Boise Public Library and Information Center (1929)
Boise State University Library (1966)
Idaho State Law Library (unknown)
Idaho State Library (1971)

Caldwell

College of Idaho Terteling Library (1930)

Moscow

University of Idaho College of Law Library (1978)
University of Idaho Library (1907) REGIONAL

Pocatello

Idaho State University Eli Oboler Library (1908)

Rexburg

Ricks College David O. McKay Library (1946)

Twin Falls

College of Southern Idaho Library (1970)

ILLINOIS

Bloomington

Illinois Wesleyan University Sheean Library (1964)

Carbondale

Southern Illinois University at Carbondale Morris Library (1932)
Southern Illinois University School of Law Library (1978)

Carlinville

Blackburn College Lumpkin Library (1954)

Cartersville

Shawnee Library System (1971)

Champaign

University of Illinois Law Library (1965)

Charleston

Eastern Illinois University Booth Library (1962)

Chicago

Chicago Public Library (1876)
Chicago State University Paul and Emily Douglas Library (1954)
DePaul University Law Library (1979)
Field Museum of Natural History Library (1963)
Illinois Institute of Technology Chicago-Kent College of Law Library (1978)
Illinois Institute of Technology Kemper Library (1982)
John Marshall Law School Library (1981)
Loyola University of Chicago E. M. Cudahy Memorial Library (1966)
Loyola University School of Law Library (1979)
Northeastern Illinois University Library (1961)
Northwestern University School of Law Library (1978)
University of Chicago Law Library (1964)
University of Chicago Library (1897)
University of Illinois at Chicago Library (1957)
William J. Campbell Library of the U.S. Courts (1979)

Decatur

Decatur Public Library (1954)

De Kalb

Northern Illinois University Founders' Memorial Library (1960)
Northern Illinois University College of Law Library (1978)

Des Plaines

Oakton Community College Library (1976)

Edwardsville

Southern Illinois University Lovejoy Memorial Library (1959)

Elsah

Principia College Marshall Brooks Library (1957)

Evanston

Northwestern University Library (1876)

Freeport

Freeport Public Library (1905)

Galesburg

Galesburg Public Library (1896)

Jacksonville

MacMurray College Henry Pfeiffer Library (1929)

Kankakee

Olivet Nazarene College Benner Library and Learning Resource Center (1946)

Lake Forest

Lake Forest College Donnelley Library (1962)

Lebanon

McKendree College Holman Library (1968)

Lisle

Illinois Benedictine College Theodore F. Lownik Library (1911)

Macomb

Western Illinois University Government Publications & Legal Reference Library (1962)

Moline

Black Hawk College Learning Resources Center (1970)

Monmouth

Monmouth College Hewes Library (1860)

Mount Carmel

Wabash Valley College Bauer Media Center (1975)

Mount Prospect

Mount Prospect Public Library (1977)

Normal

Illinois State University Milner Library (1877)

Oak Park

Oak Park Public Library (1963)

Oglesby

Illinois Valley Community College Jacobs Memorial Library (1976)

Palos Hills

Moraine Valley Community College Library (1972)

Park Forest South

Governors' State University Library (1974)

Peoria

Bradley University Cullom-Davis Library (1963)
Peoria Public Library (1883)

River Forest

Rosary College Library Rebecca Crown Library (1966)

Rockford

Rockford Public Library (1895)

Romeoville

Lewis University Library (1952)

Springfield

Illinois State Library (unknown) REGIONAL

Streamwood

Poplar Creek Public Library (1980)

Urbana

University of Illinois Documents Library (1907)

Wheaton

Wheaton College Buswell Memorial Library (1964)

Woodstock

Woodstock Public Library (1963)

INDIANA

Anderson

Anderson College Charles E. Wilson Library (1959)
Anderson Public Library (1983)

Bloomington

Indiana University Library (1881)
Indiana University Law Library (1978)

Crawfordsville

Wabash College Lilly Library (1906)

Evansville

Evansville and Vanderburgh County Public Library (1928)
Indiana State University at Evansville Evansville Campus Library (1969)

Fort Wayne

Allen County Public Library (1896)
Indiana University-Purdue University at Fort Wayne Helmke Library (1965)

Franklin

Franklin College Library (1976)

Gary

Gary Public Library (1943)
Indiana University Northwest Campus Library (1966)

Greencastle

De Pauw University Roy O. West Library (1879)

Hammond

Hammond Public Library (1964)

Hanover

Hanover College, Duggan Library (1892)

Huntington

Huntington College Loew Alumni Library (1964)

Indianapolis

Butler University Irwin Library (1965)
Indianapolis-Marion County Public Library (1906)
Indiana State Library (unknown) REGIONAL
Indiana Supreme Court Law Library (1975)
Indiana University School of Law Library (1967)
Indiana University-Purdue University Library (1979)

Kokomo

Indiana University at Kokomo Learning Resource Center (1969)

Muncie

Ball State University Library (1959)
Muncie Public Library (1906)

New Albany

Indiana University Southeastern Campus Library (1965)

Notre Dame

University of Notre Dame Memorial Library (1883)

Rensselaer

Saint Joseph's College Library (1964)

Richmond

Earlham College Lilly Library (1964)
Morrison-Reeves Library (1906)

South Bend

Indiana University at South Bend Library (1965)

Terre Haute

Indiana State University Cunningham Memorial Library (1906)

Valparaiso

Valparaiso University Moellering Memorial Library (1930)
Valparaiso University Law Library (1978)

West Lafayette

Purdue University Libraries (1907)

IOWA

Ames

Iowa State University Library (1907)

Cedar Falls

University of Northern Iowa Library (1946)

Council Bluffs

Free Public Library (1885)
Iowa Western Community College Herbert Hoover Library (1972)

Davenport

Davenport Public Library (1973)

Des Moines

Drake University Cowles Library (1966)
Drake University Law Library (1972)
Public Library of Des Moines (1888)
State Library of Iowa (unknown)

Dubuque

Carnegie-Stout Public Library (unknown)
Loras College Wahlert Memorial Library (1967)

Fayette

Upper Iowa University Henderson-Wilder Library (1974)

Grinnell

Grinnell College Burling Library (1874)

Iowa City

University of Iowa College of Law Law Library (1968)
University of Iowa Libraries (1884) REGIONAL

Lamoni

Graceland College Frederick Madison Smith Library (1927)

Mason City

North Iowa Area Community College Library (1976)

Mount Vernon

Cornell College Russell D. Cole Library (1896)

Orange City

Northwestern College Ramaker Library (1970)

Sioux City

Sioux City Public Library (1894)

KANSAS

Atchison

Benedictine College Library (1965)

Baldwin City

Baker University Collins Library (1908)

Colby

Colby Community College H.F. Davis Memorial Library (1968)

Emporia

Emporia State University William Allen White Library (1909)

Hays

Fort Hays State University Forsyth Library (1926)

Hutchinson

Hutchinson Public Library (1963)

Fort Scott

Fort Scott Community College Learning Resources Center Library (1979)

Lawrence

University of Kansas Law Library (1971)
University of Kansas Spencer Research Library (1869) REGIONAL

Manhattan

Kansas State University Farrell Library (1907)

Pittsburg

Pittsburg State University Leonard H. Axe Library (1952)

Salina

Kansas Wesleyan University Memorial Library (1930)

Shawnee Mission

Johnson County Library (1979)

Topeka

Kansas State Historical Society Library (1877)
Kansas State Library (unknown)
Kansas Supreme Court Law Library (1975)
Washburn University of Topeka Law Library (1971)

Wichita

Wichita State University Ablah Library (1901)

KENTUCKY

Ashland

Boyd County Public Library (1946)

Barbourville

Union College Abigail E. Weeks Memorial Library (1958)

Bowling Green

Western Kentucky University Helm-Cravens Library (1934)

Crestview Hills

Thomas More College Library (1970)

Danville

Centre College Grace Doherty Library (1884)

Frankfort

Kentucky Department of Libraries and Archives (1967)
Kentucky State Law Library (unknown)
Kentucky State University Blazer Library (1972)

