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**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 to assure international competitiveness and leadership of U.S. industry, science and technology. NBS work involves development and transfer of measurements, standards and related science and technology, in support of continually improving U.S. productivity, product quality and reliability, innovation and underlying science and engineering. 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 Institute for Materials Science and Engineering.

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; provides calibration services; and manages the National Standard Reference Data System. 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 Engineering³

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 divisions:

- Information Systems Engineering
- Systems and Software Technology
- Computer Security
- Systems and Network Architecture
- Advanced Systems

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-cutting 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 Institute consists of the following divisions:

- Ceramics
- Fracture and Deformation³
- Polymers
- Metallurgy
- Reactor Radiation

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

² Some divisions within the center are located at Boulder, CO 80303.
Located at Boulder, CO, with some elements at Gaithersburg, MD.

*NBS Special Publication 305
Supplement 19*

Publications of the National Bureau of Standards 1987 Catalog

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Gaithersburg, MD 20899*

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CATALOG STRUCTURE AND USE

Full bibliographic citations including keywords and abstracts for National Bureau of Standards papers published and entered into the National Technical Information Service (NTIS) collection are cited in the "NBS Publications Announcements" section of this catalog. (Also included are NBS papers published prior to 1987 but not reported in previous supplements of this annual catalog.) Entries are arranged by NTIS subject classifications which consist of 38 broad subject categories (see back cover) and over 350 subcategories. Within a subcategory, entries are listed alphanumerically by NTIS order number.

Four additional abbreviated indexes are included to allow the user to identify NBS papers by personal author, keywords, title, and NTIS order/report number. Each entry lists the appropriate title, the NTIS order number, and the abstract number.

NBS papers may also be identified by searching the NTIS database either online via the commercially available DIALOG system or in the issues of NTIS's *Government Reports Announcements and Index* and its *Government Reports Annual Index*.

AVAILABILITY AND ORDERING INFORMATION

The highest quality and least expensive copies of NBS publications published as Government documents are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Publications cited with stock numbers (SN) and purchase orders should be cited by these numbers. GPO will accept payment by check, money order, VISA, Mastercharge, or deposit account. For availability and price, write to the GPO or telephone (202) 783-3258. Should an NBS publication be out of print at the GPO, its continued availability is assured at NTIS which sells publications in microfiche or paper copy reproduced from 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, Mastercharge, or deposit account. NTIS is the sole source of Federal Information Processing Standards (FIPS), NBS 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 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 NBS publications (see inside back cover for a description of the various NBS publication series). While not every Government publication is sent to all depository libraries, certain depositories designated as Regional Depositories receive and retain one copy of all Government publications made available. Contact the depository library in your area to obtain information on what is 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 of each District Office contains review copies of many Government publications.

NBS PUBLICATIONS ANNOUNCEMENTS

SAMPLE ENTRY

COMPUTERS,
CONTROL &
INFORMATION
THEORY

NTIS Subject Category

Computer Software

700,664

PB87-157228

PC A05/MF A01

National Bureau of Standards, Gaithersburg, MD. Center for Programming Science and Technology.

Programming Languages for Knowledge-Based Systems

J. V. Cuglini, Feb 87, 82p

NBS/SP-500/145

Contract F-000000

Keywords: *Programming languages, *Symbolic programming, Procedure oriented languages, . . .

Knowledge-Based Systems (KBS) represent a new software methodology which can broaden the scope of computer applications.

NTIS Subcategory

Abstract Number

NTIS order number

Availability

Price Codes

Corporate or performing organization

Report Title

Personal authors

Report date

Page count

Report Number

Contract or grant number

Keywords: * indicates keyword index entry

Abstract

ADMINISTRATION & MANAGEMENT

Specifications for a standard Information Resource Dictionary System (IRDS) have been developed. The software tool documents, controls, protects, and facilitates the use of an organization's information resources. The system, which uses an entity-relationship-attribute model, includes the functions available in existing data dictionary systems. The paper introduces the organization and functions of the IRDS, and indicates some areas of current and future development.

Keywords: *Office management, *Office equipment, Planning, Benefit cost analysis, Automation, Requirements, Guidelines, Data processing, *Office automation, *Managers, Word processing, Computer applications, Analysis.

The report is designed to help managers maximize the benefits to be achieved through the application of office automation technologies. It presents a systematic planning method which will guide the manager to technology solutions which can improve the quality, efficiency, or effectiveness of an organization's products or services. Planning for office automation is accomplished through a requirements analysis study. The study can be initiated in response to installing office automation systems in a non-automated office or acquiring additional systems for an existing automated environment. The report provides guidance in the overall process of determining requirements for office automation systems.

Management Information Systems

700,001

PB89-139100

Not available NTIS

National Bureau of Standards (ICST), Gaithersburg, MD. Information Systems Engineering Div.

Information Resource Dictionary System.

Final rept.,

A. Goldfine. 1985, 9p

Pub. in Proceedings of the International Conference on Entity-Relationship Approach (4th), Chicago, IL, October 28-30, 1985, p114-122.

Keywords: Information systems, Organizations, Standards, Specifications, *Information management, *Data dictionaries, *Software tools.

Management Practice

700,002

PB87-179719

PC A06/MF A01

National Bureau of Standards, Gaithersburg, MD. Center for Programming Science and Technology.

Guidance on Requirements Analysis for Office Automation Systems.

Special pub.,

L. S. Rosenthal, E. G. Parker, T. Landberg, and S. W. Watkins. Mar 87, 106p NBS/SP-500/147

See also PB81-152100. Also available from Supt. of Docs as SN003-003-02791-0. Library of Congress catalog card no. 87-619807.

Productivity

700,003

PB88-110770

Not available NTIS

ADMINISTRATION & MANAGEMENT

Productivity

National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Defining 'Productivity'.
Final rept.,
S. F. Weber. 1984, 1p
Pub. in *Batiment International: Building Research and Practice*, p201 Jul/Aug 84.

Keywords: *Productivity, *Construction industry, Input, Output, Economic analysis, Performance, Production rate, Work measurement.

The article summarizes research on alternative productivity measures for the construction industry. The shortcomings of the most widely used approach, the single factor productivity index, are discussed. The more comprehensive approach, called total factor productivity, is described. The specific recommendation is to use a total factor productivity index with relative input cost shares applied as weights to combine the input quantities.

Public Administration & Government

700,004
PB87-151973 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Program Office.
Infratechnologies and the Role of Government.
Final rept.,
G. Tassey. 1982, 18p
Pub. in *Technological Forecasting and Social Change* 21, p163-180 1982.

Keywords: *National government, *Industries, *Technology innovation, Policies, Infratechnologies, Commodities.

Government support of technological change is a complex issue because barriers resulting in underinvestment exist to some degree in most industries, so difficult allocation decisions for limited government resources are necessary. The structure and timing of government support is further complicated because in any one technological area, the nature and severity of underinvestment phenomena vary during the evolution or life cycles of the relevant industries. The paper focuses on the methods and rationale for government support of two elements in industrial technology, generic technology, from which specific products and processes (i.e., innovations) are derived, and 'infratechnologies', which are necessary for the evolution of the generic technology and its applications. Particular emphasis is given to infratechnologies because they are largely supplied by sources outside the industry and have consequently been largely overlooked in previous discussions of industrial policy. A case study of one major source of infratechnology, including quantitative estimates of industry impacts, is presented.

700,005
PB87-165163 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Internal Revenue Service Post-of-Duty Location Modeling System - Programmer's Manual for Pascal Solver,
P. D. Domich, R. H. F. Jackson, and M. A. McClain.
Feb 87, 62p NBSIR-86/3472
Sponsored by Internal Revenue Service, Washington, DC.

Keywords: *Site surveys, *Facilities management, *Programming manuals, *Regional planning, *Fixed costs, *Mathematical models, Lagrangian functions, Microcomputers, Data displays, Computer graphics, Optimization, Travel, Cost engineering, *Site selection, *Internal Revenue Service, *Government agencies, *PASCAL subroutine, *Fortran subroutine.

The report is a programmer's manual for a microcomputer system designed at the National Bureau of Standards for selecting optimal locations of IRS Posts-of-Duty. The mathematical model is the uncapacitated, fixed charge, facility location model which minimizes travel and facility costs. The package consists of two sections of code, one in FORTRAN and the other in PASCAL. The FORTRAN driver handles graphics displays and controls input and output for the solution procedure. The report discusses the mathematical techniques used to solve the mathematical model developed and includes a Greedy procedure, an Inter-

change procedure, and a Lagrangian approach to the related linear program. A description of these PASCAL routines and definitions of key data structures and variables are provided.

700,006
PB87-165171 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Internal Revenue Service Post-of-Duty Location Modeling System - Programmer's Manual for Fortran Driver,
P. D. Domich, R. H. F. Jackson, and M. A. McClain.
Feb 87, 55p NBSIR-86/3473
Sponsored by Internal Revenue Service, Washington, DC.

Keywords: *Site surveys, *Facilities management, *Regional planning, Programming manuals, Data displays, Microcomputers, Computer graphics, Cost engineering, *Site selection, *Government agencies, *Internal Revenue Service, Personal computers, PASCAL subroutines, Fortran subroutines, Costs.

The report is a programmer's manual for a microcomputer package which was designed by the National Bureau of Standards to assist the Internal Revenue Service in choosing locations for its posts-of-duty which will minimize costs to the IRS and to the taxpayer. The package was written in two sections of code, one in FORTRAN and the other in PASCAL. The manual describes the FORTRAN driver which handles graphics displays and controls input and output for the solution procedures.

Research Program Administration & Technology Transfer

700,007
PB87-157236 PC A04/MF A01
National Bureau of Standards, Gaithersburg, MD.
Cooperative Research Opportunities at NBS (National Bureau of Standards).
Special pub.,
Dec 86, 57p NBS/SP-723
Also available from Supt. of Docs as SN003-003-02788-0. Library of Congress catalog card no. 86-600570.

Keywords: *Research projects, Chemical analysis, Ceramics, Chemical engineering, Polymers, Metallurgy, Nondestructive tests, *US NBS.

Contents: Cooperative research at NBS; Research opportunities; Analytical chemistry; Applied mathematics; Basic standards; Building technology; Ceramics; Chemical engineering; Chemical physics; Computer sciences and technology; Electronics and electrical engineering; Fire research; Fracture and deformation; Manufacturing engineering; Metallurgy; Neutron scattering and diffraction; Nondestructive evaluation; Polymers; Product standards; Radiation research; Standards reference data.

700,008
PB88-137062 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
Office of the Director.
Engineering Property Data--A National Priority.
Final rept.,
E. Ambler. 1985, 5p
Pub. in *ASTM (American Society for Testing and Materials) Standardization News*, p46-50 Aug 85.

Keywords: *Engineering data, *Information systems, Access, Quality, Standardization, Leadership, Technical societies, Engineering societies, Materials, Reprints, *Technology transfer, Computer aided design, Computer aided manufacturing, Information dissemination, Personal computers, Government agencies, Metal properties council, National Bureau of Standards, User needs, Industry.

As American industry rises to meet new challenges, engineers are becoming aware of the need to improve the quality and accessibility of data needed for technical decisions. One major reason is the widespread computerization of industry. Computer-aided design and manufacturing (CAD/CAM) is a reality; now computers are being asked to provide better access to technical data. The paper describes the progress that

the National Bureau of Standards, the Metal Properties Council, and other groups have made towards meeting these needs. The key elements have been: better understanding of the role of large on-line systems and the use of personal computers, greater emphasis on the evaluation of data, and recognition of the importance of standards. Current ideas are discussed, and the need for leadership by existing technical societies and government agencies is highlighted.

700,009
PB88-147186 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Office of Energy-Related Inventions.
Energy Related Inventions Program.
Final rept.,
T. A. Coulas. 1985, 3p
See also DE87002295. Sponsored by American Solar Energy Society, Boulder, CO.
Pub. in *Proceedings of the National Passive Solar Conference* (10th), Raleigh, NC., October 15-20, 1985, p410-412.

Keywords: *Inventions, Evaluation, *Solar products, *Energy saving products.

One part of the United States Federal Nonnuclear Energy Research and Development Act of 1974 directs the National Bureau of Standards (NBS) to evaluate all promising nonnuclear energy-related inventions for the purpose of obtaining direct grants for their development from the Department of Energy (DOE). The purpose of the program is to provide an opportunity for independent inventors and small businesses to obtain Federal assistance in developing and commercializing their inventions. NBS evaluates the inventions and recommends those considered sufficiently promising to DOE for support. The operation of the program and several case histories will be discussed. Inventions such as one that produces fuel gas from wood, flat plate solar collectors, solar residential heating systems, energy from wind, and some novel solar energy conversion devices will be described. The path of these entrepreneurs through evaluation, grant, demonstration and market will be followed. Both the usual and some unusual pitfalls will be illustrated.

700,010
PB88-155775 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
Status of Emerging Technologies: An Economic/Technological Assessment to the Year 2000.
Final rept.,
E. Ambler. Jun 87, 33p NBSIR-87/3671

Keywords: *International trade, *Barriers, Computer science, Electronics, Materials, Medicine, Automation, Thin films, Exports, United States, Assessment, *Technology utilization, *Economic development, *Innovations, *Businesses, *Commercialization, *Trade barriers, Biotechnology, Office automation.

The Department of Commerce has concluded, in a review of emerging technologies and their future impacts on the economy, that American businesses lag behind many of their foreign competitors especially the Japanese, in exploiting technological breakthroughs. The review was ordered by Deputy Secretary Clarence J. Brown in April 1986 to identify the new technologies that will lead to new products or processes, analyze their commercialization, and recommend means of reducing the barriers. It is based on an assessment by technical experts and agency heads within the Department. They studied scientific and industrial plans and the commercialization process here and abroad. Remarks by Deputy Secretary Brown in releasing the report are included.

AERONAUTICS & AERODYNAMICS

Test Facilities & Equipment

700,011
PB88-109921 PC A04/MF A01
 National Bureau of Standards (NML), Gaithersburg, MD. Center for Mfg. Engineering.
Wind Tunnel Model Surface Gauge for Measuring Roughness.
 Final rept.,
 T. V. Vorburger, D. E. Gilsinn, E. C. Teague, C. H. W. Giauque, and F. E. Scire. Jun 87, 57p NBSIR-87/3586
 Sponsored by National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.

Keywords: *Surface roughness, *Optical measuring instruments, Wind tunnel models.