Highland Heights

Northern Kentucky University W. Frank Steely Library (1973)

Hopkinsville

Hopkinsville Community College Library (1976)

Lexington

University of Kentucky Law Library (1968)
University of Kentucky Libraries (1907) REGIONAL

Louisville

Louisville Free Public Library (1904)
University of Louisville Ekstrom Library (1925)
University of Louisville Law Library (1975)

Morehead

Morehead State University Camden-Carroll Library (1955)

Murray

Murray State University Waterfield Library (1924)

Owensboro

Kentucky-Wesleyan College Library Learning Center (1966)

Richmond

Eastern Kentucky University John Grant Crabbe Library (1966)

Williamsburg

Cumberland College Norma Perkins Hagan Memorial Library (1983)

LOUISIANA

Baton Rouge

Louisiana State Library (1976)
Louisiana State University Middleton Library (1907) REGIONAL
Louisiana State University Paul M. Hebert Law Center Library (1929)
Southern University Law School Library (1979)
Southern University Library (1952)

Eunice

Louisiana State University at Eunice LeDoux Library (1969)

Hammond

Southeastern Louisiana University Sims Memorial Library (1966)

Lafayette

University of Southwestern Louisiana Library (1938)

Lake Charles

McNeese State University Lether E. Frazar Memorial Library (1941)

Monroe

Northeast Louisiana University Sandel Library (1963)

Natchitoches

Northwestern State University Watson Memorial Library (1887)

New Orleans

Law Library of Louisiana (unknown)

Loyola University Library (1942)

Loyola University Law Library (1978)

New Orleans Public Library (1883)

Our Lady of Holy Cross College Library (1982)

Southern University in New Orleans Leonard S. Washington Memorial Library (1962)

Tulane University Law Library (1976)

Tuland University Howard-Tilton Memorial Library (1884)

U.S. Court of Appeals Fifth Circuit Library (1973)

University of New Orleans Earl K. Long Library (1963)

Pineville

Louisiana College Richard W. Norton Memorial Library (1969)

Ruston

Louisiana Technical University Prescott Memorial Library (1896)
REGIONAL

Shreveport

Louisiana State University at Shreveport Library (1967)
Shreve Memorial Library (1923)

Thibodaux

Nicholls State University Ellender Memorial Library (1962)

MAINE

Augusta

Maine Law and Legislative Reference Library (1973)
Maine State Library (unknown)

Bangor

Bangor Public Library (1884)

Brunswick

Bowdoin College Library (1884)

Castine

Maine Maritime Academy Nutting Memorial Library (1969)

Lewiston

Bates College George and Helen Ladd Library (1883)

Orono

University of Maine Raymond H. Fogler Library (1907) REGIONAL

Portland

Portland Public Library (1884)

University of Maine School of Law Garbrecht Law Library (1964)

Presque Isle

University of Maine at Presque Isle Library/Learning Resources Center (1979)

Waterville

Colby College Miller Library (1884)

MARYLAND

Annapolis

Maryland State Law Library (unknown)

U.S. Naval Academy Nimitz Library (1895)

Baltimore

Enoch Pratt Free Library (1887)

Johns Hopkins University Milton S. Eisenhower Library (1882)

Morgan State University Soper Library (1940)

University of Baltimore Langsdale Library (1973)

University of Baltimore Law Library (1980)

University of Maryland School of Law Marshall Law Library (1969)

U.S. Court of Appeals 4th Circuit Library (1982)

Bel Air

Harford Community College Library (1967)

Beltsville

Department of Agriculture National Agricultural Library (1895)

Bethesda

Department of Health and Human Services National Library of Medicine (1978)

Uniformed Services University of Health Sciences, Learning Resource Center (1983)

Catonsville

University of Maryland Baltimore County Albin O. Kuhn Library & Gallery (1971)

Chestertown

Washington College Clifton M. Miller Library (1891)

College Park

University of Maryland McKeldin Library (1925) REGIONAL

Cumberland

Allegheny Community College Library (1974)

Frostburg

Frostburg State College Library (1967)

Patuxent River

Patuxent River Central Library (1968)

Rockville

Montgomery County Department of Public Libraries (1951)

Salisbury

Salisbury State College Blackwell Library (1965)

Towson

Goucher College Julia Rogers Library (1966)

Towson State University Cook Library (1979)

Westminster

Western Maryland College Hoover Library (1886)

MASSACHUSETTS

Amherst

Amherst College Library (1884)

University of Massachusetts University Library (1907)

Boston

Boston Athenaeum Library (unknown)

Boston Public Library (1859) REGIONAL

Boston University School of Law Pappas Law Library (1979)

Northeastern University Dodge Library (1962)

State Library of Massachusetts (unknown)

Suffolk University Law Library (1979)

Supreme Judicial Court Social Law Library (1979)

U.S. Court of Appeals First Circuit Library (1978)

Brookline

Public Library of Brookline (1925)

Cambridge

Harvard College Library (1860)

Harvard Law School Library (1981)

Massachusetts Institute of Technology Libraries (1946)

Chicopee

College of Our Lady of the Elms, Alumnae Library (1969)

Lowell

University of Lowell Alumni-Lydon Library (1952)

Lynn

Lynn Public Library (1953)

Medford

Tufts University Library (1899)

Milton

Curry College, Levin Library (1972)

New Bedford

New Bedford Free Public Library (1858)

Newton

Boston College Thomas P. O'Neill Jr. Library (1963)

Newton Centre

Boston College Law School Library (1979)

North Dartmouth

Southeastern Massachusetts University Library (1965)

North Easton

Stonehill College Cushing-Martin Library (1962)

Springfield

Springfield City Library (1966)

Western New England College Law Library (1978)

Waltham

Brandeis University Library (1965)

Waltham Public Library (1982)

Wellesley

Wellesley College Library (1943)

Wenham

Gordon College Winn Library (1963)

Williamstown

William College Library (unknown)

Worcester

American Antiquarian Society Library (1814)

University of Massachusetts Medical Center Lamar Soutter Library (1972)

Worcester Public Library (1859)

MICHIGAN

Albion

Albion College Stockwell Memorial Library (1966)

Allendale

Grand Valley State College Zumberge Library (1963)

Alma

Alma College Library (1963)

Ann Arbor

University of Michigan Harlan Hatcher Graduate Library (1884)

University of Michigan Law Library (1978)

Benton Harbor

Benton Harbor Public Library (1907)

Bloomfield Hills

Cranbrook Institute of Science Library (1940)

Dearborn

Henry Ford Centennial Library (1969)

Henry Ford Community College Library (1957)

Detroit

Detroit College of Law Library (1979)

Detroit Public Library (1868) REGIONAL

Marygrove College Library (1965)

Mercy College of Detroit Library (1965)

University of Detroit Library (1884)

University of Detroit School of Law Library (1978)

Wayne State University G. Flint Purdy Library (1937)

Wayne State University Arthur Neef Law Library (1971)

Dowagiac

Southwestern Michigan College Matthews Library (1971)

East Lansing

Michigan State University Documents Library (1907)

Farmington Hills

Oakland Community College Martin L. King Learning Resources Center (1968)

Flint

Flint Public Library (1967)

University of Michigan-Flint Library (1959)

Grand Rapids

Calvin College & Seminary Library (1967)

Grand Rapids Public Library (1876)

Houghton

Michigan Technological University Library (1876)

Jackson

Jackson District Library (1965)

Kalamazoo

Kalamazoo Public Library (1907)

Western Michigan University Dwight B. Waldo Library (1963)

Lansing

Library of Michigan (unknown) REGIONAL

Thomas M. Cooley Law School Library (1978)

Livonia

Schoolcraft College Library (1962)

Madison Heights

Madison Heights Public Library (1982)

Marquette

Northern Michigan University Olson Library (1963)

Monroe

Monroe County Library System (1974)

Mount Clemens

Macomb County Library (1968)

Mount Pleasant

Central Michigan University Library (1958)

Muskegon

Hackley Public Library (1894)

Olivet

Olivet College Library (1974)

Petoskey

North Central Michigan College Library (1962)

Port Huron

Saint Clair County Library (1876)

Rochester

Oakland University Kresge Library (1964)

Royal Oak

Royal Oak Public Library (1984)

Saginaw

Hoyt Public Library (1890)

Sault Ste. Marie

Lake Superior State College Kenneth Shouldice Library (1982)

Traverse City

Northwestern Michigan College Mark Osterlin Library (1964)

University Center

Delta College Learning Resources Center (1963)

Warren

Warren Public Library Arthur J. Miller Branch (1973)

Wayne

Wayne Oakland Library Federation (1957)

Ypsilanti

Eastern Michigan University Library (1965)

MICRONESIA

Community College of Micronesia Library (1982)

MINNESOTA

Bemidji

Bemidji State University A. C. Clark Library (1963)

Blaine

Anoka County Library (1971)

Collegeville

Saint John's University Alcuin Library (1954)

Cottage Grove

Washington County Library-Park Grove (1983)

Duluth

Duluth Public Library (1909)
University of Minnesota Library and Learning Resources Service
(1984)

Eagan

Dakota County Eagan Library (1983)

Edina

Southdale-Hennepin Area Library (1971)

Mankato

Mankato State University Library (1962)

Minneapolis

Minneapolis Public Library (1893)
University of Minnesota Law School Library (1978)
University of Minnesota Wilson Library (1907) REGIONAL

Moorhead

Moorhead State University Livingston Lord Library (1956)

Morris

University of Minnesota, Morris, Rodney A. Briggs Library (1963)

Northfield

Carleton College Library (1930)
Saint Olaf College Rolvaag Memorial Library (1930)

Saint Cloud

Saint Cloud State University, Learning Resources Center (1962)

Saint Paul

Hamline University School of Law Library (1978)

Minnesota Historical Society Library (1867)
Minnesota State Law Library (unknown)
Saint Paul Public Library (1914)
University of Minnesota Saint Paul Campus Library (1974)
William Mitchell College of Law Library (1979)

Saint Peter

Gustavus Adolphus College Library (1941)

Willmar

Pioneerland Library (1958)

Winona

Winona State University Maxwell Library (1969)

MISSISSIPPI

Cleveland

Delta State University W. B. Roberts Library (1975)

Columbus

Mississippi University for Women John Clayton Fant Memorial Library
(1929)

Hattiesburg

University of Southern Mississippi Joseph A. Cook Memorial Library
(1935)

Jackson

Jackson State University Henry Thomas Sampson Library (1968)
Millsaps College Millsaps-Wilson Library (1963)
Mississippi College School of Law Library (1977)
Mississippi Library Commission (1947)
Mississippi State Law Library (unknown)

Lorman

Alcorn State University Library (1970)

Mississippi State

Mississippi State University Mitchell Memorial Library (1907)

University

University of Mississippi J. D. Williams Library (1883) REGIONAL
University of Mississippi James O. Eastland Law Library (1967)

MISSOURI

Cape Girardeau

Southeast Missouri State University Kent Library (1916)

Columbia

University of Missouri at Columbia Library (1862)
University of Missouri-Columbia Law Library (1978)

Fayette

Central Methodist College George M. Smiley Library (1962)

Fulton

Westminster College Reeves Library (1875)

Jefferson City

Lincoln University Inman E. Page Library (1944)

Missouri State Library (1963)

Missouri Supreme Court Library (unknown)

Joplin

Missouri Southern State College Library (1966)

Kansas City

Kansas City Public Library (1881)

Rockhurst College Greenlease Library (1917)

University of Missouri at Kansas City General Library (1938)

University of Missouri-Kansas City Leon E. Bloch Law Library (1978)

Kirksville

Northeast Missouri State University Pickler Memorial Library (1966)

Liberty

William Jewell College Charles F. Curry Library (1900)

Maryville

Northwest Missouri State University B. D. Owens Library (1982)

Rolla

University of Missouri-Rolla Curtis Laws Wilson Library (1907)

Saint Charles

Lindenwood College Margaret Leggat Butler Library (1973)

Saint Joseph

Saint Joseph Public Library (1891)

Saint Louis

Maryville College Library (1976)

Saint Louis County Library (1970)

Saint Louis Public Library (1866)

Saint Louis University Law Library (1967)

Saint Louis University Pius XII Memorial Library (1866)

U.S. Court of Appeals Eighth Circuit Library (1972)

University of Missouri at Saint Louis Thomas Jefferson Library (1966)

Washington University John M. Olin Library (1960)

Washington University Law Library (1978)

Springfield

Drury College, Walker Library (1874)

Southwest Missouri State University Library (1963)

Warrensburg

Central Missouri State University Ward Edwards Library (1914)

MONTANA

Billings

Eastern Montana College Library (1958)

Bozeman

Montana State University Renne Library (1907)

Butte

Montana College of Mineral Science and Technology Library (1901)

Havre

Northern Montana College Library (1980)

Helena

Carroll College Library (1974)

Montana Historical Society Library (unknown)

Montana State Library (1966)

State Law Library of Montana (1977)

Missoula

University of Montana Maurene & Mike Mansfield Library (1909)
REGIONAL

NEBRASKA

Blair

Dana College Dana-LIFE Library (1924)

Crete

Doane College Perkins Library (1944)

Fremont

Midland Lutheran College Luther Library (1924)

Kearney

Kearney State College Calvin T. Ryan Library (1962)

Lincoln

Nebraska Library Commission (1972) REGIONAL

Nebraska State Library (unknown)

University of Nebraska-Lincoln College of Law Library (1981)

University of Nebraska-Lincoln D. L. Love Memorial Library (1907)

Omaha

Creighton University Reinert/Alumni Library (1964)

Creighton University Law Library (1979)

Omaha Public Library W. Dale Clark Library (1880)

University of Nebraska at Omaha University Library (1939)

Scottsbluff

Scottsbluff Public Library (1925)

Wayne

Wayne State College U.S. Conn Library (1970)

NEVADA

Carson City

Nevada State Library (unknown)
Nevada Supreme Court Library (1973)

Las Vegas

Clark County Library District (1974)
University of Nevada at Las Vegas James Dickinson Library (1959)

Reno

National Judicial College Law Library (1979)
Nevada Historical Society Library (1974)
University of Nevada-Reno Library (1907) REGIONAL
Washoe County Library (1980)

NEW HAMPSHIRE

Concord

Franklin Pierce Law Center Library (1973)
New Hampshire State Library (unknown)

Durham

University of New Hampshire Library (1907)

Hanover

Dartmouth College Library (1884)

Henniker

New England College Danforth Library (1966)

Manchester

Manchester City Library (1884)
New Hampshire College H. A. B. Shapiro Memorial Library (1976)
Saint Anselm's College Geisel Library (1963)

Nashua

Nashua Public Library (1971)

NEW JERSEY

Bayonne

Bayonne Public Library (1909)

Bloomfield

Bloomfield Public Library (1965)

Bridgeton

Cumberland County Library (1966)

Camden

Rutgers University Camden Library (1966)
Rutgers University School of Law Library (1979)

Convent Station

College of Saint Elizabeth Mahoney Library (1938)

East Brunswick

East Brunswick Public Library (1977)

East Orange

East Orange Public Library (1966)

Elizabeth

Elizabeth Free Public Library (1895)

Glassboro

Glassboro State College Savitz Learning Resource Center (1963)

Hackensack

Johnson Public Library (1966)

Irvington

Irvington Public Library (1966)

Jersey City

Jersey City Public Library (1879)
Jersey City State College Forrest A. Irwin Library (1963)

Lawrenceville

Rider College, Franklin F. Moore Library (1975)

Madison

Drew University Library (1939)

Mahwah

Ramapo College Library (1971)

Mount Holly

Burlington County Library (1966)

New Brunswick

New Brunswick Free Public Library (1908)
Rutgers University Alexander Library (1907)