The report covers research performed in the optical inspection of surface roughness by members of the Center for Manufacturing Engineering under contracts L-4718B and L-20078B with the NASA Langley Research Center. The project has proceeded along two lines: first research into a quantitative understanding of light scattering from metal surfaces and into the appropriate models to describe the surfaces themselves, and second, the development of a practical instrument for the measurement of rms roughness of high performance wind tunnel models with smooth finishes. The research has been discussed in previous articles and is only summarized here. The report is concerned primarily with the latter subject.

AGRICULTURE & FOOD

Agricultural Chemistry

700,012
PB87-197794 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Chemical Process Metrology Div.
Mass Basis Karl Fischer Titration Equation for Moisture Determination.
 Final rept.,
 F. E. Jones. 1985, 1p
 Pub. in Jnl. of the Association of Official Analytical Chemists 62, n11 p1605 1985.

Keywords: *Grain, Moisture, Titration equation, Water content, Reprints, Karl Fischer titration, *Mass basis.

An equation is presented for calculation of moisture content of grain from measurements, on a mass basis, of various quantities in Karl Fischer titration procedures. This equation complements a similar equation in which the quantities are expressed on a volume basis.

Food Technology

700,013
PB87-149464 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Free Radical Chemistry of Natural Products.
 Final rept.,
 P. Neta, and M. G. Simic. 1985, 10p
 Pub. in Chem. Changes Food Process., p63-72 1985.

Keywords: *Free radicals, *Food chemistry, Food processing, Chemical radicals, Reprints, *Chemical re-

action kinetics, Peroxyl radicals, Alkoxy radicals, Hydroperoxyl radicals, Superoxide radicals, Hydroxyl radicals.

Free radicals are continuously generated in natural products by various processes involving atmospheric oxygen, enzymes, light induced sensitization, heating, etc. They are unequivocally formed by ionizing radiation in the radiation processing of food. In the presence of oxygen most free radicals react with it to give corresponding peroxy radicals and/or superoxide radicals. The former process is more prevalent in hydrophobic media while the latter occurs frequently in aqueous media. Many of the naturally occurring free radicals can also be generated by radiation. Using pulse radiolysis in conjunction with product characterization, complete physico-chemical description of these radicals can be obtained and the kinetic and mechanistic aspects of their chemistry derived. Kinetic and mechanistic aspects of free radicals commonly found or expected to be present in natural products will be reviewed and the predictability of their reactions discussed.

700,014
PB87-162186 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Antioxidants.
 Final rept.,
 M. G. Simic, and E. P. L. Hunter. 1985, 13p
 Pub. in Chem. Changes Food Process., p107-119 1985.

Keywords: *Food chemistry, *Antioxidants, Chemical reactivity, Chemical radicals, Chemical reactions, Reprints, Peroxy radicals, Phenoxyl radicals.

The methods and techniques used in the measurements of the reactivities of antioxidant with free radicals in general are reviewed. Special attention is paid to the characterization of the antioxidant intermediates, e.g. to phenoxyl radicals for phenolic antioxidants, and their reactivities with each other, other free radicals and food components. A distinction is made between the chemistry of the manmade antioxidants and the complex processes associated with the natural antioxidants.

700,015
PB88-117627 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Stabilization of Ascorbic Acid and Its Measurement by Liquid Chromatography in Nonfat Dry Milk.
 Final rept.,
 S. Margolis, and I. Black. 1987, 4p
 Pub. in Jnl. of the Association of Official Analytical Chemists 70, n5 p806-809 1987.

Keywords: *Ascorbic acid, *Milk, *Dried foods, Vitamins, Reprints, *Nonfat dry milk, Liquid column chromatography.

The determination of ascorbic acid by liquid chromatography (LC) was improved by performing the analysis in the presence of solvents that had been purged with argon to reduce the concentration of oxygen. This methodological modification eliminated the oxidation of ascorbic acid during the chromatographic procedure and reduced the minimum detection level to 1 microgram. Solutions of ascorbic acid have been successfully stabilized for 67 days by addition of dithiothreitol to a deaerated solution of water-acetonitrile (25 + 75 v/v), sealed under argon in amber vials and stored at -20 degrees C.

ASTRONOMY & ASTROPHYSICS

Astronomy & Celestial Mechanics

700,016
PB88-117387 Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Numerical Models of Star Formation in X-ray Cluster Cooling Flows.

Final rept.,
 R. E. White, and C. L. Sarazin. 1987, 16p
 Contract NAGW-764, Grant NSF-AST81-20260
 See also PB88-117395. Sponsored by National Aeronautics and Space Administration, Washington, DC., and National Science Foundation, Washington, DC.
 Pub. in Astrophysical Jnl. 318, p629-644, 15 Jul 87.

Keywords: Models, Reprints, *Galaxy clusters, *Cooling flows, Star formation, X ray sources, *Numerical models.

At the center of each observed X-ray cluster cooling flow is a central dominant galaxy accreting up to several hundred solar masses per year from the flow. To assess whether these galaxies are currently being formed by their associated cooling flows, the authors calculate theoretical models of such flows, including the effects of ongoing star formation. The authors relate the local star formation rate in these models to either the local cooling rate of the gas or the local growth rate of thermal instabilities. The authors show how the structure of cooling flows is affected by variations in the star formation rate, as well as by variations in intracluster temperature, overall accretion rate, elemental abundances, and the form of the gravitational potential. The authors calculate the X-ray emission from these models and show that the spatial variation of the hard/soft X-ray ratio is a clean diagnostic for ongoing star formation in X-ray cluster cooling flows. Finally, the authors calculate the spatial distribution of newly formed stars in each of the authors models and compare it to that of the accreting galaxy. The authors find that star formation in a cooling flow can produce stellar density profiles similar to those observed in galaxies. The authors also find that the shallowest density profile is still steeper than that of an isothermal. They thus conclude that accretion populations are more likely to contribute to the luminous parts of accreting galaxies unless the density profile of a dark component can be steeper than the canonical isothermal.

700,017
PB88-117395 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Determining Star Formation Rates in X-ray Cluster Cooling Flows.
 Final rept.,
 R. E. White, and C. L. Sarazin. 1987, 8p
 Contract NAGW-764, Grant NSF-AST81-20260
 See also PB88-117387. Sponsored by National Aeronautics and Space Administration, Washington, DC., and National Science Foundation, Washington, DC.
 Pub. in Astrophysical Jnl. 318, p621-628, 15 Jul 87.

Keywords: Reprints, *Cooling flows, *Galaxy clusters, Intergalactic medium, Hydrodynamics, Interstellar matter, Stars, X rays.

Many X-ray clusters of galaxies are observed to have cooling flows at their centers. Each of these cooling flows is depositing mass onto a central dominant galaxy at a rate of approx 10-400 M per yr. With such large accretion rates it seems possible that these accreting galaxies are still being formed through ongoing star formation in their associated cooling flows. In the paper, the authors develop techniques to determine directly the distributions of local star formation rate, mass, gas density, temperature, and velocity from cooling flow X-ray surface brightness data. These techniques take account of the potentially important X-ray emission from starforming cooling condensations dropping out of the background flow. The authors consider separately surface brightness data with either good or poor energy resolution.

700,018
PB88-117411 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Determination of the Masses of the Magellanic Cloud Planetary Nebulae Using (O II) Doublet Ratio Electron Densities.
 Final rept.,
 M. J. Barlow. 1987, 23p
 Pub. in Monthly Notices of the Royal Astronomical Society 227, p161-183 1987.

ASTRONOMY & ASTROPHYSICS

Astronomy & Celestial Mechanics

Keywords: Reprints, *Distance scales, *Electron densities, *Forbidden lines, *Magellanic clouds, Nebular masses, Planetary nebulae, Recombination radiation.

Spectrophotometric data, including (O II) 3726, 3729 A doublet ratios, are presented for 32 planetary nebulae (PN) in the Magellanic Clouds. It is argued that the electron densities derived from these ratios provide a much better diagnostic for the determination of nebular masses than previously assumed. The 32 PN are classified as either Type I or else as optically thick or optically thin in the hydrogen Lyman continuum. The optically thick PN are found to all have electron densities greater than 6000 per cm cube, while the optically thin PN all have electron densities below 500 per cm cube. The optically thin PN show a range of only a factor of 2.0 in their derived masses, and have a mean ionized mass of 0.27 plus or minus 0.06M. The absolute H Beta fluxes of the optically thick nebulae show a range of only a factor of 1.8. The application of these results to Galactic PN would yield distances which are generally larger than those previously estimated. A method of distance determination is proposed for optically thin PN that uses integrated nebular (O II) electron densities rather than angular diameters.

Astrophysics

700,019
PB87-153680 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Photospheres of Hot Stars. 2. An Analysis of Zeta Puppi.

Final rept.,
B. Bohannan, D. C. Abbott, S. A. Voels, and D. G. Hummer. 1986, 8p
Grant NSF-AST85-05919
See also Part 1, PB86-102464. Sponsored by National Science Foundation, Washington, DC.
Pub. in Astrophysical Jnl. 308, n2 p728-735, 15 Sep 86.

Keywords: *Stellar atmospheres, Stellar evolution, Photosphere, Reprints, *Zeta Puppi star, Hot stars, Stellar winds.

High signal-to-noise ratio line profiles of zeta Puppi (O4f) obtained with a CCD camera are compared with theoretical model atmospheres that include radiation scattered back from the stellar wind onto the photosphere, an effect referred to as wind blanketing. Comparison with tracks of stellar evolution with mass loss suggests that zeta Puppi was initially a 70-90 solar mass star.

700,020
PB87-153730 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Observed and Computed Stellar Line Profiles: The Roles Played by Partial Redistribution, Geometrical Extent and Expansion.

Final rept.,
J. L. Linsky. 1985, 26p
Grant NGL-06-003-057, Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in NATO Advanced Study Institutes Series C, Prog. Stellar Spectral Line Form 152, p1-26 1985.

Keywords: Ultraviolet spectra, Reprints, *Stellar radiation, *Stellar chromospheres, Stellar winds, Late stars.

Partial redistribution (PRD) radiative transfer is reviewed, with emphasis on the complex interaction of observations and theoretical predictions of spectral line shapes. Work is summarized that has led to 'realistic' plane parallel static chromospheric models for the Sun and other late-type stars, with emphasis on the determination of the temperature minimum at the base of the chromosphere and the physical basis for resonance line limb darkening, the brightness of the line wings, and the width of the emission features. The various roles played by atmospheric extension and expansion (winds) in determining resonance line profile shapes are discussed and the existing PRD calculations for late-type stars are summarized.

700,021
PB87-163671 Not available NTIS

National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

VLA Radio-Continuum Survey of a Sample of Confirmed and Marginal Barium Stars.

Final rept.,
S. A. Drake, T. Simon, and J. L. Linsky. Jan 87, 5p
Grant NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Astronomical Jnl. 91, n1 p163-167 Jan 87.

Keywords: *Stars, *Radio sources(Astronomy), Radio astronomy, Identifying, Reprints, *Barium stars, Mass loss.

The authors describe a 6 cm VLA survey of five confirmed Ba II stars and eight mild Ba II stars.

700,022
PB87-163796 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Ultraviolet and Optical Variability of RY Tauri.
Final rept.,
A. Brown, J. L. Linsky, S. A. Drake, and W. Herbst. 1986, 3p
Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Proceedings of Conference on New Insights in Astrophysics, London, England, July 14-16, 1986, p177-179.

Keywords: *Stars, Emission spectra, Ultraviolet spectra, Variability, Magnesium, *RY Tau star, *T Tauri stars, Stellar chromospheres, Stellar winds, IUE.

Ultraviolet and optical observations of the T Tauri star RY Tau show evidence for strong variability over the past two years. High dispersion IUE observations of the Mg II emission line profiles show significant changes in the wind of RY Tau, with the wind absorption almost disappearing on 1986 March 20. The behavior of the emission line flux variability when compared to the optical light curve shows evidence for both changes in circumstellar extinction and changes in starspot/plage distribution on the visible hemisphere of the star.

700,023
PB87-163804 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

High Dispersion IUE Observations of Hybrid-Chromosphere Stars.

Final rept.,
A. Brown, D. Reimers, and J. L. Linsky. 1986, 4p
Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Proceedings of Conference on New Insights in Astrophysics, London, England, July 14-16, 1986, p169-172.

Keywords: *Stars, Emission spectra, Magnesium, *Stellar winds, Stellar chromospheres, IUE.

High dispersion, wavelength calibrated IUE spectra of the hybrid-chromosphere stars alpha TrA (K2 IIb-IIa) and gamma Ag1 (K3 II) are presented. These observations allow accurate measurement of the wind terminal velocities as seen in the Mg II emission line profiles.

700,024
PB87-163838 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Microwave Continuum Measurements and Estimates of Mass Loss Rates for Cool Giants and Supergiants.

Final rept.,
S. A. Drake, and J. L. Linsky. 1986, 7p
Grant NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Irish Astronomical Jnl. 17, n3 p288-294 1986.

Keywords: *Giant stars, Radio sources(Astronomy), Radio astronomy, Microwaves, Reprints, *Supergiant stars, *Mass loss, Stellar chromospheres, Late stars.

The authors briefly summarize the results of a sensitive 6 cm radio continuum survey made with the NRAO Very Large Array of 39 of the nearest, single cool giants and supergiants with spectral types G0-M5. A detailed description of this survey will appear in a forthcoming paper (Drake and Linsky 1986). Our goal was to obtain accurate measurements of the mass loss rates of ionized gas for a representative sample of such stars to provide constraints upon and a better understanding of the total mass loss rates. These data should also be valuable in determining the mass loss mechanism for such stars.

coming paper (Drake and Linsky 1986). Our goal was to obtain accurate measurements of the mass loss rates of ionized gas for a representative sample of such stars to provide constraints upon and a better understanding of the total mass loss rates. These data should also be valuable in determining the mass loss mechanism for such stars.

700,025
PB87-163846 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Modelling Extended Chromospheres.
Final rept.,
J. L. Linsky. 1986, 9p
Grant NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in the Irish Astronomical Jnl. 17, n3 p343-351 1986.

Keywords: *Stars, Ultraviolet spectra, Reprints, *Stellar chromospheres, Mass loss, Radiative transfer.