Newark

Newark Public Library (1906) REGIONAL
Rutgers-The State University of New Jersey John Cotton Dana
Library (1966)
Rutgers University Law School Library (1979)
Seton Hall University Law Library (1979)

Passaic

Passaic Public Library (1964)

Pemberton

Burlington County College Library (1979)

Phillipsburg

Phillipsburg Free Public Library (1976)

Plainfield

Plainfield Public Library (1971)

Pomona

Stockton State College Library (1972)

Princeton

Princeton University Library (1884)

Randolph

County College of Morris Sherman H. Masten Learning Resource Center (1975)

Rutherford

Fairleigh Dickinson University Messler Library (1953)

Shrewsbury

Monmouth County Library (1968)

South Orange

Seton Hall University McLaughlin Library (1947)

Teaneck

Fairleigh Dickinson University Teaneck/Hackensack Campus Weiner Library (1963)

Toms River

Ocean County College Learning Resources Center (1966)

Trenton

New Jersey State Library (unknown)
Trenton Free Public Library (1902)

Union

Kean College of New Jersey Nancy Thompson Library (1973)

Upper Montclair

Montclair State College Harry A. Sprague Library (1967)

Wayne

Wayne Public Library (1972)

West Long Branch

Monmouth College Guggenheim Memorial Library (1963)

Woodbridge

Woodbridge Public Library (1965)

NEW MEXICO

Albuquerque

University of New Mexico Medical Center Library (1973)
University of New Mexico School of Law Library (1973)
University of New Mexico General Library (1896) REGIONAL

Hobbs

New Mexico Junior College Pannell Library (1969)

Las Cruces

New Mexico State University Library (1907)

Las Vegas

New Mexico Highlands University Donnelly Library (1913)

Portales

Eastern New Mexico University Golden Library (1962)

Santa Fe

New Mexico State Library (1960) REGIONAL
New Mexico Supreme Court Law Library (unknown)

Silver City

Western New Mexico University Miller Library (1972)

Socorro

New Mexico Institute of Mining & Technology Martin Speare Memorial Library (1984)

NEW YORK

Albany

Albany Law School Library (1979)
New York State Library (unknown) REGIONAL
State University of New York at Albany University Library (1964)

Auburn

Seymour Library (1972)

Bayside

CUNY Law School at Queens College CUNY Law Library (1983)
Queensborough Community College Library (1972)

Binghamton

State University of New York at Binghamton Glenn G. Bartle Library (1962)

Brockport

State University of New York at Brockport Drake Memorial Library (1967)

Bronx

Fordham University Library (1937)
Herbert H. Lehman College Library (1967)
New York Public Library (1973)
State University of New York Maritime College Stephen B. Luce
Library (1947)

Bronxville

Sarah Lawrence College Library (1969)

Brooklyn

Brooklyn College Library (1936)
Brooklyn Law School Library (1974)
Brooklyn Public Library (1908)
Polytechnic Institute of New York Spicer Library (1963)
Pratt Institute Library (1891)
State University of New York Downstate Medical Center Library
(1958)

Buffalo

Buffalo and Erie County Public Library (1895)
State University of New York at Buffalo Charles B. Sears Law
Library (1978)
State University of New York at Buffalo Lockwood Memorial Library
(1963)

Canton

Saint Lawrence University Owen D. Young Library (1920)

Cheektowaga

Cheektowaga Public Library Reinstein Memorial Branch (1978)

Corning

Corning Community College Arthur A. Houghton Jr. Library (1963)

Cortland

State University of New York College at Cortland Memorial Library
(1964)

Delhi

State University Agricultural and Technical College Library (1970)

Douglaston

Cathedral College Library (1971)

East Islip

East Islip Public Library (1973)

Elmira

Elmira College Gannett Tripp Learning Center (1956)

Farmingdale

State University of New York at Farmingdale Library (1917)

Flushing

Queens College Paul Klapper Library (1939)

Garden City

Adelphi University Swirbul Library (1966)

Geneseo

State University of New York at Geneseo Milne Library (1967)

Greenvale

Long Island University B. Davis Schwartz Memorial Library (1964)

Hamilton

Colgate University, Everett Needham Case Library (1902)

Hempstead

Hofstra University Library (1964)
Hofstra University School of Law Library (1979)

Ithaca

Cornell University Library (1907)
Cornell Law Library (1978)
New York State College of Agriculture and Human Ecology Albert R.
Mann Library (1943)

Jamaica

Queens Borough Public Library (1926)
Saint John's University Library (1956)
Saint John's University School of Law Library (1978)

Kings Point

U.S. Merchant Marine Academy Schuyler Otis Bland Library (1962)

Long Island City

Fiorello H. LaGuardia Community College Library (1981)

Mount Vernon

Mount Vernon Public Library (1962)

New Paltz

State University College at New Paltz Sojourner Truth Library (1965)

New York City

Cordoza Law School Library (1979)
City University of New York City College Library (1884)
College of Insurance Library (1965)
Columbia University Libraries (1882)
Columbia University School of Law Library (1981)
Copper Union for the Advancement of Science and Arts Library
(1930)
Medical Library Center of New York (1976)
New York Law Institute Library (1909)
New York Law School Library (1979)
New York Public Library (1907)
New York Public Library (1884)
New York University Law Library (1974)
New York University, Elmer Holmes Bobst Library (1967)
U.S. Court of Appeals Second Circuit Library (1976)
Yeshive University Pollack Library (1979)

Newburgh

Newburgh Free Library (1909)

Niagara Falls

Niagara Falls Public Library (1976)

Oakdale

Dowling College Library (1965)

Oneonta

State University College at Oneonta James M. Milne Library (1966)

Oswego

State University College at Oswego Penfield Library (1966)

Plattsburgh

State University College at Plattsburgh Benjamin F. Feinberg Library (1967)

Potsdam

Clarkson College of Technology Harriet Call Burnap Memorial Library (1938)

State University College at Potsdam Frederick W. Crumb Memorial Library (1964)

Poughkeepsie

Vassar College Library (1943)

Purchase

State University of New York, College of Purchase Library (1969)

Rochester

Rochester Public Library (1963)
University of Rochester Rush Rhees Library (1880)

Saint Bonaventure

Saint Bonaventure University Friedsam Memorial Library (1938)

Saratoga Springs

Skidmore College Library (1964)

Schenectady

Union College Schaffer Library (1901)

Southampton

Southampton College Library (1973)

Staten Island

Wagner College Horrmann Library (1953)

Stony Brook

State University of New York at Stony Brook Main Library (1963)

Syracuse

Onondaga County Public Library (1978)
Syracuse University Library (1878)
Syracuse University William C. Ruger Law Library (1978)

Troy

Troy Public Library (1869)

Uniondale

Nassau Library System (1965)

Utica

Utica Public Library (1885)
SUNY College of Technology Library (1977)

West Point

U.S. Military Academy Cadet Library (unknown)

White Plains

Pace University Law School Library (1978)

Yonkers

Yonkers Public Library Getty Square Branch (1910)

Yorktown Heights

Mercy College Library (1976)

NORTH CAROLINA

Asheville

University of North Carolina at Asheville D. Hiden Ramsey Library (1965)

Boiling Springs

Gardner-Webb College Dover Memorial Library (1974)

Boone

Appalachian State University Library (1963)

Buies Creek

Campbell University Carrie Rich Memorial Library (1965)

Chapel Hill

University of North Carolina at Chapel Hill Wilson Library (1884)
REGIONAL
University of North Carolina Law Library (1978)

Charlotte

Public Library of Charlotte and Mecklenburg County (1964)
Queens College Everett Library (1927)
University of North Carolina at Charlotte Atkins Library (1964)

Cullowhee

Western Carolina University Hunter Library (1953)

Davidson

Davidson College Library (1893)

Durham

Duke University School of Law Library (1978)

Duke University William R. Perkins Library (1890)

North Carolina Central University Law Library (1979)

North Carolina Central University James E. Shepard Memorial Library (1973)

Elon College

Elon College Iris Holt McEwen Library (1971)