The author discusses calculations by Drake and by Drake and Linsky for the Mg II k line of Arcturus (alpha Boo, K2 III), assuming a spherically-symmetric chromosphere, two level mg(H+) ion, and angle-averaged R(II-A) (x',x) redistribution functions. These calculations were based on an original program by Paul Kunasz and modified to include partial redistribution of this particular type.

700,026
PB87-163853 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Where Do Flares Occur In RS CVn Systems - Analysis of the October 3, 1981 Flare on V711 Tau = HR 1099 Observed by IUE.

Final rept.,
J. L. Linsky, J. E. Neff, B. D. Gross, T. Simon, A. D. Andrews, and M. Rodono. 1986, 4p
Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Proceedings of Conference on New Insights in Astrophysics, London, England, July 14-16, 1986, p161-164.

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

The authors report on a unique set of observations of V711 Tau = HR 1099 (K1 IV and G2 V) in which high-resolution spectra with both the SWP and LWR cameras were obtained during the luminous flare of October 3, 1981. Multi-gaussian fits to the Mg II k and C IV 1548 A lines are consistent with the flare radial velocity being identical to that of the K star. Thus, the flare probably occurred on the K star. No evidence was found for flows as were previously seen during a flare on UX Ari.

700,027
PB87-165668 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Review of the Ultraviolet Studies of Galactic Novae.

Final rept.,
S. Starrfield. 1986, 7p
Pub. in Proceedings of Conference on New Insights in Astrophysics, London, England, July 14-16, 1986, p239-245.

Keywords: *Novae, Ultraviolet spectra, White dwarf stars, Ultraviolet astronomy, IUE.

The ultraviolet studies of galactic novae both in outburst and also in quiescence have provided new and fundamental data on these exploding stars. As a direct result of the IUE spectral studies, the authors have identified a new class of novae in which the outburst occurs on an ONeMg white dwarf. The authors have also been able to determine ejected masses, elemental abundances, and ultraviolet light curves for a wide variety of nova outbursts.

700,028
PB87-165700 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Proposed LYMAN Far Ultraviolet Spectroscopic Explorer.

Final rept.,
J. L. Linsky, 1986, 13p
Pub. in Proceedings of Conference of New Insights in Astrophysics, London, England, July 14-16, 1986, p537-549.

Keywords: Ultraviolet spectroscopy, Far ultraviolet radiation, *Ultraviolet astronomy.

Summarized here are the scientific and technical ideas presented in the proposal for the LYMAN Far Ultraviolet Spectroscopic Explorer in response to NASA's Dear Colleague Letter for Explorer Concepts. LYMAN is designed to answer a broad range of exciting questions in astrophysics that require high resolution, high sensitivity spectroscopy in the 912-1200 Å band and in the EUV, which cannot be answered by other means.

700,029

PB87-165718 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

HRS GTO Program to Study the Neutral Hydrogen Column Density and D/H Ratio in the Local Interstellar Medium.

Final rept.,
J. L. Linsky, W. B. Landsman, B. D. Savage, S. R. Heap, A. M. Smith, and J. C. Brandt. 1986, 4p
Grant NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Advances of Space Research 6, n2 p91-94 1986.

Keywords: *Interstellar matter, Ultraviolet spectra, Deuterium, Hydrogen, Reprints.

Early in the HST mission the HRS Team will observe the Lyman alpha line at 100,000 spectral resolution toward 7 late-type local stars. The purpose is to derive the hydrogen and deuterium column densities and D/H ratios along lines of sight toward nearby stars. Here they present theoretical line profiles that demonstrate why 100,000 spectral resolution and high signal-to-noise are needed to derive accurate column densities from spectral lines that lie close to the flat part of the curve of growth and may contain multiple velocity components. The aim of the HRS program is to obtain column densities in the hydrogen and deuterium Lyman alpha lines along a variety of lines of sight within and extending beyond the local cloudlet in which the Sun is located near an edge.

700,030

PB87-173688 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

High-Dispersion Observations of Alpha Bootis (K1 III) with the International Ultraviolet Explorer.

Final rept.,
T. R. Ayres, P. Judge, C. Jordan, A. Brown, and J. L. Linsky. 15 Dec 86, 13p
Grants NAG5-82, NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Astrophysical Jnl. 311, n2 p947-959, 15 Dec 86.

Keywords: *Stars, Ultraviolet spectra, Reprints, *Arcturus star, *Alpha Bootis star, Stellar chromospheres, Late stars, IUE.

The authors have taken very deeply exposed echelle spectrograms of the bright red giant Arcturus (K1 III) using the International Ultraviolet Explorer. They have combined their new observations with existing material from the Archives of the IUE to construct high-quality tracings of important regions of the vacuum ultraviolet spectrum of the archetypal early-K giant.

700,031

PB87-173704 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Rotational Modulation and Flares on RS CVn and BY Dra-Type Stars I. Photometry and Spot Models for BY Dra, AU Mic, AR Lac, II Peg and V711 Tau (=HR 1099).

Final rept.,
M. Rodono, G. Cutispoto, V. Pazzani, S. Catalano, P. B. Byrne, J. G. Doyle, C. J. Butler, A. D. Andrews, C. Blanco, E. Marilli, J. L. Linsky, F. Scaltriti, and M. Busso. 1986, 22p
Pub. in Astronomy and Astrophysics 165, p135-156 1986.

Keywords: *Stellar atmospheres, Variable stars, Binary stars, Photometry, Reprints, *Starspots, Late stars, Stellar flares.

The authors present multi-color wide-band photometry of five active stars obtained as part of a coordinated radio, optical and IUE program aimed at studying spatial and temporal correlations among activity phenomena at various atmospheric levels. The observations were carried out at several places before, during and after the period of IUE observations (3-8 August 1980 and 1-7 October 1981) for the purpose of determining the location, sizes and evolution of photospheric spots at the time when chromospheric, transition region and coronal activity data were obtained from UV and radio observations.

700,032

PB87-179446 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Torsionally Excited Methanol in Hot Molecular Cloud Cores.

Final rept.,
K. M. Menten, C. M. Walmsley, C. Henkel, T. L. Wilson, L. E. Snyder, J. M. Hollis, and F. J. Lovas. 1986, 10p
Grant NATO-731
Sponsored by North Atlantic Treaty Organization, Brussels (Belgium).
Pub. in Astronomy and Astrophysics 169, p271-280 1986.

Keywords: *Methyl alcohol, *Interstellar matter, Reprints, *Molecular clouds, *Methanols.

The authors report the detection of centimeter lines of torsionally excited methanol (CH₃OH) towards four galactic molecular cloud sources using the Effelsberg 100-m telescope. It is shown that for the sources observed, radiative and collisional excitation are both capable of populating the torsionally excited levels.

700,033

PB87-180923 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Formation of a Solar Coronal Transient with Forerunner.

Final rept.,
E. B. Gliner, and V. A. Osherovich. 1987, 11p
Pub. in Astrophysical Jnl. 312, n1 p412-422, 1 Jan 87.

Keywords: *Solar corona, Magnetohydrodynamics, Solar magnetic fields, Transients, Reprints.

A model of a solar coronal transient in the course of its formation is constructed. The main idea is that the formation of a coronal transient occurs at a quasi-stationary state of the solar atmosphere as a result of the interaction of weak coronal currents with a slowly growing magnetic field originating below the future transient area. The explanation of forerunner formation which takes place much before the appearance of the transient itself is one of the verification of the model. The application of the model to the transient event of 1974 January 10 demonstrates the reasonable values of model parameters for reproducing the observed columnar density distribution. An analytical technique, based on using exact analytical solution of the plasma equilibrium equation, is explained in detail.

700,034

PB87-201729 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Three Remarkable 6-cm Flares on YZ Canis Minoris.

Final Rept.,
D. M. Gibson. 1984, 7p
Pub. in Proceedings of Southwest Regional Conference on Astronomy and Astrophysics, Fort Davis, TX., May 14, 1983, v9 p35-41 1984.

Keywords: Radio astronomy, Circular polarization, *YZ Canis Minoris star, *Flare stars.

The dm3.5e flare star, YZ CMi, was observed at 6, 20, and 21-cm on 1982 October 26 as part of a continuing effort to monitor flare stars for both quiescent and flaring emission. The six-hour observing run was notable for three flares which occurred at 6-cm. No comparable activity was seen at the longer wavelengths.

700,035

PB87-219044 Not available NTIS

National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Non-LTE Analysis of Massive Stars in the Magellanic Clouds.

Final rept.,
T. Gehren, D. Husfeld, R. P. Kudritzki, P. S. Conti, and D. G. Hummer. 1986, 2p
Pub. in Luminous Stars and Associations in Galaxies, p413-414 1986.

Keywords: Helium, Abundance, Reprints, *Magellanic Clouds, Early stars, Hot stars, Stellar temperature.

The effective temperatures, surface gravities, and helium abundances of six main-sequence O-type stars, obtained by fitting non-LTE model atmospheres to high quality spectra are presented. These are the first results from a long-term program to determine accurately the parameters and chemical abundances of massive stars in the Magellanic Clouds.

700,036

PB87-219077 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Acceleration of Charged Particles at Relativistic Shock Fronts.

Final rept.,
J. G. Kirk, and P. Schneider. 1987, 9p
Grant NSG-7128
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Astrophysical Jnl. 315, n2 p425-433, 15 Apr 87.

Keywords: *Cosmic rays, Reprints, *Particle acceleration, Relativistic range, Cosmic radio sources, Galactic nuclei.

The diffusive acceleration of highly relativistic particles at a shock is reconsidered. Using the same physical assumptions as Blandford and Ostriker, but dropping the restriction to nonrelativistic shock velocities, we find approximate solutions of the particle kinetic equation by generalizing the diffusion approximation to higher order terms in the anisotropy of the particle distribution. The general solution of the transport equation on either side of the shock is constructed, which involves the solution of an eigenvalue problem. By matching the two solutions at the shock, the spectral index of the resulting power law is found by taking into account a sufficiently large number of eigenfunctions. Low-order truncation corresponds to the standard diffusion approximation and to a somewhat more general method described by Peacock. In addition to the energy spectrum, our method yields the angular distribution of the particles and its spatial dependence.

700,037

PB87-219085 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Non-Adiabatic Analysis of Low-Frequency Oscillations of Uniformly Rotating Stars.

Final rept.,
U. Lee, and H. Saio. 1987, 9p
Pub. in Monthly Notices of the Royal Astronomical Society 225, p643-651 1987.

Keywords: *Variable stars, Reprints, *Stellar oscillations.

Solving linear differential equations of fully non-adiabatic non-radial oscillations, the authors examined the stability of low-frequency oscillations of uniformly rotating massive main-sequence stars. They found that the dynamically overstable convective modes coupled with higher order g modes in the envelope remain overstable in the full non-adiabatic analysis. The amplitude of such mixed-mode oscillations is large both in the core and in the envelope. This result supports the suggestion based on an adiabatic analysis that such mixed-mode oscillations are responsible for the oscillations in the variable B stars.

700,038

PB87-220513 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

ASTRONOMY & ASTROPHYSICS

Astrophysics

Chromospheres and Coronae of Five G-K Main-Sequence Stars.

Final rept.,
C. Jordan, T. R. Ayres, A. Brown, J. L. Linsky, and T. Simon. 1987, 35p
Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Monthly Notices of the Royal Astronomical Society 225, p903-937 1987.

Keywords: Ultraviolet spectra, Reprints, *Stellar chromospheres, *Stellar coronae, Cosmic x-ray sources, Late stars, IUE.

Five main-sequence stars (chi sup 1) Ori (GOV), alpha Cen A (G2V), xi Boo A (G8V), alpha Cen B (K0V), and epsilon Eri (K2V) have been observed at low and high dispersion with the International Ultraviolet Explorer (IUE) satellite. The data obtained and X-ray observations reported in the literature are used here to make models of the structure of the atmospheres of these stars, from the high chromosphere to the corona. The electron pressures and coronal temperatures in these stars range from being similar to those in the quiet solar atmosphere (alpha Cen A) to the higher values found more typically in solar active regions (e.g., (chi sup 1) Ori, xi Boo A).

700,039
PB87-220554 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

New Measurements of Photospheric Magnetic Fields in Late-Type Stars and Emerging Trends.

Final rept.,
S. H. Saar, and J. L. Linsky. 1986, 4p
Grant NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Adv. Space Res. 6, n8 p235-238 1986.

Keywords: *Stellar atmospheres, Measurement, Reprints, *Stellar magnetic fields, Late stars.

The authors report on recent results of their program to measure photospheric magnetic field strengths and filling factors from the analysis of unpolarized high spectral resolution and S/N line profiles. They have analyzed spectra obtained with the KPNO 4-m FTS, the MMT, and the McMath Reticon Spectrograph. With the latter instrument they now have an extensive data set through their synoptic and survey observing programs. Photospheric magnetic field parameters are obtained by comparison of observed and theoretical line profiles using a LTE code that includes line saturation and the full Zeeman pattern.

700,040
PB87-220562 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Linear Thermal Stability Analysis for the Vertical Structure of Alpha Model Accretion Disks.

Final rept.,
H. Saio, J. K. Cannizzo, and J. C. Wheeler. 15 May 87, 5p
Pub. in Astrophysical Jnl. 316, n2 p716-720, 15 May 87.

Keywords: Thermal stability, Reprints, *Accretion disks, *Star accretion, *Dwarf novae.

Linear equations are derived that describe the thermal stability of the convective and radiative vertical structure of an alpha model accretion disk. For a specific model chosen to be representative of a dwarf nova disk the authors find that the eigenfunction for the temperature, T, shows large excursions in the zone of partial ionization, but that the eigenfunctions for the unstable fundamental mode perturbations of the vertical distance, z, and flux, F(z), are nearly constant over the vertical extent of the disk. The growth of any instability is thus nearly homologous and the stability criteria derived for vertically averaged structures represent an adequate approximation.

700,041
PB87-222956 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Narrow-Angle Tail Radio Sources and the Distribution of Galaxy Orbits in Abell Clusters.

Final rept.,
C. P. O'Dea, C. L. Sarazin, and F. N. Owen. 1987, 14p
Pub. in Astrophysical Jnl. 316, p113-126, 1 May 87.

Keywords: *Radio sources(Astronomy), *Galaxies, Clustering, Cosmology, Reprints.

The distribution of the orientation of the tails of narrow-angle tail (NAT) radio sources can be used to constrain the distribution of galaxy orbits in clusters. In the paper, the authors present data on the orientations of the tails with respect to the cluster centers of a sample of 70 NATs in Abell clusters. They consider the whole sample as well as subsamples of sources based on projected distance from the cluster center and on cluster morphology.

700,042
PB87-223707 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

High Magnetic Reynolds Number Dynamo.

Final rept.,
F. W. Perkins, and E. G. Zweibel. Apr 87, 6p
Contract NASW-91
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Physics of Fluids 30, n4 p1079-1084 Apr 87.

Keywords: *Solar magnetic fields, Magnetohydrodynamics, Reprints.

A boundary-layer solution to a high magnetic Reynolds number R periodic dynamo model shows that: (1) flux expulsion forces the magnetic field into flux sheets; (2) the principal contribution to the alpha effect arises from regions of flow stagnation along a flux sheet; and (3) the alpha effect scales as 1/the square root of R. Arguments for these effects persisting in turbulent dynamos are given.

700,043
PB87-223715 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Off-Center Ignition of Nuclear Burning in Merging White Dwarfs.

Final rept.,
Y. Kawai, H. Saio, and K. Nomoto. 1987, 5p
Contract DE-AC02-76CH00016
Sponsored by Department of Energy, Washington, DC.
Pub. in Astrophysical Jnl. 315, p229-233, 1 Apr 87.

Keywords: *Binary stars, Nuclear fusion, Ignition, Reprints, *White dwarf stars.

The ignition of nuclear burning in merging white dwarfs is investigated for various combinations of component stars composed of He, C+O, and O+Ne+Mg. The authors assume that a rapidly accreting white dwarf mimics the massive component of a merging double white dwarf binary system. By computing steady models the authors obtain the location of nuclear ignition as a function of the accretion rate and the mass of accreting stars.

700,044
PB87-223780 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Search For Technetium (Tc II) in Barium Stars.

Final rept.,
I. R. Little-Marein, and S. J. Little. Jun 87, 3p
Pub. in Astronomical Jnl. 93, n6 p1539-1541 Jun 87.

Keywords: *Technetium, Ultraviolet spectra, Line spectra, Reprints, *Barium stars, IUE, Ultraviolet astronomy.

The authors searched without success for the lines of Tc II at 2647.02, 2610.00 and 2543.24 Å in IUE spectra of the barium stars HR 5058, omicron Vir, and zeta Cap. The lack of Tc II implies that the observed s-process enhancements were produced more than half a million years ago and supports the suggestion that the spectral peculiarities of barium stars are probably related to the binary nature of the stars.

700,045
PB87-223798 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Investigation of Stellar Coronae with AXAF.

Final rept.,
J. L. Linsky. 1987, 14p
Contract NASA-H-80531B
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Astro. Letters and Communications 26, p21-34 1987.

Keywords: X ray spectra, Reprints, *Stellar coronae, Flare stars, Late stars, Cosmic x-ray sources.

While the Einstein and EXOSAT satellites were able to discover many late-type stars as coronal X-ray sources and to study their statistical properties, they were unable to measure the coronal plasma physical parameters for most of these stars. The AXAF spectroscopic instruments will add enormously to the authors understanding of stellar coronal physics as high throughput, angular resolution, and spectral resolution are needed to measure the emission measure-temperature distribution, electron density, emitting volume, and flow velocities. These parameters are essential to model stellar coronae and to understand their energy balance. The author lists some of the fundamental questions of stellar coronal physics and indicate to what extent the different instruments on AXAF will be able to answer these questions.

700,046
PB87-224044 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Hydrodynamic Studies of Oxygen, Neon, and Magnesium Novae.

Final rept.,
S. Starrfield, W. M. Sparks, and J. W. Truran. Jun 87, 5p
Grant NSF-AST83-14788, Contract NASA-NAG5-481
Sponsored by National Science Foundation, Washington, DC., National Aeronautics and Space Administration, Washington, DC., and Department of Energy, Washington, DC.
Pub. in Stellar Pulsations p401-405 Jun 87.

Keywords: *Novae, Oxygen, Neon, Magnesium, Reprints, *White dwarf stars.

In the paper the authors present the results of recent theoretical studies that have examined the properties of nova outbursts on O-Ne-Mg white dwarfs. These outbursts are much more violent and occur much more frequently than outbursts on CO white dwarfs. Hydrodynamic simulations of both kinds of outbursts are in excellent agreement with the observations.

700,047
PB87-224051 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Pulsational Analyses of Post Planetary Nebula Central Stars and Degenerate Dwarfs.

Final rept.,
S. Starrfield. Jun 87, 10p
Grant NSF-AST83-14788, Contract NASA-NAG5-481
Sponsored by National Science Foundation, Washington, DC., National Aeronautics and Space Administration, Washington, DC., and Department of Energy, Washington, DC.
Pub. in Stellar Pulsations p332-341 Jun 87.

Keywords: *Planetary nebulae, *Variable stars, *Dwarf stars, Reprints, Stellar oscillations, Stellar pulsations.

Recent observational and theoretical studies of the ZZ Ceti variables (DA degenerate dwarfs), the DBV variables (DB degenerate dwarfs), and the GW Vir variables (DO degenerate dwarfs) have shown them to be pulsating in nonradial g-modes. The pulsation mechanism has been identified for each class of variable star. For the ZZ Ceti and DBV variables it is both the kappa and gamma effects in the partial ionization regions of either hydrogen or helium and also a recently identified pulsation driving mechanism called 'convection blocking.' For the GW Vir variables, it is the kappa and gamma effects in the partial ionization region of carbon and oxygen.

700,048
PB87-224077 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Low Frequency Oscillations of Uniformly Rotating Stars and a Possible Excitation Mechanism for Variable B Stars.

Final rept.,
U. Lee, and H. Saio. Jun 87, 4p
Pub. in Stellar Pulsation p102-105 Jun 87.

Keywords: *Variable stars, Reprints, *Stellar oscillations, *B stars.

In order to search for the excitation mechanism of variable B star pulsations, the authors have conducted a

study of low frequency nonradial oscillations in a uniformly rotating massive main sequence star with a convective core. The first intention of their study was to examine Osaki's mechanism, which was originally proposed for the excitation mechanism of beta Cephei pulsations. Subsequently, they have tried to make clear the general nature of low frequency oscillations of rotating stars. In the paper, they summarize their present theoretical understanding of the properties of low frequency oscillations of rotating stars.

700,049
PB87-233904 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Rotational Modulation and Flares on RS CVn and BY Dra Stars. 6. Physical Parameters of the Chromospheres/Transition Regions of V 711 Tau (HR 1009), II Peg and AR Lac during October 1981.

Final rept.,
P. B. Byrne, J. G. Doyle, A. Brown, J. L. Linsky, and M. Rodono. 1987, 11p
Contract NASA-NAGS-82
See also PB87-173704. Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Astronomy and Astrophysics* 180, p172-182 1987.

Keywords: *Stellar atmospheres, Variable stars, Binary stars, Photometry, Reprints, *Starspots, Late stars, Stellar flares.

Ground-based optical and IUE satellite-ultraviolet observations of three RS CVn stars are combined with density sensitive line ratios and differential emission measure curves to describe the physical conditions in their outer atmospheres. Solar-like densities are found to be representative of average conditions on two of the stars, V 711 Tau and AR Lac. The authors estimate the total radiative losses from these two stars and find these to be larger than the Sun by at least two orders of magnitude. Consideration of the volume emitting in two of the principal transition region lines suggest a possible relation between the disk 'filling factor' for these two lines and the dynamo-related Rossby number. Only one hemisphere of the star II Peg, the one showing least evidence of starspots, is similar. On the opposite hemisphere the presence of a discrete emitting region is deduced which is almost coincident in phase with the passage of the dominant optical spot group across the visible disk. The dimensions of the region and an illustrative interpretation in terms of a large emitting magnetic loop are discussed. The authors compare it to large active region loops on the Sun.

700,050
PB87-233979 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Theory of Transition-Layer Emission Measures and Coronae.

Final rept.,
E. Bohm-Vitense. 15 Jun 87, 10p
Grant NSG-5398
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Astrophysical Jnl.* 317, p750-759, 15 Jun 87.

Keywords: Temperature gradients, Stratification, Reprints, *Stellar coronae, Transition layers.

The authors study the temperature stratification and the emission measures for transition layers and coronae. The transition layers consist of two parts for which the energy balance is quite different. In the upper part of the transition layers, the temperature stratification is governed by heat conduction. In the lower part of the transition layers the temperature stratification is determined by an equilibrium between mechanical flux input and radiative energy losses. The coronal temperatures increase with increasing mechanical flux and damping length in the upper transition zone. For strong stellar winds, here is a noticeable reduction of the coronal temperature due to the wind.

700,051
PB88-111133 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Of Galactic Novae.

Final rept.,
S. Starfield, and M. A. J. Snijders. 1987, 17p
Contract NAG5-481, Grant NSF-AST83-14788
Sponsored in part by Grant NSF-AST85-16173. Sponsored by Department of Energy, Washington, DC., Na-

tional Aeronautics and Space Administration, Washington, DC., and National Science Foundation, Washington, DC.

Pub. in *Exploring the Universe with the IUE (International Ultraviolet Explorer) Satellite*, p377-393 1987.

Keywords: *Novae, Reviews, White dwarf stars, Ultraviolet astronomy, IUE.

For the past 8 years novae have been studied by the International Ultraviolet Explorer Satellite and it is the purpose of the review to outline the advances made in the understanding of the nova outburst as a result of the ultraviolet observations. There have been more than 10 novae that were studied while in outburst and at least 10 more novae have been studied after they had returned to minimum. The authors have been able to determine elemental abundances, total mass ejected, and ejection speeds as a result of the IUE observations. They have also been able to determine rates of mass ejection by winds and mass accretion through the accretion disk. As a direct result of both ultraviolet and infrared studies, they have recently identified a new class of novae which are ejecting material rich in oxygen, neon, magnesium, and silicon. At the present time there are two bright novae being studied with the IUE satellite.

700,052
PB88-111141 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Chromospheres and Transition Regions.

Final rept.,
C. Jordan, and J. L. Linsky. 1987, 35p
Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Exploring the Universe with the IUE (International Ultraviolet Explorer) Satellite*, p259-293 1987.

Keywords: Ultraviolet spectra, *Stellar chromospheres, Cool stars, Late stars, IUE.

The chapter reviews studies on the chromospheres and transition regions of cool stars using the International Ultraviolet Explorer during the years 1978-1986. A bibliography of more than 150 entries is included.

700,053
PB88-120993 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.

Accurate Determination of the Fine-Structure Intervals in the triplet P Ground States of (13)C and (12)C by Far-Infrared Laser Magnetic Resonance.

Final rept.,
A. L. Cooks, R. J. Saykally, J. M. Brown, and K. M. Evenson. 1986, 5p
Pub. in *Astrophysical Jnl.* 309, p828-832, 15 Oct 86.

Keywords: *Carbon 12, *Interstellar matter, Far infrared radiation, Ground state, Abundance, Reprints, *Carbon atoms, *Carbon 13, Fine structure, Laser magnetic resonance.

Accurate values are given for the fine-structure intervals in the triplet P ground state of neutral atomic carbon-12 and carbon-13 as obtained from laser magnetic resonance spectroscopy. The rigorous analysis of (13)C hyperfine structure, the measurement of resonant fields for (13)C transitions at several additional far-infrared laser frequencies, and the increased precision of the (12)C measurements permit significant improvement in the evaluation of these energies relative to earlier work. The results will expedite the direct and precise measurement of these transitions in interstellar sources and should assist in the determination of the interstellar (12)C/(13)C abundance ratio.

700,054
PB88-121157 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

X-ray Sources in Regions of Star Formation. 2. The Pre-Main Sequence G Star HDE 283572.

Final rept.,
F. M. Walter, A. Brown, J. L. Linsky, A. E. Rydgren, F. Vbra, M. Roth, L. Carrasso, P. F. Chuganinov, N. I. Shakovskaya, and C. L. Imhoff. 1987, 11p
Contract NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.

Pub. in *Astrophysical Jnl.* 314, p297-307, 1 Mar 87.

Keywords: Reprints, *X ray stars, T Tauri stars, Stellar chromospheres, Pre-main sequence stars, HDE 283572 star.

The authors have detected HDE 283572, a ninth-magnitude G star 8' south of RY Tau, as a bright X-ray source, and subsequent observations have revealed it to be one of the brightest late-type pre-main-sequence stars. It has a rotation period of 1.5(d) and strong chromospheric and coronal emission yet no evidence for an IR excess or a strong stellar wind. H(alpha) is in absorption. The Li abundance is cosmic. They conclude that HDE 283572 is a 2 solar masses naked T Tauri star. They have calculated simple models of the outer atmospheric structure of HDE 283572 based on the observed ultraviolet and X-ray emission measures.

700,055
PB88-129689 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Star Formation in X-ray Cluster Cooling Flows.

Final rept.,
R. E. White, and C. L. Sarazin. 1987, 9p
Contract NAGW-764, Grant NSF-AST81-20260
Sponsored by National Aeronautics and Space Administration, Washington, DC., and National Science Foundation, Washington, DC.
Pub. in *Astrophysical Jnl.* 318, p612-620, 15 Jul 87.

Keywords: Reprints, *Star formation, X ray sources, Galactic clusters.

At the center of each observed X-ray cluster, cooling flow is a central dominant galaxy accreting up to several hundred solar masses per year from the flow. With such accretion rates, the mass accumulated in a Hubble time by a central galaxy would be comparable to that of the galaxy itself. The authors therefore consider whether these accreting galaxies are formed, substantially or in part, by ongoing star formation in their associated cooling flows. In the paper, the first of a series, the authors derive the basic equations relevant to cooling flows, including the effects of star formation. They developed a local approximation for the star formation rate, based on a detailed thermal instability analysis which shows that the fastest-growing linear flow perturbations are radial, isobaric, and comoving. The prescription for the star formation rate allows analytic solutions to be found for both isobaric and gravity-dominated cooling flows.

700,056
PB88-134580 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

What is the Essential! Physics of Mass Loss from Late-Type Stars.

Final rept.,
J. L. Linsky. 1987, 17p
Grant NGL-06-003-057, Contract NASA-NAG5-82
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Circumstellar Matter, Proceedings of IAU Symposium 122, Heidelberg, Germany, June 23-27, 1986*, p271-287 1987.

Keywords: Solar atmosphere, Reviews, Reprints, *Late stars, *Stellar mass, Mass loss, Mira variables, Supergiant stars.