Fayetteville

Fayetteville State University Charles W. Chesnut Library (1971)

Greensboro

North Carolina Agricultural and Technical State University F. D. Bluford Library (1937)

University of North Carolina at Greensboro Walter Clinton Jackson Library (1963)

Greenville

East Carolina University, J. Y. Joyner Library (1951)

Laurinburg

Saint Andrews Presbyterian College DeTamble Library (1969)

Lexington

Davidson County Public Library (1971)

Mount Olive

Mount Olive College Moyer Library (1971)

Murfreesboro

Chowan College Whitaker Library (1963)

Pembroke

Pembroke State University Mary H. Livermore Library (1956)

Raleigh

Department of Cultural Resources Division of State Library (unknown)

North Carolina State University D. H. Hill Library (1923)

North Carolina Supreme Court Library (1972)

Wake County Public Library (1969)

Rocky Mount

North Carolina Wesleyan College Library (1969)

Salisbury

Catawba College Library (1925)

Wilmington

University of North Carolina at Wilmington William M. Randall Library (1965)

Wilson

Atlantic Christian College Hackney Library (1930)

Winston-Salem

Forsyth County Public Library (1954)

Wake Forest University Z. Smith Reynolds Library (1902)

NORTH DAKOTA

Bismarck

North Dakota State Library (1971)

North Dakota Supreme Court Law Library (unknown)

State Historical Society of North Dakota State Archives & Historical Research Library (1907)

Veteran's Memorial Public Library (1967)

Dickinson

Dickinson State College Stoxen Library (1968)

Fargo

Fargo Public Library (1964)

North Dakota State University Library (1907) REGIONAL

Grand Forks

University of North Dakota Chester Fritz Library (1890)

Minot

Minot State College Memorial Library (1925)

Valley City

Valley City State College Library (1913)

OHIO

Ada

Ohio Northern University J. P. Taggart Law Library (1965)

Akron

Akron-Summit County Public Library (1952)

University of Akron Bierce Library (1963)

University of Akron School of Law Library (1978)

Alliance

Mount Union College Library (1888)

Ashland

Ashland College Library (1938)

Athens

Ohio University Alden Library (1886)

Batavia

University of Cincinnati at Batavia Clermont General and Technical College Library (1973)

Bluffton

Bluffton College, Musselman Library (1951)

Bowling Green

Bowling Green State University Jerome Library (1933)

Canton

Malone College Everett L. Cattell Library (1970)

Chardon

Geauga County Public Library (1971)

Cincinnati

Public Library of Cincinnati and Hamilton County (1884)

University of Cincinnati Central Library (1929)

University of Cincinnati College of Law (1978)

Cleveland

Case Western Reserve University Freiburger Library (1913)

Case Western Reserve University School of Law Library (1979)

Cleveland Public Library (1886)

Cleveland State University Cleveland-Marshall College of Law, Joseph W. Bartunek III Law Library (1978)

Cleveland State University Library (1966)

Municipal Reference Library (1970)

Cleveland Heights

Cleveland Heights-University Heights Public Library (1970)

Columbus

Capital University Law School Library (1980)

Capital University Library (1968)

Ohio State University Libraries (1907)

Ohio Supreme Court Law Library (1973)

Public Library of Columbus and Franklin County (1885)

State Library of Ohio (unknown) REGIONAL

Dayton

Dayton and Montgomery County Public Library (1909)

University of Dayton Roesch Library (1969)

Wright State University Library (1965)

Delaware

Ohio Wesleyan University L. A. Beeghly Library (1845)

Elyria

Elyria Public Library (1966)

Findlay

Findlay College Shafer Library (1969)

Gambier

Kenyon College Library (1873)

Granville

Denison University Libraries, William H. Doane Library (1884)

Hiram

Hiram College Teachout-Price Memorial Library (1874)

Kent

Kent State University Libraries (1962)

Marietta

Marietta College Dawes Memorial Library (1884)

Marion

Marion Public Library (1979)

Middletown

Miami University-Middletown Gardner-Harvey Library (1970)

New Concord

Muskingum College Library (1966)

Oberlin

Oberlin College Library (1858)

Oxford

Miami University Libraries King Library (1909)

Portsmouth

Portsmouth Public Library (unknown)

Rio Grande

Rio Grande College and Community College Jeanette Albiez Davis Library (1966)

Springfield

Warder Public Library (1884)

Steubenville

University of Steubenville Starvaggi Memorial Library (1971)
Public Library of Steubenville and Jefferson County (1950)

Tiffin

Heidelberg College Beeghly Library (1964)

Toledo

Toledo-Lucas County Public Library (1884)
University of Toledo College of Law Library (1981)
University of Toledo Library (1963)

University Heights

John Carroll University Grasselli Library (1963)

Westerville

Otterbein College Courtright Memorial Library (1967)

Wooster

College of Wooster Andrews Library (1966)

Youngstown

Public Library of Youngstown and Mahoning County (1923)

Youngstown State University William F. Maag Library (1971)

OKLAHOMA

Ada

East Central Oklahoma State University Linscheid Library (1914)

Alva

Northwestern Oklahoma State University J. W. Martin Library (1907)

Bethany

Bethany Nazarene College R. T. Williams Learning Resources Center (1971)

Durant

Southeastern Oklahoma State University Henry G. Bennett Memorial Library (1929)

Edmond

Central State University Library (1934)

Enid

Public Library of Enid and Garfield County (1908)

Langston

Langston University G. Lamar Harrison Library (1941)

Muskogee

Muskogee Public Library (1971)

Norman

University of Oklahoma Libraries Bizzell Memorial Library (1893)

University of Oklahoma Law Library (1978)

Oklahoma City

Metropolitan Library System Main Library (1974)

Oklahoma City University Library (1963)

Oklahoma Department of Libraries (1893) REGIONAL

Shawnee

Oklahoma Baptist University Library (1933)

Stillwater

Oklahoma State University Library (1907) REGIONAL

Tahlequah

Northeastern Oklahoma State University John Vaughan Library (1923)

Tulsa

Tulsa City-County Library System (1963)

University of Tulsa College of Law Library (1979)

University of Tulsa McFarlin Library (1929)

Weatherford

Southwestern Oklahoma State University Al Harris Library (1958)

OREGON

Ashland

Southern Oregon State College Library (1953)

Corvallis

Oregon State University Library (1907)

Eugene

University of Oregon Law Library (1979)

University of Oregon Library (1883)

Forest Grove

Pacific University Harvey W. Scott Memorial Library (1897)

Klamath Falls

Oregon Institute of Technology Library (1982)

La Grande

Eastern Oregon College Walter M. Pierce Library (1954)

McMinnville

Linfield College Northup Library (1965)

Monmouth

Western Oregon State College Library (1967)

Pendleton

Blue Mountain Community College Library (1983)

Portland

Lewis and Clark College Aubrey R. Watzek Library (1967)

Library Association of Portland (1884)

Northwestern School of Law Lewis and Clark College Paul L. Boley
Law Library (1979)
Portland State University Library (1963) REGIONAL
Reed College Library (1912)
U.S. Department of Energy Bonneville Power Administration
Library (1962)

Salem

Oregon State Library (unknown)
Oregon Supreme Court Law Library (1974)
Willamette University College of Law Library (1979)
Willamette University Main Library (1969)

PENNSYLVANIA

Allentown

Muhlenberg College Haas Library (1939)

Altoona

Altoona Area Public Library (1969)

Bethel Park

Bethel Park Public Library (1980)

Bethlehem

Lehigh University Libraries Liderman Library (1876)

Blue Bell

Montgomery County Community College Learning Resources
Center (1975)

Bradford

University of Pittsburgh at Bradford Bradford Campus Library (1979)

Carlisle

Dickinson College Boyd Lee Spahr Library (1947)
Dickinson School of Law Sheeley-Lee Law Library (1978)

Cheyney

Cheyney University Leslie Pinckney Hill Library (1967)

Collegeville

Ursinus College Myrin Library (1963)