In the review the author considers what clues the data are providing them concerning the mass loss from late-type stars. The author considers in turn, the major classes of mass-loss mechanisms (thermally-driven winds, radiatively-driven winds, and wave-driven winds), and considers whether the empirical mass loss rates and other data are consistent with any of these mechanisms acting alone. It is likely that several mechanisms act together to produce the large mass loss rates in the Mira and non-pulsating M supergiants. Studies of the solar atmosphere suggest that thermal bifurcation driven by molecular condensation instabilities may play a critical role in cooling the atmospheres of luminous cool stars and forming silicate dust. It is possible that several metastable modes of atmospheric structure may exist for a given set of stellar parameters.

700,057
PB88-140165 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

ASTRONOMY & ASTROPHYSICS

Astrophysics

IUE Spectra of Flares on AU Mic.

Final rept.,
C. J. Butler, M. Rodono, and J. L. Linsky. 1986, 4p
See also N87-19203.
Pub. in *New Insights in Astrophysics--8 Years of UV Astronomy with IUE*, p229-232 1986.

Keywords: *Dwarf stars, Ultraviolet spectra, Reprints, *Au Mic star, *Stellar flares, Stellar activity, Ultraviolet astronomy, IUE.

IUE spectra were obtained in August 1980 through a substantial part of the optical cycle of the BY Draconis-type, spotted M dwarf star, AU Mic. No modulation of the ultraviolet emission line fluxes in antiphase with the optical curve was detected. Simultaneous optical photometry of AU Mic, when available, shows remarkably poor correlation of optical flare strength and ultraviolet emission-line enhancements. In general, the 'flares' detected on AU Mic, show considerable variety in the degree of enhancement in the various emission lines and optical continuum.

700,058

PB88-140173 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Correcting Observed Stellar Lyman Alpha Profiles for the Effects of Interstellar Absorption and Geocoronal Emission.

Final rept.,
J. E. Neff, J. L. Linsky, W. B. Landsman, and K. G. Carpenter. 1986, 4p
Contract NAG5-82

See also N87-19296. Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *New Insights in Astrophysics--8 Years of UV Astronomy with IUE*, p669-672 1986.

Keywords: *Dwarf stars, Ultraviolet spectra, Stellar spectra, Absorption, Correction, Reprints, Late stars, Cool stars, Lyman lines, Geocoronal emissions, Ultraviolet astronomy, IUE.

The hydrogen Lyman alpha emission line is one of the most important cooling channels for the outer atmospheres of late-type stars. In cool dwarfs, its flux exceeds the sum of all the other transition region lines combined. Yet, despite its importance, most programs using the International Ultraviolet Explorer (IUE) to study late-type stars have neglected this important diagnostic, due to two observational complications -- geocoronal emission and interstellar absorption. The authors have developed techniques that allow them to compensate for both of these difficulties, and are applying these techniques to a large number of low-resolution IUE spectra of nearby late-type dwarfs.

700,059

PB88-140181 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

IUE Study of the Very Local Interstellar Medium.

Final rept.,
R. C. Henry, J. Murthy, H. W. Moos, W. B. Landsman, J. L. Linsky, A. Vidal-Madjar, and C. Gry. 1986, 4p

See also N87-19271.
Pub. in *New Insights in Astrophysics--8 Years of UV Astronomy with IUE*, p555-558 1986.

Keywords: *Interstellar matter, Far ultraviolet radiation, Deuterium, Hydrogen, Comparison, Reprints, Late stars, Capella star, Procyon star, Ultraviolet astronomy, OAO 3, IUE.

IUE and Copernicus results are compared, for studies of the very local interstellar medium. Despite its lower resolution, IUE produces results of comparable quality, giving important confirmation of Copernicus results on the density, temperature, turbulence, and deuterium-to-hydrogen ratio in the region within about 10 pc of the sun. The stars observed are in a very low-density quarter of the galaxy: multi-component structure seen in other directions may not be present in the direction of most of the authors observed stars. The exceedingly low densities observed in certain directions encourages the idea that EUV (wavelength <912 Å) studies of certain normal stars may be possible.

700,060

PB88-140199 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Activity in Warm Stars: IUE Observations of Early F Dwarfs.

Final rept.,
F. M. Walter, and J. L. Linsky. 1986, 4p
Contract NAG5-429
See also N87-19172. Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *New Insights in Astrophysics--8 Years of UV Astronomy with IUE*, p103-106 1986.

Keywords: *Dwarf stars, Emission spectra, Ultraviolet spectra, Reprints, *Stellar activity, Ultraviolet astronomy, IUE.

The authors discuss deep low dispersion, short wavelength IUE observations of 69 F dwarfs ($0.31 \leq B-V \leq 0.52$). They overexposed the long wavelength end of the SWP camera by up to 100 times in order to bring up the weak chromospheric and transition region (TR) emission lines. All but one of the stars observed show evidence for stellar activity, as defined by the presence of large C II and C IV surface fluxes, with fluxes in excess of 100,000 ergs/cm squared/sec. Unlike the situation in stars with $B-V > 0.45$, they observed no correlation between surface flux and the stellar rotation rate in the early F dwarfs.

700,061

PB88-140207 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

TZ Fornacis--An Eclipsing Capella-Like System Observed with the IUE.

Final rept.,
K. Eriksson, M. Saxner, B. Gustafsson, A. Ayres, J. L. Linsky, and J. Andersen. 1986, 3p
See also N87-19202.

Pub. in *New Insights in Astrophysics--8 Years of UV Astronomy with IUE*, p225-227 1986.

Keywords: *Binary stars, *Giant stars, Ultraviolet spectra, Emission spectra, Magnesium, Reprints, *Eclipsing binary stars, *TZ Fornacis stars, Late stars, Capella star, Stellar chromospheres, Ultraviolet astronomy, IUE.

Binary systems consisting of two late-type giants are rare, and TZ Fornacis is the only well-studied eclipsing binary with two late-type giants. This allows for accurate determination of e.g. the masses of the components and their evolutionary status. The authors have observed TZ For with the IUE in 1984-86, at orbital phases 0.0, 0.25 and 0.79. Most of the exposures were LWP-HI or SWP-LO. Conclusions are discussed.

700,062

PB88-140868 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Steady State Cooling Flow Models for Normal Elliptical Galaxies.

Final rept.,
C. L. Sarazin, and R. E. White. 1987, 17p
Contract NAGW-764, Grant NSF-AST81-20260
Sponsored by National Aeronautics and Space Administration, Washington, DC., and National Science Foundation, Washington, DC.
Pub. in *Astrophysical Jnl.* 320, p32-48, 1 Sep 87.

Keywords: *Galaxies, Interstellar matter, Steady state, Cooling, X rays, X ray spectra, Reprints, *Elliptical galaxies, Flow models, Mass loss.

Recent X-ray observations show that normal elliptical galaxies contain large quantities of hot gas. They present spherically symmetric, steady state inflow models for this gas, which is assumed to be from stellar mass loss within the galaxy. Particular attention is paid to the boundary conditions on the flow. They calculate the X-ray luminosities, spectra, and surface brightness profiles of a grid of cooling flow models for galaxies spanning a range of optical luminosities. To constrain the amount of dark matter and the rates of energy and mass input in ellipticals, they consider galaxy models with and without dark halos and with various supernova and stellar mass-loss rates. They also consider the effects on the models of outer pressure variations and the inflow of external gas.

700,063

PB88-140876 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Simple Cooling Flow Model for X-ray Coronae Around Elliptical Galaxies.

Final rept.,
C. L. Sarazin. 1986, 6p
Grant NSF-AST81-20260, Contract NAGW-764
Sponsored by National Science Foundation, Washington, DC., and National Aeronautics and Space Administration, Washington, DC.
Pub. in *Proceedings of Gaseous Halos of Galaxies Workshop*, Green Bank, WV., May 30-June 1, 1985, p223-228 1986.

Keywords: *Galaxies, Coronas, X rays, Cooling, *Elliptical galaxies, Flow models.

As a simple model for the x-ray coronae observed around normal elliptical galaxies, the author proposes that the hot gas forms a steady-state cooling flow, in which the gas is heated by ejection from stars and infall and not primarily by supernovae. This model requires that elliptical galaxies have heavy haloes, and that the rate of supernova heating be somewhat smaller than is usually thought. This model naturally reproduces the temperature, x-ray luminosity, and the density distribution of the hot gas.

700,064

PB88-140892 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Particle Acceleration at Shocks: A Monte Carlo Method.

Final rept.,
J. Kirk, and P. Schneider. 1987, 10p
Pub. in *Astrophysical Jnl.* 322, p256-265, 1 Nov 87.

Keywords: *Cosmic rays, Monte Carlo method, Synchrotron radiation, Shock waves, Reprints, *Particle acceleration, Relativistic range.

A Monte Carlo method is presented for the problem of the acceleration of test particles at relativistic shocks. The particles are assumed to diffuse in pitch angle as a result of scattering off magnetic irregularities frozen into the fluid. Our method involves techniques designed to handle this kind of diffusion efficiently. Several tests are performed using the analytic results available for both relativistic and nonrelativistic shock speeds. They then investigate the acceleration at relativistic shocks under the influence of radiation losses, and include the effects of a momentum dependence in the diffusion coefficient.

700,065

PB88-140918 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Electron Injection by Relativistic Protons in Active Galactic Nuclei.

Final rept.,
M. Sikora, J. G. Kirk, M. C. Begelman, and P. Schneider. 1987, 5p
Grant NSF-AST83-51997, Contract NAGW-766
Sponsored by National Science Foundation, Washington, DC., and National Aeronautics and Space Administration, Washington, DC.
Pub. in *Astrophysical Jnl.* 320, pL81-L85, 15 Sep 87.

Keywords: *Galactic cosmic rays, *Cosmic rays, Pair production, Quasars, X rays, Gamma rays, Protons, Electrons, Reprints, *Galactic nuclei, Photon-proton interactions, Cosmic x-ray sources, Particle acceleration.

It is shown that protons with Lorentz factors larger than about one million are cooled very rapidly by collisions with soft photons in the environment of an active galactic nucleus (AGN). Proton-photon collisions result in the production of ultrarelativistic e^+e^- pairs and mesons. The latter are predominantly neutral pions, which decay into gamma rays. Such gamma rays interact with soft photons, providing an additional source of ultrarelativistic pairs. As a result of p-gamma interactions, protons cannot be accelerated by the first-order Fermi process (e.g., in strong shocks) beyond some maximum Lorentz factor, which we estimate. If the energy distribution of accelerated protons is sufficiently flat, then most of the energy contained in relativistic protons will be transformed to pairs, and then to radiation. Under these conditions, proton cooling due to p-gamma interactions is much more important than energy losses due to inelastic proton-proton collisions. Pairs produced as a consequence of p-gamma interactions have much higher energies than those attainable through shock acceleration of elec-

trons. These energies are large enough to initiate and sustain the pair cascade process, not only by Compton upscattering of ambient radiation, but also by synchrotron production of gamma rays and direct pair production by electron-photon interactions.

700,066

PB88-151980

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

IUE Observations of Hydrogen and Deuterium in the Local Interstellar Medium.

Final rept.,

J. Murthy, R. C. Henry, H. W. Moos, W. B. Landsman, J. L. Linsky, A. Vidal-Madjar, and C. Gry. 1987, 12p

Pub. in *Astrophysical Jnl.* 315, p675-686, 15 Apr 87.

Keywords: *Interstellar matter, *Hydrogen, *Deuterium, Ultraviolet spectra, Abundance, Reprints, Late stars, IUE, Procyon star, Altair star, Capella star.

The authors present and analyze high-dispersion IUE observations of the interstellar hydrogen and deuterium Ly(α) absorption profiles toward the late-type stars epsilon Eri (3.3 pc), Procyon (3.5 pc), Altair (5.1 pc), Capella (13.2 pc), and HR 1099 (33 pc).

700,067

PB88-152012

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Rotational Modulation and Flares on RS CVn and BY Dra Systems. 2. IUE Observations of BY Draconis and AU Microscopii.

C. J. Butler, J. G. Doyle, A. D. Andrews, P. B. Byrne, J. L. Linsky, P. L. Bornmann, M. Rodono, V. Pazzani, and T. Simon. 1987, 19p

Contract NAG5-82

See also PB87-173704, and PB88-152020. Sponsored by National Aeronautics and Space Administration, Washington, DC.

Pub. in *Astron. Astrophys.* 174, p139-157 1987.

Keywords: *Stellar atmospheres, Dwarf stars, Ultraviolet spectra, Variable stars, Reprints, *Starspots, *Stellar flares, Flare stars, Stellar activity, IUE.

IUE spectra were obtained in 1980 August and 1981 October through a substantial part of the optical cycle of two examples of the class of BY Draconis-type, spotted M-dwarf stars, AU Mic and BY Dra. For BY Dra itself, a small rotational modulation of the strong UV emission lines has probably been detected. This may be interpreted as evidence for 'plage-type' regions in the stellar chromosphere which overlie the photospheric spots. For AU Mic no such modulation is evident in the authors data.

700,068

PB88-152020

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Rotational Modulation and Flares on RS CVn and BY Dra Stars. 3. IUE Observations of V711 Tau (=HR1099), II Peg, and AR Lac.

Final rept.,

M. Rodono, P. B. Byrne, J. E. Neff, J. L. Linsky, T. Simon, C. J. Butler, S. Catalano, G. Cutispoto, J. G. Doyle, A. D. Andrews, and D. M. Gibson. 1987, 18p

Contract NAG5-82

See also PB88-152012. Sponsored by National Aeronautics and Space Administration, Washington, DC.

Pub. in *Astron. Astrophys.* 176, p267-284 1987.

Keywords: *Stellar atmospheres, Ultraviolet spectra, Variable stars, Reprints, *Stellar flares, *Starspots, Late stars, IUE.

The authors present observations of three RS CVn stars, which were obtained over the stellar rotation cycles with the IUE satellite. Emission lines from high-temperature transition regions and chromospheres analogous to those observed in the solar spectrum were observed. However, the stellar line surface fluxes are hundreds of times the solar values. The only visible component of II Peg and both components of V711 Tau and AR Lac appear to be chromospherically active. For the latter systems, the Mg(II) line surface flux from the G-type star is higher than that from the K subgiant, which dominates the observed UV line flux. Moreover, evidence of long-term ultraviolet variability is presented for AR Lac.