Coraopolis

Robert Morris College Library (1978)

Doylestown

Bucks County Free Library (1970)

East Stroudsburg

East Stroudsburg University Kemp Library (1966)

Erie

Erie County Library System (1897)

Greenville

Theil College Langenheim Memorial Library (1963)

Harrisburg

State Library of Pennsylvania (unknown) REGIONAL

Haverford

Haverford College Magill Library (1897)

Hazleton

Hazleton Area Public Library (1964)

Indiana

Indiana University of Pennsylvania Rhodes R. Stabley Library (1962)

Johnstown

Cambria County Library System Glosser Memorial Library Building
(1965)

Lancaster

Franklin and Marshall College Shadek-Fackenthal Library (1895)

Lewisburg

Bucknell University Ellen Clarke Bertrand Library (1963)

Mansfield

Mansfield University Library (1968)

Meadville

Allegheny College Lawrence Lee Pelletier Library (1907)

Millersville

Millersville University Helen A. Ganser Library (1966)

Monessen

Monessen Public Library (1969)

New Castle

New Castle Public Library (1963)

Newtown

Bucks County Community College Library (1968)

Norristown

Montgomery County-Norristown Public Library (1969)

Philadelphia

Drexel University Library (1963)

Free Library of Philadelphia (1897)
Saint Joseph's University Drexel Library (1974)
Temple University Paley Library (1947)
Temple University Law Library (1979)
Thomas Jefferson University Scott Memorial Library (1978)
U.S. Court of Appeals Third Circuit Library (1973)
University of Pennsylvania Biddle Law Library (1974)
University of Pennsylvania Library (1886)

Pittsburgh

Allegheny County Law Library (1977)
Carnegie Library of Pittsburgh (1895)
Carnegie Library of Pittsburgh Allegheny Regional Branch (1924)
Duquesne University Law Library (1978)
La Roche College John J. Wright Library (1974)
U.S. Department of Interior Bureau of Mines Library (1962)
University of Pittsburgh Hillman Library (1910)
University of Pittsburgh Law Library (1979)

Pottsville

Pottsville Free Public Library (1967)

Reading

Reading Public Library (1901)

Scranton

Scranton Public Library (1895)

Shippensburg

Shippensburg University Ezra Lehman Memorial Library (1973)

Slippery Rock

Slippery Rock University Bailey Library (1965)

Swarthmore

Swarthmore College Library (1923)

University Park

Pennsylvania State University Libraries Pattee Library (1907)

Villanova

Villanova University Law School Pulling Law Library (1964)

Warren

Warren Library Association Warren Public Library (1885)

Washington

Washington and Jefferson College U. Grant Miller Library (1884)

Waynesburg

Waynesburg College Library (1964)

West Chester

West Chester University Francis Harvey Green Library (1967)

Wilkes-Barre

King's College D. Leonard Corgan Library (1949)

Williamsport

Lycoming College Library (1970)

York

York College of Pennsylvania Schmidt Library (1963)

Youngwood

Westmoreland County Community College Learning Resources Center (1972)

PUERTO RICO

Mayaguez

University of Puerto Rico Mayaguez Campus Library (1928)

Ponce

Catholic University of Puerto Rico Encarnacion Valdes Library (1966)
Catholic University of Puerto Rico School of Law Library (1978)

Rio Piedras

University of Puerto Rico General Library (1928)

RHODE ISLAND

Kingston

University of Rhode Island Library (1907)

Newport

U.S. Naval War College Library (1963)

Providence

Brown University John D. Rockefeller Jr. Library (unknown)
Providence College Phillips Memorial Library (1969)
Providence Public Library (1884)
Rhode Island College James P. Adams Library (1965)
Rhode Island State Law Library (1979)
Rhode Island State Library (1895)

Warwick

Warwick Public Library (1966)

Westerly

Westerly Public Library (1909)

Woonsocket

Woonsocket Harris Public Library (1977)

SOUTH CAROLINA

Charleston

Baptist College at Charleston L. Mendel Rivers Library (1967)
The Citadel Daniel Library (1962)
College of Charleston Robert Scott Small Library (1869)

Clemson

Clemson University Cooper Library (1893)

Columbia

Benedict College Payton Learning Resources Center (1969)

South Carolina State Library (1895)

University of South Carolina Coleman Karesh Law Library (1983)

University of South Carolina Thomas Cooper Library (1884)

Conway

University of South Carolina Coastal Carolina College Kimbel Library (1974)

Due West

Erskine College McCain Library (1968)

Florence

Florence County Library (1967)

Francis Marion College James A. Rogers Library (1970)

Greenville

Furman University Library (1962)

Greenville County Library (1966)

Greenwood

Lander College Larry A. Jackson Library (1967)

Orangeburg

South Carolina State College Miller F. Whittaker Library (1953)

Rock Hill

Winthrop College Dacus Library (1896)

Spartansburg

Spartansburg County Public Library (1967)

SOUTH DAKOTA

Aberdeen

Northern State College Beulah Williams Library (1963)

Brookings

South Dakota State University H. M. Briggs Library (1889)

Pierre

South Dakota State Library (1973)

South Dakota Supreme Court Library (1978)

Rapid City

Rapid City Public Library (1963)

South Dakota School of Mines and Technology Devereaux Library (1963)

Sioux Falls

Augustana College Mikkelsen Library (1969)

Sioux Falls Public Library (1903)

Spearfish

Black Hills State College Library Learning Center (1942)

Vermillion

University of South Dakota I.D. Weeks Library (1889)

Yankton

Yankton College James Lloyd Library (1904)

TENNESSEE

Bristol

King College E. W. King Library (1970)

Chattanooga

Chattanooga-Hamilton County Bicentennial Library (1908)

U.S. Tennessee Valley Authority Technical Library (1976)

Clarksville

Austin Peay State University Felix G. Woodward Library (1945)

Cleveland

Cleveland State Community College Library (1973)

Columbia

Columbia State Community College John W. Finney Memorial Library (1973)

Cookeville

Tennessee Technological University Jere Whitson Memorial Library (1969)

Jackson

Lambuth College Luther L. Gobbel Library (1967)

Jefferson City

Carson-Newman College Library (1964)

Johnson City

East Tennessee State University Sherrod Library (1942)

Knoxville

Public Libraries Knoxville-Knox County, Lawson McGhee Library (1973)

University of Tennessee at Knoxville James D. Hoskins Library (1907)

University of Tennessee Law Library (1971)

Martin

University of Tennessee at Martin Paul Meek Library (1957)

Memphis

Mamphis-Shelby County Public Library and Information Center (1896)

Memphis State University Cecil C. Humphreys School of Law Library (1979)

Memphis State University Libraries (1966)

Murfreesboro

Middle Tennessee State University Todd Library (1912)

Nashville

Fisk University Library (1965)

Public Library of Nashville and Davidson County (1884)

Tennessee State Law Library (1976)

Tennessee State Library and Archives (unknown)

Tennessee State University Brown-Daniel Library (1972)

Vanderbilt University Law Library (1976)

Vanderbilt University Library (1884)

Sewanee

University of the South Jessie Ball duPont Library (1873)

TEXAS

Abilene

Abilene Christian University Margaret and Herman Brown Library (1978)

Hardin-Simmons University Rupert and Pauline Richardson Library (1940)

Arlington

Arlington Public Library (1970)

University of Texas at Arlington Library (1963)

Austin

Texas State Law Library (1972)

Texas State Library (unknown) REGIONAL

University of Texas at Austin Perry-Castañeda Library (1884)

University of Texas at Austin Edie and Lew Wasserman Public Affairs Library (1966)

University of Texas at Austin Tarlton Law Library (1965)

Baytown

Lee College Library (1970)

Beaumont

Lamar University Mary and John Gray Library (1957)

Brownwood

Howard Payne University Walker Memorial Library (1964)

Canyon

West Texas State University Cornette Library (1928)

College Station

Texas Agricultural and Mechanical University Library (1907)

Commerce

East Texas State University Library (1937)

Corpus Christi

Corpus Christi State University Library (1976)

Corsicana

Navarro College Gaston T. Gooch Library (1965)

Dallas

Bishop College Zale Library (1966)

Dallas Baptist College Vance Memorial Library (1967)

Dallas Public Library (1900)

Southern Methodist University Fondren Library (1925)

University of Texas Health Science Center-Dallas Library (1975)

Denton

North Texas State University Library (1948)

Edinburg

Pan American University Library (1959)

El Paso

El Paso Public Library (1906)

University of Texas at El Paso Documents & Maps Library (1966)

Fort Worth

Fort Worth Public Library (1905)

Texas Christian University Mary Coats Burnett Library (1916)

Galveston

Rosenberg Library (1909)

Houston

Houston Public Library (1884)

North Harris County College Learning Resource Center (1974)

Rice University Fondren Library (1967)

South Texas College of Law Library (1981)

Texas Southern University Thurgood Marshall School of Law Library (1982)

University of Houston-Clear Lake Alfred R. Neumann Library (1980)

University of Houston Library (1957)

University of Houston School of Law Library (1979)

Huntsville

Sam Houston State University Library (1949)

Irving

Irving Public Library System (1974)

Kingsville

Texas Arts and Industries University Jernigan Library (1944)

Laredo

Laredo Junior College Harold R. Yeary Library (1970)

Longview

Nicholson Memorial Public Library (1961)

Lubbock

Texas Tech University Library (1935) REGIONAL
Texas Tech University School of Law Library (1978)

Marshall

Wiley College Thomas Winston Cole Sr. Library (1962)

Nacogdoches

Stephen F. Austin State University Steen Library (1965)

Plainview

Wayland Baptist University Van Howeling Memorial Library (1963)

Richardson

University of Texas at Dallas Library (1972)

San Angelo

Angelo State University Porter Henderson Library (1964)

San Antonio

Saint Mary's University Academic Library (1964)
Saint Mary's University Law Library (1982)
San Antonio College Library (1972)
San Antonio Public Library (1899)
Trinity University Library (1964)
University of Texas at San Antonio Library (1973)

San Marcos

Southwest Texas State University Library (1955)

Seguin

Texas Lutheran College Blumberg Memorial Library (1970)

Sherman

Austin College Arthur Hopkins Library (1963)

Texarkana

Texarkana Community College Palmer Memorial Library (1963)

Victoria

Victoria College/University of Houston Victoria Campus Library (1973)

Waco

Baylor University Law Library (1982)
Baylor University Moody Memorial Library (1905)

Wichita Falls

Midwestern State University Moffett Library (1963)

UTAH

Cedar City

Southern Utah State College Library (1964)

Ephraim

Snow College Lucy A. Phillips Library (1963)

Logan

Utah State University Merrill Library and Learning Resources Center (1907) REGIONAL

Ogden

Weber State College Stewart Library (1962)

Provo

Brigham Young University Harold B. Lee Library (1908)
Brigham Young University Law Library (1972)

Salt Lake City

University of Utah Eccles Health Sciences Library (1970)
University of Utah Law Library (1966)
University of Utah Marriott Library (1893)
Utah State Library (unknown)
Utah State Supreme Court Law Library (1975)

VERMONT

Burlington

University of Vermont Bailey/Howe Library (1907)

Castleton

Castleton State College Calvin Coolidge Library (1969)

Johnson

Johnson State College John Dewey Library (1955)

Lyndonville

Lyndon State College Samuel Reed Hall Library (1969)

Middlebury

Middlebury College Egbert Starr Library (1884)

Montpelier

Vermont Department of Libraries (1895)

Northfield

Norwich University Library (1908)

South Royalton

Vermont Law School Library (1978)

VIRGIN ISLANDS

Saint Croix

Florence Williams Public Library (1974)

Saint Thomas

College of the Virgin Islands Ralph M. Paiewonsky Library (1973)
Enid M. Baa Library and Archives (1968)

VIRGINIA

Alexandria

Dept. of the Navy Office of Judge Advocate General Law Library (1963)

Arlington

George Mason University School of Law Library (1981)

Blacksburg

Virginia Polytechnic Institute and State University Carol M. Newman
Library (1907)

Bridgewater

Bridgewater College Alexander Mack Memorial Library (1902)

Charlottesville

University of Virginia Alderman Library (1910) REGIONAL
University of Virginia Arthur J. Morris Law Library (1964)

Chesapeake

Chesapeake Public Library (1970)

Danville

Danville Community College Learning Resources Center (1969)

Emory

Emory and Henry College Kelly Library (1884)

Fairfax

George Mason University Fenwick Library (1960)

Fredericksburg

Mary Washington College E. Lee Trinkle Library (1940)

Hampden-Sydney

Hampden-Sydney College Eggleston Library (1891)

Hampton

Hampton Institute Huntington Memorial Library (1977)

Harrisonburg

James Madison University Carrier Library (1973)

Hollins College

Hollins College Fishburn Library (1967)

Lexington

Virginia Military Institute Preston Library (1874)
Washington and Lee University University Library (1910)
Washington and Lee University Wilbur C. Hall Law Library (1978)

Martinsville

Patrick Henry Community College Library (1971)

Norfolk

Norfolk Public Library (1895)
Old Dominion University Library (1963)
U.S. Armed Forces Staff College Library (1963)

Petersburg

Virginia State University Johnston Memorial Library (1907)

Quantico

Federal Bureau of Investigation Academy Library (1970)
Marine Corps Development and Education Command James
Carson Breckinridge Library (1967)

Reston

Department of the Interior Geological Survey Library (1962)

Richmond

U.S. Court of Appeals Fourth Circuit Library (1973)
University of Richmond Boatwright Memorial Library (1900)
University of Richmond Law School Library (1982)
Virginia Commonwealth University James Branch Cabell Library
(1971)
Virginia State Law Library (1973)
Virginia State Library (unknown)

Salem

Roanoke College Library (1886)

Williamsburg

College of William and Mary Marshall-Wythe Law Library (1978)
College of William and Mary Swem Library (1936)

Wise

Clinch Valley College John Cook Wyllie Library (1971)

WASHINGTON

Bellingham

Western Washington University Mable Zoe Wilson Library (1963)

Cheney

Eastern Washington University JFK Library (1966)

Ellensburg

Central Washington University Library (1962)

Everett

Everett Public Library (1914)

Midway

Highline Community College Library (1983)

Olympia

Evergreen State College Daniel J. Evans Library (1972)

Washington State Law Library (1979)

Washington State Library (unknown) REGIONAL

Port Angeles

North Olympic Library System (1965)

Pullman

Washington State University Library (1907)

Seattle

Seattle Public Library (1908)

University of Washington Libraries (1890)

University of Washington Marian Gould Gallagher Law Library (1969)

U.S. Court of Appeals 9th Circuit Library (1981)

Spokane

Gonzaga University School of Law Library (1979)

Spokane Public Library (1910)

Tacoma

Tacoma Public Library (1894)

University of Puget Sound Collins Memorial Library (1938)

University of Puget Sound School of Law Library (1978)

Vancouver

Fort Vancouver Regional Library (1962)

Walla Walla

Whitman College Penrose Memorial Library (1890)

WEST VIRGINIA

Athens

Concord College Library (1924)

Bluefield

Bluefield State College Hardway Library (1972)

Charleston

Kanawha County Public Library (1952)

West Virginia Library Commission (unknown)

West Virginia Supreme Court Law Library (1977)

Elkins

Davis and Elkins College Library (1913)

Fairmont

Fairmont State College Library (1884)

Glenville

Glenville State College Robert F. Kidd Library (1966)

Huntington

Marshall University James E. Morrow Library (1925)

Institute

West Virginia State College Drain-Jordon Library (1907)

Morgantown

West Virginia University Library (1907) REGIONAL

Salem

Salem College Library (1921)

Shepherdstown

Shepherd College Ruth Scarborough Library (1971)

Weirton

Mary H. Weir Public Library (1963)