700,069

PB88-152533

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.

Experimental and Theoretical Investigation of the Far-Infrared Spectrum of H₂-He Mixtures.

Final rept.,

G. Birnbaum, G. Bachet, and L. Frommhold. 1987, 7p

Pub. in *Physical Review A* 36, n8 p3729-3735, 15 Oct 87.

Keywords: *Hydrogen, *Helium, *Planetary atmospheres, *Infrared spectra, Absorption spectra, Far infrared radiation, Mixtures, Reprints.

New measurements of the rototranslational collision-induced absorption spectra in the far-infrared (FIR) frequency region of gaseous mixtures of hydrogen (H₂) and helium (He) are reported. The frequency range extends up to 1500/cm at the temperature of 195 K, and 1700/cm at 296 K. The uncertainties of the measurement are assessed. Comparison with previous measurements show substantial agreement at frequencies where the measurements overlap. For comparison with the measurement, spectra are computed from the fundamental theory using a state of the art ab initio dipole function and an isotropic potential surface as input. The observed agreement suggests that for important applications, such as the analysis of the FIR spectra of the outer planets, the spectra can be obtained reliably as a function of frequency and temperature from quantum calculations of the kind presented here.

Cosmic Ray Research

700,070

PB87-181699

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Detection of Cosmic-Background Neutrinos by Acoustic Phonon Scattering.

Final rept.,

G. Tupper, M. Danos, B. Muller, and J. Rafelski. Jan 87, 3p

Pub. in *Physical Review D* 35, n1 p394-396, 1 Jan 87.

Keywords: Neutrinos, Reprints, *Cosmic neutrinos, *Neutrino detection, Phonon scattering, Background radiation, Big bang cosmology.

The possible detection of cosmic-background neutrinos is examined, using coherent neutrino-phonon scattering. The conclusion is that, at least for simple detector schemes, the reaction rate is unobservably small.

ATMOSPHERIC SCIENCES

Meteorological Data Collection, Analysis, & Weather Forecasting

700,071

PB87-219036

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

Selection of Soil Thermal Properties for Mesoscale Numerical Models.

Final rept.,

L. A. Salomone. 1983, 4p

Pub. in *Proceedings of the Conference on Severe Local Storms* (13th), Tulsa, OK., October 17-20, 1983, p320-323 1983.

Keywords: *Weather forecasting, Mathematical models, Soil tests, Heat transfer, Soil water, Thermal conductivity, Surface waters, Vegetation, Connection, Boundary layer, *Severe storms.

Mesoscale numerical models developed for severe weather forecasting can be improved by incorporating smaller-scale features into model at the surface. Here,

changes in soil thermal and moisture properties, elevation, surface vegetation and albedo are encountered. Therefore, each of these surface characteristics should be included in the model through the surface energy balance from which the surface temperature and humidity are computed. The paper discusses the factors that affect soil thermal resistivity and the equipment and approach that can be used for establishing representative values of thermal resistivity for mesoscale numerical models.

700,072

PB87-234100

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Heterodyne Measurements of Hot Bands and Isotopic Transitions of N₂O near 7.8 Micrometers.

Final rept.,

A. Hinz, J. S. Wells, and A. G. Maki. 1987, 8p

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

Pub. in *Z. Phys. D - Atoms, Molecules and Clusters* 5, p351-358 1987.

Keywords: *Nitrogen oxide, Nitrous oxide, Wavelengths, Reprints, *Calibration frequencies, *Heterodyne frequencies, Hot bands, Molecular constants.

Heterodyne frequency measurements are reported for absorption transitions of N₂O in the frequency range from 1257 to 1335 cm⁻¹. The measurements use a CO laser as a transfer oscillator whose frequency is measured directly against combinations of frequencies of two stabilized CO₂ lasers whose frequencies are well known. A tunable diode laser is locked to the N₂O absorption feature and the frequency difference is measured between the diode laser and the CO laser. The v₃ fundamental bands of the ¹⁵N¹⁴N¹⁶O and ¹⁴N¹⁵N¹⁶O isotopes are reported. Measurements are also given for the 00(sup 002-001(sub 0) and 2(sup 0)1-02(sup 0)0, and 02(sup 2)1-02(sup 2)0 vibrational transitions of N₂O. A table of frequencies is given for the 00(sup 0)2-00(sup 0)0 band near 2560 cm⁻¹ based on these and earlier measurements.

BEHAVIOR & SOCIETY

Education, Law, & Humanities

700,073

PB87-201588

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Lead Isotope Studies of Some of the Finds from the Serce Liman Shipwreck.

Final rept.,

I. L. Barnes, R. H. Brill, E. C. Deal, and G. V. Piercy. 1986, 11p

Pub. in *Proceedings of the Int. Archaeometry Symposium*, Washington, DC, May 14-18, 1984, p1-11 1986.

Keywords: Glass, Ceramics, Mediterranean Sea, Turkey, *Shipwrecks, Tracer techniques, Lead isotopes, Sunken ships, Underwater archaeology.

The remains of a shipwreck at Serce Liman, along the southern coast of Turkey, were recently excavated by the Institute of Nautical Archaeology. The wreck was that of a merchant ship which went down in about A.D. 1025. A major part of the cargo consisted of more than half-a-million fragments of broken glass vessels and chunks of glass cullet. The excavators wish to learn whether the ship was Byzantine or Islamic, to trace the final route of the ship, to identify the nationality of her crew, and to learn where the glass was made. Identification of the proveniences of the cargo, the ship's fittings, and the personal belongings found on board could provide valuable evidence for answering these questions. Isotope determinations have been made for lead extracted from several lead-containing objects from the wreck. These include certain types of glasses, glazed ceramic wares, a bronze sword hilt, and a group of net sinkers. The study poses a severe test for the classification of objects and the determination of proveniences by lead isotope studies.

BEHAVIOR & SOCIETY

Education, Law, & Humanities

700,074

PB88-144142 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
Preservation of the Declaration of Independence and the Constitution of the United States.
Final rept.
2 Jul 51, 21p NBS/CIRC-505
Also available from Supt. of Docs.

Keywords: *Inert atmospheres, United States, *Historic preservation, *Declaration of Independence, *Constitution, *Preservation, Physical radiation effects.

At the request of the Librarian of Congress, an investigation was undertaken by the National Bureau of Standards to determine the best means of preserving the original copies of the Declaration of Independence and the Constitution of the United States. Consideration was given to three aspects of the problem. (1) Preservation of the documents in an inert atmosphere. (2) Filter to protect against harmful radiation. (3) Lighting conditions to improve viewing of the documents. The report summarizes the investigation on the first two subjects. The third subject will be discussed in a separate report.

International Relations

700,075

PB88-137120 Not available NTIS
National Bureau of Standards, Gaithersburg, MD.
National Bureau of Standards' International Relations.
Final rept.,
H. S. Peiser. 1980, 5p
Pub. in Proceedings of Commonwealth Regional Metrology Programme, Report on the First Review Meeting, Wellington, New Zealand, October 29-November 9, 1979, v2 p39-43 Apr 80.

Keywords: *International Relations, Meetings, International Cooperation, *National Bureau of Standards.

International relations are vital to the National Bureau of Standards. Our Director, Dr. Ernest Ambler, who would have wished, but was unable personally, to address you during this meeting, sends warm greetings, especially to PEL. He is himself very interested in the international and regional cooperative programmes of the NBS. As his maturing years were spent within the Commonwealth, he would have appreciated participating in a meeting co-sponsored by the Commonwealth Science Council.

Job Training & Career Development

700,076

PB88-138862 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Beginning at a Government Agency.
Final rept.,
J. S. Suehle. 1984, 1p
Pub. in Engineering Horizons, p52 1984.

Keywords: *Engineers, *Personnel development, Government, Laboratories, Reprints.

The author suggests that graduating engineers may want to consider beginning their professional careers in a government laboratory and outlines reasons why.

BIOMEDICAL TECHNOLOGY & HUMAN FACTORS ENGINEERING

Biomedical Instrumentation & Bioengineering

700,077

PB87-218293 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Generation of Separate Density and Compressibility Images in Tissue.
Final rept.,
S. J. Norton. Jul 83, 13p
Pub. in Ultrasonic Imaging 5, n3 p240-252 Jul 83.

Keywords: *Compressibility, *Density, Imaging, Reprints, *Diffusion tomography, Image reconstruction, Ultrasonic tomography.

A method is suggested for reconstructing separate images of the variations in density and compressibility in the same tissue sample. The images can be obtained from near-scattering measurements using only two long, rectangular transducer elements. As in diffraction tomography, 180 degrees access around the region of interest is required. The approach differs from conventional diffraction tomography, however, in that no transducer arrays are required and broadband illumination is used. A flat transducer, assumed long relative to the extent of the object, is used as a source of broadband, plane-wave illumination, and as a receiver of the backscattered sound. A second transducer, oriented at a different angle with respect to the first, is used as a receiver only. The two transducers are rotated together 180 degrees around the object, and backscattering measurements are performed during the rotation. The arrangement can be shown to sample the plane-wave spectrum of the object directly, and provides sufficient information to reconstruct independent images of the variations in both the density and compressibility of the scattering medium. Image resolution is limited by the bandwidth of the illuminating sound.

700,078

PB88-110739 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Adsorption of PMDM, the Adduct of Pyromellitic Dianhydride with 2-hydroxyethyl Methacrylate, on Hydroxyapatite.
Final rept.,
D. N. Misra, and R. L. Bowen. 1987, 8p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Colloids and Surfaces 26, p101-108 1987.

Keywords: *Dentin, *Dental materials, Calcium phosphates, Adsorption, Enamels, Bonding, Reprints, Apatites.

Adsorption of an isomeric mixture of the adduct of pyromellitic dianhydride with 2-hydroxy-ethyl methacrylate, PMDM, from ethanolic solutions onto synthetic hydroxyapatite was studied at 23 degrees C. This was done to determine if PMDM adsorbs on synthetic hydroxyapatite surfaces and to elucidate its role in a procedure for bonding composites with dentin and enamel.

700,079

PB88-122072 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Dental Adhesive Bonding.
Final rept.,
R. L. Bowen. 1987, 1p
Sponsored by American Dental Association Health Foundation, Chicago, IL.

Pub. in Update, p8 Aug/Sep 87.

Keywords: *Dental materials, *Enamels, Bonding, Adhesion, Reprints.

After decades of research, a combined dentin and enamel bonding method developed at the Paffenbarger Research Center, National Bureau of Standards, is beginning to address and minimize problems associated with the adhesion of dental composites to tooth surfaces. At the conclusion of a five-year clinical trial, it is hoped that new products based on these new adhesive materials will be introduced into U.S. and international dental materials markets.

700,080

PB88-141106 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
High Resolution Radiography: Applications to Biomedical Imaging.
Final rept.,
R. C. Dobbyn, M. Kuriyama, S. Takagi, and L. C. Chow. 1987, 4p
Grants PHS-DE-05030, PHS-DE-06060-01
Sponsored by Public Health Service, Rockville, MD.
Pub. in Proceedings of the Southern Biomedical Engineering Conference (6th), Dallas, TX., October 23-24, 1987, p194-197.

Keywords: *Meetings, *Radiography, X rays, *Biomedical imaging, Microradiography.

The superior spatial resolution obtained with parallel-beam microradiography over conventional contact microradiography has allowed us to image microstructural features of dental hard tissue not previously reported. The efforts to extend these techniques to provide a real-time capability for viewing in situ demineralization and remineralization effects, at and below the 1 um level, have resulted in an instrument with several novel and unique features having direct application to biomedical imaging. Using a synchrotron radiation source of x-rays and diffraction image magnification, the authors are now able to eliminate undesired scattered radiation. In addition, the energy range over which the instrument operates allows one to change magnification at will (x-ray zoom lens) and gives considerable flexibility in optimizing image contrast.

700,081

PB88-141270 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Research Directions for Bioanalytical Sensors Development.
Final rept.,
R. A. Durst, A. L. Plant, L. L. Brown, R. M. Kannuck, and J. M. Bellama. 1986, 12p
Pub. in Bioelectroanalytical Symposium (1st), p3-14 1986.

Keywords: *Bioinstrumentation, Detectors, Reprints.

Bioanalytical sensors (biosensors) are a relatively new class of analytical devices which use biological components for the recognition of specific analytes and the measurement of the resulting amplified chemical perturbation. Both electrochemical (voltammetric) and optical (fluorescence) measurements will be used to quantify the extent of analyte-induced biochemical reaction. As envisioned in the research, the biosensors will consist of three components: biological receptors, liposomes (for marker encapsulation), and electrochemical and optical detectors. The sensitivity of electrochemical detection is improved by the modification of electrodes with ion-exchange polymers. The use of the electrode in conjunction with complement or surfactant lysis of marker-containing liposomes provides a novel approach to the development of an extremely sensitive bioanalytical sensor.

700,082

PB88-147558 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Laser Resonance Ionization Mass Spectrometry.
Final rept.,
J. D. Fassett, L. J. Moore, J. C. Travis, and J. R. DeVoe. 1985, 6p
Pub. in Science 230, n4723 p262-267 1985.

Keywords: *Lasers, Reprints, *Inorganic analysis, *Mass spectrometers, Resonant ionization, Ultratrace analysis.

The brief review describes the recent research in the coupling of lasers with mass spectrometers for investigating resonant ionization processes of inorganic species. The laser-mass spectrometer system promises to make significant improvements in ionization efficiency, to reduce isobaric interferences thereby simplifying chemical processing for isotope dilution mass spectrometry, and the measurement of abundance ratios.

BUILDING INDUSTRY TECHNOLOGY

Architectural Design & Environmental Engineering

700,083
DE85001736 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Correlations of Solar Irradiance and Daylight Illuminance for Building Energy Analysis.
G. Gillette, and S. Treado. Oct 84, 35p ORNL/Sub-81-22201/2
Contract AC05-84OR21400

Keywords: *Daylighting, *Buildings, Cloud Cover, Diffuse Solar Radiation, Direct Solar Radiation, Energy Analysis, Insolation, Seasonal Variations, Standards, Turbidity, ERDA/320100.