WISCONSIN

Appleton

Lawrence University Seeley G. Mudd Library (1869)

Beloit

Beloit College Col. Robert H. Morse Library (1888)

Eau Claire

University of Wisconsin-Eau Claire William D. McIntyre Library (1951)

Fond du Lac

Fond du Lac Public Library (1966)

Green Bay

University of Wisconsin-Green Bay Learning Resources Center (1968)

La Crosse

La Crosse Public Library (1883)

University of Wisconsin-La Crosse Murphy Library (1965)

Madison

Madison Public Library (1965)

State Historical Society of Wisconsin Library (1870) REGIONAL

University of Wisconsin-Madison Memorial Library (1939)

University of Wisconsin-Madison Law Library (1981)

Wisconsin State Law Library (unknown)

Milwaukee

Alverno College Library/Media Center (1971)

Medical College of Wisconsin, Inc. Todd Wehr Library (1980)

Milwaukee County Law and Reference Library (1934)

Milwaukee Public Library (1861) REGIONAL

Mount Mary College Haggerty Library (1964)

University of Wisconsin-Milwaukee Library (1960)

Oshkosh

University of Wisconsin-Oshkosh Forrest R. Polk Library (1956)

Platteville

University of Wisconsin-Platteville Karrmann Library (1964)

Racine

Racine Public Library (1898)

Ripon

Ripon College Library (1982)

River Falls

University of Wisconsin-River Falls Chaimer Davee Library (1962)

Sheboygan

Mead Public Library (1983)

Stevens Point

University of Wisconsin-Stevens Point Learning Resources Center (1951)

Superior

Superior Public Library (1908)

University of Wisconsin-Superior Jim Dan Hill Library (1935)

Waukesha

Waukesha Public Library (1966)

Wausau

Marathon County Public Library (1971)

Whitewater

University of Wisconsin-Whitewater Harold Anderson Library (1963)

WYOMING

Casper

Natrona County Public Library (1929)

Cheyenne

Wyoming State Law Library (1977)

Wyoming State Library (unknown) REGIONAL

Gillette

Campbell County Public Library (1980)

Laramie

University of Wyoming, Coe Library (1907)

University of Wyoming Law Library (1978)

Powell

Northwest Community College John Taggart Hinckley Library (1967)

Riverton

Central Wyoming College Library (1969)

Rock Springs

Western Wyoming College Library (1969)

Sheridan

Sheridan College, Griffith Memorial Library (1963)

APPENDIX B

List of District Offices of the U.S. Department of Commerce

NORTHEASTERN REGION I

CONNECTICUT

***Hartford**—Room 610-B, Federal Office Building, 450 Main Street 06103, Area Code 203 Tel 244-3530, FTS 244-3530

MAINE

•**Augusta (Boston, Massachusetts District)**—1 Memorial Circle, Casco Bank Bldg. 04330, Area Code 207 Tel 622-8249, FTS 833-6249

MASSACHUSETTS

Boston—10th Floor, 441 Stuart Street 02116, Area Code 617 Tel 223-2312, FTS 223-2312

NEW HAMPSHIRE

Serviced by Boston District Office

NEW YORK

Buffalo—1312 Federal Building, 111 West Huron Street 14202, Area Code 716 Tel 846-4191, FTS 437-4191

•**Rochester**—183 E. Main St., Rm. 666, 16404, Area Code 716 Tel 263-6480, FTS 963-6480

New York—Room 3718, Federal Office Building, 26 Federal Plaza, Foley Square 10278, Area Code 212 Tel 264-0634, FTS 264-0600

RHODE ISLAND

•**Providence (Boston, Massachusetts District)**—7 Jackson Walkway 02903, Area Code 401 Tel 277-2605, ext. 22, FTS 838-4482

VERMONT

Serviced by Boston District Office

MID-ATLANTIC REGION II

DELAWARE

Serviced by Philadelphia District Office

DISTRICT OF COLUMBIA

Serviced by Baltimore District Office

MARYLAND

Baltimore—415 U.S. Customhouse, Gay and Lombard Streets 21202, Area Code 301 Tel 962-3560, FTS 922-3560

•**Rockville**—101 Monroe St., 15th Floor, 20850, Area Code 301 Tel 251-2345

NEW JERSEY

***Trenton**—Capitol Plaza, 8th Fl., 240 West State St., 08608, Area Code 609 Tel 989-2100, FTS 483-2100

PENNSYLVANIA

Philadelphia—9448 Federal Building, 600 Arch Street 19106 Area Code 215 Tel 597-2866, FTS 597-2866

Pittsburgh—2002 Federal Building, 1000 Liberty Avenue 15222, Area Code 412 Tel 644-2850, FTS 722-2850

APPALACHIAN REGION III

KENTUCKY

Louisville—Room 636B, U.S. Post Office and Courthouse Building 40202, Area Code 502 Tel 582-5066, FTS 352-5066

NORTH CAROLINA

***Greensboro**—203 Federal Building, West Market Street, P.O. Box 1950 27402, Area Code 919 Tel 378-5345, FTS 699-5345

•**Raleigh**—Dobbs Bldg., Rm. 294, 430 N. Salisbury St., 27611, Area Code 919 Tel 755-4687, FTS 672-4687

SOUTH CAROLINA

Columbia—Strom Thurmond Fed. Bldg., Suite 172, 1835 Assembly Street 29201 Area Code 803 Tel 765-5345, FTS 677-5345

•**Charleston**—505 Federal Building, 334 Meeting Street 29403, Area Code 803 Tel 677-4361, FTS 677-4361

•**Greenville**—P.O. Box 5823, Station B, 29606, Area Code 803 Tel 235-5919

TENNESSEE

Nashville—Suite 1427, One Commerce Place, 37239, Area Code 615 Tel 251-5161, FTS 852-5161

•**Memphis**—3693 Central Ave., 38111, Area Code 901 Tel 521-4826, FTS 222-4826

VIRGINIA

Richmond—8010 Federal Bldg., 400 North 8th Street, 23240, Area Code 804 Tel 771-2246, FTS 925-2246

•(**Fairfax County**) Dunn Loring—8100 Oak St. Ste. 32, 22027, Area Code 703 Tel 573-9460, FTS 235-1519

WEST VIRGINIA

Charleston—3000 New Federal Building, 500 Quarrier Street 25301, Area Code 304 Tel 343-6181, ext. 375, FTS 924-1375

SOUTHEASTERN REGION IV

ALABAMA

***Birmingham**—Suite 200-201, 908 South 20th Street, 35205, Area Code 205 Tel 254-1331, FTS 229-1331

FLORIDA

Miami—Suite 224, Federal Building, 51 S.W. First Avenue 33130, Area Code 305 Tel 350-5267, FTS 350-5267

•**Clearwater**—128 North Osceola Avenue 33515, Area Code 813 Tel 461-0011

•**Jacksonville**—3 Independent Drive, 32202, Area Code 904 Tel 791-2796, FTS 946-2796

•**Orlando**—75 East Ivanhoe Blvd. 32802 Area Code 305 Tel 425-1247

•Tallahassee–Collins Bldg., Rm. G-20 32304, Area Code 904 Tel 488-6469, FTS 946-4320

GEORGIA

Atlanta–Suite 600, 1365 Peachtree Street, N.E. 30309, Area Code 404 Tel 881-7000, FTS 257-7000

Savannah–27 E. Bay Street, P.O. Box 9746, 31401, Area Code 912 Tel 944-4204, FTS 248-4204

MISSISSIPPI

Jackson–Jackson Mall Office Ctr., Ste. 3230, 300 Woodrow Wilson Blvd., 39213, Area Code 601 Tel 960-4388, FTS 490-4388

PUERTO RICO

San Juan (Hato Rey)–Room 659-Federal Building 00918, Area Code 809 Tel 753-4555, Ext. 555, FTS 8-809-753-4555

GREAT LAKES REGION V

ILLINOIS

Chicago–1406 Mid Continental Plaza Building, 55 East Monroe Street 60603, Area Code 312 Tel 353-4450, FTS 353-4450

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