The concept of luminous efficacy, the ratio of daylight illuminance to solar irradiance, is investigated for use in building energy analyses. Horizontal and vertical luminous efficacies are evaluated as functions of solar altitude, cloud condition, atmospheric extinction coefficient, turbidity, and season. Based on sky measurements made at the National Bureau of Standards, values of luminous efficacy for total, diffuse, and direct beam radiation are presented. (ERA citation 09:050006)

700,084
PB87-153821 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Ventilation Measurements in Large Office Building.
Final rept.,
A. K. Persily, and R. A. Grot. 1984, 1p
Sponsored by Public Buildings Service, Washington, DC., and Department of Energy, Washington, DC.
Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Jnl. 26, n5 p55 1984.

Keywords: *Ventilation, Air infiltration, Reprints, *Office buildings, Tracer techniques, Federal buildings.

Ventilation rates were measured in nine office buildings using an automated tracer gas measurement system. The buildings range in size from a two-story federal building with a floor area of about 2,000 sq meter to a 26-story office building with a floor area of 64,000 sq meter. The ventilation rates were measured for about one hundred hours in each building over a range of weather conditions. The results are presented and examined for variation with time and weather. In most cases, the ventilation rate of a building is similar for hot and cold weather. In mild weather, outside air is used to cool the building and the ventilation rate increases. In the buildings where infiltration is a significant portion of the total ventilation rate, this total rate exhibits a dependence on weather conditions. The measured ventilation rates are discussed in relation to the outside air intake strategy in each building.

700,085
PB87-161899 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Pressurization Testing of Federal Buildings.
Final rept.,
A. K. Persily, and R. A. Grot. 1986, 17p
Sponsored by General Services Administration, Washington, DC.
Pub. in American Society for Testing and Materials Special Technical Publication 904, p184-200 1986.

Keywords: Pressurizing, Reprints, *Federal buildings, *Airtightness, Air infiltration.

Seven federal buildings ranging in size from 1900 to 48,000 sq. meter of floor area were pressure tested to determine the airtightness of the building envelopes. These tests are part of a larger project to evaluate the thermal integrity of the envelopes of federal buildings. The buildings were pressurized using the air-handling equipment in the buildings and a constant-injection, tracer gas technique to measure the airflow through the fans. In addition, selected windows in some of these buildings were pressure tested separately to determine the airtightness of individual components. The results of the whole building and component pressurization tests are presented and discussed. In addition, the component pressurization test results are used to estimate the contribution of the windows to the total building air leakage. The results of the building pressurization tests are compared empirically to measured infiltration rates on the same buildings. The large building infiltration model developed by Shaw and Tamura of the National Research Council of Canada is applied to the buildings to predict air infiltration rates induced by weather.

700,086
PB87-161907 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Measurements of Air Infiltration and Airtightness in Passive Solar Homes.
Final rept.,
A. K. Persily. 1986, 15p
Contract DE-AL01-76PR06010
Sponsored by Department of Energy, Washington, DC.
Pub. in American Society for Testing and Materials Special Technical Publication 904, p46-60 1986.

Keywords: *Houses, Reprints, *Airtightness, Passive solar heating systems, Passive solar cooling systems.

The airtightness of 82 passive solar homes located throughout the United States was studied using tracer gas measurements of air infiltration and pressurization testing. The air infiltration measurements employed the tracer gas decay technique in a low-cost mode employing air sample bags and off-site infiltration determination. The infiltration rates measured under natural conditions ranged from about 0.05 to almost 2 air changes per hour (ACH). The pressurization test results ranged from 1 to more than 30 ACH at 50 Pa, with an average of about 10 ACH. By comparing the pressurization measurements on these homes to measurements on other homes, the passive solar homes were found to be in general no tighter than other U.S. homes. The air infiltration and pressurization measurements of the Class B homes were compared using existing infiltration models and other empirical relations.

700,087
PB87-173761 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Effect of Wall Mass on the Summer Space Cooling of Residences.
Final rept.,
D. M. Burch, S. A. Malcolm, and K. L. Davis. 1984, 1p
Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Jnl. 26, n5 p39 1984.

Keywords: *Residential buildings, *Walls, *Cooling load, Reprints, Thermal mass, Energy conservation.

Six test buildings were extensively instrumented for measuring summer space cooling loads and indoor comfort. The test buildings were 20x20 ft (6.1x6.1m) one-room buildings and had the same floor plan and orientation. They were identical, except for the wall construction, which was as follows: insulated lightweight wood frame; uninsulated lightweight wood frame; uninsulated masonry with outside mass; uninsulated masonry; log; and insulated masonry with inside mass. The test buildings were exposed to summer climate at Gaithersburg, MD. Tests were carried out to investigate the effect of wall mass on the space cooling requirements when the test buildings were operated in the following fashions: fixed indoor thermostat setting of 65 degree F (18 degree C), fixed indoor thermostat setting of 76 degree F (24 degree C), and night ventilation cooling. The purpose of the test with a fixed indoor thermostat setting of 65 degree F (18 degree C) was to simulate building performance with a thermostat setting of 76 degree F (24 degree C) which would

occur in hotter climates. The study conclusively demonstrates the existence of a thermal mass effect on daily cooling requirements, peak cooling load, and the cooling energy savings achieved by night ventilation for the six test buildings.

700,088
PB87-174306 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.
Field Performance of Three Residential Heat Pumps in the Heating Mode.
J. Y. Kao, W. J. Mulroy, and D. A. Didion. Feb 87, 80p NBSIR-87/3528
Sponsored by Department of Energy, Washington, DC.

Keywords: *Heat pumps, Residential buildings, Space heating, Defrosting, Field tests, Houses.

The report presents the results of a field performance study of three heat pumps operating in the heating mode. The objective of this study was to evaluate the thermal, energy, defrosting, cycling, and other related performance under in-situ conditions and to confirm the validity of Department of Energy (DoE) test procedures by comparing these field results with those obtained in the laboratories. The seasonal COPs without auxiliary heat were 1.83, 2.31, and 1.92. The seasonal COPs with auxiliary heat were 1.71, 1.95, and 1.60. General agreement was found in two houses for cycling rates and building load estimation. Defrost penalty was found to be light above 40 deg F. One house was analyzed for cyclic performances. The cyclic degradation factor (CD) was found to be worse than the optimal factor (0.25) of the DoE procedure.

700,089
PB87-180253 PC A11/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Applied Economics Group.
Comprehensive Guide for Least-Cost Energy Decisions.
R. T. Ruegg, and S. R. Petersen. Jan 87, 245p NBS/SP-709
Also available from Supt. of Docs as SN003-003-02790-1. Library of Congress catalog card no. 86-600605. Prepared in cooperation with Catholic Univ. of America, Washington, DC. Sponsored by Department of Energy, Washington, DC.

Keywords: *Energy conservation, *Cost analysis, Economic analysis, Federal buildings, Computer applications.

The purpose of the book is to assist builders, building designers, owners, and operators to find a balance between energy consumption and energy conservation which will result in more cost-effective buildings. It assists in four ways: by guiding the decision maker to ask the right economic questions; by showing how to evaluate the cost effectiveness of energy conservation and renewable energy investments; by providing two computational aids- worksheets and a computer program; and by supplying some of the data that are needed to make the evaluations.

700,090
PB87-184750 CP D99
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
NBSLCC Program (for Microcomputers).
Software,
S. R. Petersen, and R. T. Ruegg. Apr 87, 1 diskette NBS/SW/DK-87/006
The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC XT AT microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB87-180253. Contact NTIS Computer Products for prices.

Keywords: *Software, *Buildings, Cost engineering, Diskettes, *Energy conservation, Life-cycle cost, L=Basic, H=IBM PC; IBM PC/XT; IBM PC/AT.

The diskette provides the NBSLCC programs and related files referenced in NBS SP 709, Comprehensive Guide for Least-Cost Energy Decisions. The NBSLCC programs perform economic analysis of buildings, building systems and components, with special emphasis on energy conservation projects. Software Description: The software is written in Basic for implementation on IBM-PC/XT/AT machines using the MS-DOS operating system. A minimum of 128K bytes of core storage is required.

BUILDING INDUSTRY TECHNOLOGY

Architectural Design & Environmental Engineering

700,091

PB87-219135

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.

Procedure for Measuring the Dynamic Thermal Performance of Wall Specimens Using a Calibrated Hot Box.

Final rept.,
D. M. Burch, R. R. Zarr, T. K. Faison, B. A. Licitra, and C. E. Arnold. 1987, 13p
Sponsored by Department of Energy, Washington, DC. Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Transactions, v93 pt2 13p 1987.

Keywords: *Walls, *Composite materials, *Heat transfer, Measurement, Finite difference theory, Polystyrene, Thermal insulation, Reprints.

An experimental procedure is developed that permits a calibrated hot box to be used to measure the transient heat-transfer rate through a composite wall specimen. In this procedure, a composite wall specimen is installed between the metering and climatic chambers of a calibrated hot box (CHB), and a time-dependent outdoor climatic condition, such as a sol-air diurnal temperature cycle, is generated in the climatic chamber. The metering chamber is maintained at a typical indoor condition and is used as a calorimeter. The transient heat-transfer rate through the wall specimen at hourly time steps is determined from an energy balance of the metering chamber. In the energy balance, the time-dependent heat-transfer rate through the specimen support frame is predicted using a finite-difference model, and the energy-storage rate within the metering chamber is predicted using a semi-empirical model. A dynamic calibration test was conducted to investigate the accuracy of this procedure. A masonry wall, comprised of 4-in-thick (0.1 m) polystyrene insulation and 5.6-in-thick (0.14 m) solid concrete block and having known heat-transfer properties, was tested. Good agreement was observed between the measured-and-predicted-specimen heat-transfer rates, thereby supporting the validity of the energy balance under dynamic conditions.

700,092

PB88-122122

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.

Refrigerant Migration in a Split-Unit Air Conditioner.

Final rept.,
W. J. Mulroy, and D. A. Didion. 1985, 14p
Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Transactions 91, pt1A p193-206 1985.

Keywords: *Refrigerants, *Air conditioners, Measurement, Capacity, Performance evaluation, Cyclic loads, Tests, Standards, Mathematical models, Reprints.

The relationship between cyclic refrigerant migration and cyclic loss for a residential, split-system air conditioner has been investigated. The cyclic refrigerant migration was measured at different points in the operating cycle by simultaneously shutting five pneumatically operated valves that isolated the refrigerant in the major system components. The refrigerant was then removed, weighed, and returned to the system. The unit tested was found to have a high initial capacity as migrated refrigerant was removed from the evaporator and then a low, slowly increasing capacity as trapped refrigerant was returned to the system from the accumulator. The unit performance was also compared to single and double time constant regressive approximations and to the time constant calculated from the evaporator mass and heat transfer coefficient.

700,093

PB88-122130

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.

Testing and Rating Solar Domestic Hot Water Systems Using ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Standard 95-1981.

Final rept.,
A. H. Fanney, K. A. Reed, and J. E. Hill. 1983, 30p
Sponsored by Department of Energy, Washington, DC. Pub. in Proceedings of Solar '83 International Solar Energy Symposium, Palma de Mallorca, Spain, October 2-6, 1983, p135-165.

Keywords: *Solar heating, *Hot water heating, Residential buildings, Tests, Standards, Performance evaluation, Solar collectors, Reprints.

ASHRAE has recently adopted ASHRAE Standard 95-1981, Methods of Testing to Determine the Thermal Performance of Solar Domestic Water-Heating Systems. The Standard requires the complete system, including auxiliary energy sources, to be assembled in the laboratory and subjected to a daily hot water load and irradiation profile until the daily system performance is repeatable. Data are then collected and analyzed to determine the fraction of the daily energy requirements met by solar energy. The system's solar collector array can be irradiated by a solar simulator or the net thermal energy delivered by an irradiated collector array may be provided by the use of a nonirradiated array in series with a conventional energy source.

700,094

PB88-122148

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.

Effect of Wall Mass on the Annual Space Heating and Cooling Loads of Residences.

Final rept.,
D. M. Burch, and B. A. Licitra. 1987, 8p
Pub. in Proceedings of International Congress of Building Energy Management (3rd), ICBEM '87, Lausanne, Switzerland, September 28-October 2, 1987, p248-255.

Keywords: *Walls, *Space heating, *Residential buildings, Insulation, Computer programming, Climate, Wood construction, Temperature, Reprints, TARP computer programming.

The space heating and cooling loads for a house containing partition walls and interior furnishings is simulated using a computer program called TARP. Separate computer runs are carried out for the following wall constructions: insulated wood frame; insulated masonry with mass on the exterior; and insulated masonry with insulations sandwiched between interior and exterior mass. The reductions in annual space heating and cooling loads achieved in the houses with masonry wall construction compared to identical houses with lightweight wood-frame wall construction are computed for five climates.

700,095

PB88-128640

PC A08/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.

Fenestration Design for Building Atria,

S. J. Treado, D. B. Holland, J. W. Bean, and G. L. Gillette. Sep 87, 170p NBSIR-87/3594
Sponsored by Department of Energy, Washington, DC., and American Architectural Mfrs. Association, Des Plaines, IL.

Keywords: *Architecture, *Windows, *Buildings, *Atria, Computerized simulation, Design, Graphs(Charts), *Energy efficiency.

The influence of fenestration design on building energy performance is evaluated, based on measurements in four atrium buildings and a series of detailed computer simulations using TARP and CEL-1. The impact of glazing area and solar-optical properties is examined for a linear and central atrium building for eight geographical locations. The usefulness of automatic solar shading and heat storage strategies is also investigated. Guidelines are presented for effective design of atrium fenestration.

700,096

PB88-128996

PC A07/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Characterization of Microenvironments and the Degradation of Archival Records: A Research Program,

E. Passaglia. Oct 87, 129p NBSIR-87/3635
Keywords: *Archives, *Air pollution, *Papers, Environmental engineering, Sulfur dioxide, Nitrogen oxides, Ozone, Temperature, Humidity, Storage, *Air pollution effects(Materials), Microenvironments.

Air pollutants increase the rate of degradation of documents and records in archival storage. However, with the exception of books, most of these documents and records are not exposed to the ambient environment of the archive stacks. They are instead stored in con-

tainers of various kinds. The records therefore experience the microenvironment of the interior of the container, which may be more benign than the macroenvironment exterior to it. In the report, the environment inside a container, and any changes that can occur in it as the exterior environment changes, is modelled. On the basis of the modelling, and what is known about the effects of pollutants on the degradation of archival records, a research program designed to lead to an understanding of the maximum benefit that could be obtained with various containers is laid out. The design and materials of construction are specifically discussed.

700,097

PB88-129887

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.

Allocating Funds among Projects with Variable Designs and Sizes.

Final rept.,
R. T. Ruegg. 1987, 5p
Pub. in Heating/Piping/Air Conditioning 59, n9 p75-79 Sep 87.

Keywords: *Heating, *Energy conservation, *Air conditioning, Project planning, Economic analysis, Cost effectiveness, Return on investment, Allocations, Guidelines, Reprints, *Funds, Budgeting.

When funds are limited, upgrading the design or increasing the size of variable-design/size projects may mean choosing fewer total projects. The paper provides guidelines for designing, sizing, and selecting projects under alternative budgetary conditions in order to maximize the return on the total investment. It emphasizes and illustrates with examples, the importance of identifying the appropriate budgetary perspective.

700,098

PB88-141163

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.

Aerial Thermography and Spot Radiometer Applications for Detecting Thermal Anomalies of Office Buildings.

Final rept.,
Y. M. Chang, and L. S. Galowin. 1985, 12p
Sponsored by General Services Administration, Washington, DC.
Pub. in Thermal Infrared Sensing for Diagnostics and Control (Thermosense VII), v520 p178-189 1985.

Keywords: *Heat losses, *Infrared thermography, *Radiometers, Aerial monitoring, Roofs, Office buildings, Reprints.

Aerial thermography and spot radiometer techniques were used for the assessment of roofs and heat loss through building envelopes of office buildings. The inspections were part of the diagnostic programs developed by the National Bureau of Standards (NBS) for the General Services Administration (GSA) to evaluate the thermal integrity of new and existing office buildings. The infrared inspections by aerial thermography and spot radiometer measurements were performed by outside contractors; all other tests were performed by NBS. The paper presents the analysis and results reported by the contractors, and discusses the capabilities and limitations of equipment with recommendations for aerial thermography and spot radiometer inspections on office buildings.

700,099

PB88-152327

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.

Review of Tracer-Gas Techniques for Measuring Airflows in Buildings.

Final rept.,
P. L. Lagus, and A. K. Persily. 1985, 13p
Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Transactions 91, pt2B p1075-1087 1985.

Keywords: *Air infiltration, *Tracer techniques, Ventilation, Commercial buildings, Reprints.

The paper describes tracer gas measuring techniques that have been used to characterize ventilation and air infiltration in buildings, with an emphasis on recent developments and applications in large industrial and commercial structures. Fundamentals and applica-

tions are presented for both single and multiple tracer gas methods.

Building Equipment, Furnishings, & Maintenance

700,100
PB87-171492 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
STOVE: A Predictive Model for Heat Transfer from Solid-Fuel Appliances,
R. D. Peacock, and R. A. Dipert. Feb 87, 67p
NBSIR-86/3300

Keywords: *Heating equipment, *Chimneys, *Fire safety, Walls, Heat transfer, Radiant heating, Fire tests, Models, Computer programs, *Wood burning appliances, STOVE computer program, Fortran 77 programming language.

A computer implementation of a model to predict temperatures on wall and wall protector surfaces exposed to the heating of an appliance such as a solid fuel heating appliance is described. A steady state heat transfer model with flexibility to describe a generalized method of protection for a combustible wall surface is presented along with a computer program implementing the model. Good agreement was found comparing the model predictions with data previously collected during full scale experiments conducted to evaluate the effectiveness of generic methods of wall protection in reducing temperatures on combustible wall surfaces. Extensive references of research related to solid fuel heating safety are included.

700,101
PB87-182002 PC A05/MF A01
Dayton Univ., OH. Research Inst.
Description and Results of Furniture Fire Modules Within FAST (HEMFAST (Heat and Mass Transport of Furniture Fire, Smoke and Toxic Gases)).
Interim technical rept. 1 Jun 85-1 Jun 86,
M. DiTenberger. Mar 87, 76p NBS/GCR-87/527
Grant NANB-D0557
Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Fire tests, Furniture, Smoke, Computerized simulation, Fortran, HEMFAST computer program.

The Heat and Mass Transport of Furniture Fire, Smoke and Toxic Gases (HEMFAST) program simulated the furniture fire and the toxic gas growth in a room and its spread to the other rooms. This was achieved by incorporating an improved furniture fire model into the FAST model in current usage at NBS. The furniture fire model was designed to be self-controllable in simulating a fire source utilizing as inputs only the bench scale data of new scalable material burning rates, flame spreading, thermal ignition, and the flame properties of the following: soot volume fraction, CO₂ and H₂O mass fractions of fuel weight, and gas temperatures. Since the Hottel's zoning method was used in the thermal radiation model it was possible to consider surface emissivities less than unity on all surface elements, and to consider three isothermal gray gas volumes which are the high-temperature flaming plume, the sooty upper gas layer, and the lower gas layer at 50% relative humidity. Some salient features are noted in the simulation of a sample fire growth on a furniture mockup.

700,102
PB87-200390 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Performance of Instantaneous Gas-Fired Water Heaters,
J. E. Harris, and J. Greenberg. May 87, 60p NBSIR-87/3537
Sponsored by Department of Energy, Washington, DC. Building Equipment Div.

Keywords: *Water heaters, *Energy efficiency, Energy conservation, Performance tests, Gas appliances, Tankless water heaters.

Four different instantaneous, gas-fired water heaters were tested to develop a test method to determine re-

covery efficiency (Er) and energy factor (EF). All four of the water heaters were from foreign countries (West Germany, the United Kingdom, France and Japan). Various flow rates and water draws were used during the tests to determine their influence on the recovery efficiency and energy factor. In addition, the pilot light power consumption was measured to determine the effect of a variable pilot light power rate on the energy factor. The use of recovery efficiency as a performance index seems appropriate for these units, however, the use of energy factor as presently calculated, needs further study.

700,103
PB87-201786 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Ceiling Jet-Driven Wall Flows in Compartment Fires,
L. Y. Cooper. Apr 87, 27p NBSIR-87/3535

Keywords: *Buildings, *Fires, Air flow, Walls, Ceilings(Architecture), Penetration, Flow rate, Flame propagation, Heat transfer, Plumes.

Analytic estimates are developed for the early depth of penetration of and the lateral entrainment into negatively buoyant, ceiling jet-driven wall flows which are generic to compartment fire scenarios. When walls are not too far from the fire source, of the order of the fire-to-ceiling distance, it is found that the penetration of the downward flow near such walls is a large fraction of the fire-to-ceiling distance itself, and that this fraction is relatively independent of the details of fire size, spacings, etc. Also, net rate of entrainment into the wall flow as it is buoyed back upward to the ceiling elevation is found to be several times larger than the flow rate of the driving ceiling jet flow immediately upstream of ceiling jet - wall impingement.

700,104
PB87-201851 PC A10/MF A01
California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center.
Entrainment, Chemistry, and Structure of Fire Plumes,
S. J. Toner, E. E. Zukoski, and T. Kubota. Apr 87, 223p NBS/GCR-87/528
Grant NANB-600638
Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Fires, *Flames, *Buildings, Plumes, Carbon monoxide, Soot, Combustion products, Stoichiometry, Gas analysis, Mathematical models.

The paper examines the chemistry of a flame as it impinges on a hot vitiated atmosphere. Several of the products of combustion (CO, soot etc.) are measured as a function of flame impingement, length of the flame below the hot layer and size of the fire.

700,105
PB87-201869 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Cigarette Ignition of Soft Furnishings - A Literature Review with Commentary,
J. F. Krasny. Apr 87, 109p NBSIR-87/3509

Keywords: *Ignition, *Furniture, *Upholstery, Combustion, Flammability testing, Bedding equipment, *Cigarette smoking.

Literature pertinent to the ignition by smoldering cigarettes of upholstered furniture and mattresses (soft furnishings) was searched through early 1986. This included literature on the smoldering behavior of cigarettes in air and their behavior on a variety of substrates simulating soft furnishings. According to the reviewed literature, the smoldering behavior of cigarettes on substrates differs from that of cigarettes burning in air: on substrates, cigarette temperatures tend to be lower, and burning rates slower. These differences seem to be larger for substrates which ignite than for those which self-extinguish after the cigarette burns out. The characteristics of soft furnishings which insure resistance to cigarette ignition have been established, but those of cigarettes with low propensity to ignite furnishings have not.

700,106
PB87-233771 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Elevators as a Means of Fire Escape.

Final rept.,
J. H. Klotz. 1983, 16p
See also PB82-230269.
Pub. in ASHRAE Transactions, v89 part IB p362-377 1983.

Keywords: *Fires, *Elevators(Lifts), *Escape systems, Evacuating(Transportation), Handicapped persons, Field tests, Air flow, Pressurizing, Reprints, *Building fires, Fire exits.

The paper is the initial report of an ongoing project to investigate the use of elevators as a means of fire escape for the handicapped. The use of stairs for fire evacuation poses a problem for people who cannot use stairs because of physical disabilities. The paper discusses some of the major problems associated with the use of elevators as a means of fire exit and proposes a conceptual solution to those problems. A report is made on field tests of four buildings with elevator protection systems. These protection systems and their interactions with other systems are examined.

700,107
PB88-155825 PC A05/MF A01
Maryland Univ., College Park. Dept. of Fire Protection Engineering.
Development of Cost Effective Techniques for Alleviating Water Supply Deficiencies in a Residential Sprinkler System,
J. A. Milke, and J. L. Bryan. Nov 87, 76p NBS/GCR-87/533
Grant NANB-D0720
Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research, and Fire Administration, Emmitsburg, MD.

Keywords: *Sprinkler systems, *Residential buildings, *Water supply, Houses.

Simple cost effective techniques for alleviating water supply deficiencies in a residential sprinkler system installed in a one- or two-family dwelling have been examined. The equipment associated with compensating for an inadequate municipal water supply using water storage tanks, booster pumps, and large diameter pipe have been investigated for efficiency and cost effectiveness. Hydraulically-designed, NFPA 13D, residential sprinkler systems in seven residences were used to carry out this research.

Building Standards & Codes

700,108
PB87-180865 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Standards--Tools for Excellence.
Final rept.,
R. D. Dikkers. 1987, 2p
Sponsored by National Inst. of Corrections, Washington, DC.
Pub. in Corrections Today, v49 n2 p170-171 Apr 87.

Keywords: *Building codes, Electronic security, Window glazing, Reprints, *Correctional facilities, *Jails.

General information on the development and use of building standards, and the need for guidelines, test methods, and other standards to assist in the selection of building materials, components, and systems for use in correctional facilities (jails prisons, etc.) is presented. The plans for a NBS project to address the development of standards for correctional facility products and systems is also briefly described.

700,109
PB87-201844 PC A07/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.
SASE - Standards Analysis, Synthesis and Expression Program: User Manual,
S. J. Fenves, M. T. Slava, and J. P. Barnett. Apr 87, 143p NBSIR-87/3514
Prepared in cooperation with Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.

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Building Standards & Codes

Keywords: *Standards, *Building codes, *Structural engineering, Construction, Construction materials, SASE computer program, User manuals(Computer programs), Earthquake engineering.

The Standards Analysis, Synthesis and Expression (SASE) program is intended to assist organizations engaged in the formulation, promulgation and maintenance of standards. It is expected that the user of SASE is familiar with the tutorial material contained in the report Introduction to SASE: Standards, Analysis, Synthesis and Expression. The manual is intended to provide detailed user instructions and serve as the reference manual on the use of the SASE program.

700,110
PB87-209052 PC A09/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.

Introduction to SASE: Standards Analysis, Synthesis, and Expression.

S. J. Fenves, R. N. Wright, F. I. Stahl, and K. A.

Reed. May 87, 188p NBSIR-87/3513

See also PB87-201844. Prepared in cooperation with Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.

Keywords: *Standards, *Building codes, Building, Classification, Standardization, Methodology, *SASE system, Knowledge representation.

The Standards Analysis, Synthesis, and Expression (SASE) methodology provides an objective and rigorous representation of the meaning of a standard. It is intended to assist organizations engaged in the formulation, promulgation, and maintenance of standards. In this discussion, the term standard includes all types of normative documents used to define the required qualities of buildings, building products, materials, or building processes. The term includes legal building regulations, consensus standards such as those of the American National Standards Institute and of the International Organization for Standardization, and proprietary specifications. Standards from many technology areas should be equally amenable to the SASE methodology. However, the methodology and the information models on which it is based have been tested extensively only in areas of building technology.

700,111
PB87-147715 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.

Applying Expert Systems to Building Standards.

Final rept.,

K. A. Reed. 1987, 2p

Pub. in Building Design and Construction 28, n11 p72-73 Nov 87.

Keywords: *Building codes, *Expert systems, Standards, Integrated systems, Reprints.

Current activity in the Computer Integrated Construction Program relating to standards and expert systems is summarized.

Construction Management & Techniques

700,112
PB87-164042 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

New Concepts for Construction Practice Standards for Excavations.

Final rept.,

F. Y. Yokel, R. M. Chung, and R. L. Stanevich. Apr

81, 6p

Pub. in Concrete Pipe News, p1-6 Apr 81.

Keywords: *Excavation, Soil classification, Construction industry, Standards, Reprints.

A previous NBS study concluded that it is in many instances not practical to require that an engineer design the shoring or determine the steepest allowable sideslope for shallow excavations (excavations less than 20 feet deep which cause most of the accidents in excavation cave-ins). Thus, it is necessary to have a standard or regulations which can be understood and implemented by supervisory personnel in

the field. The important features of a Standard Practice are discussed.

700,113
PB88-129903 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.

Graphical Approach to Discounted Payback.

Final rept.,

H. E. Marshall. 1985, 16p

Pub. in Construction Management and Economics 3, p105-120 1985.

Keywords: *Construction costs, *Buildings, *Project management, Graphs(Charts), Discounting, Benefit cost analysis, Cost effectiveness, Reprints, *Payback, *Discounted payback, Economic indicators.

Construction planners and building owners use payback frequently as an index of economic performance. Discounted payback, which considers the time value of money in measuring the time to project payoff, is a more accurate index of project cost effectiveness than simple payback. But being more difficult to calculate, it is used less often than simple payback. The paper provides a unique set of graphs that helps decision makers find discounted payback quickly and easily without complex calculations. Appropriate applications of simple and discounted payback are described. Examples of economic efficiency losses from using payback instead of more appropriate evaluation measures and from using simple instead of discounted payback are presented.

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700,114
PB87-150504 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

Proposed Experimental Program for Large-Scale Braced-Frame Connections.

Final rept.,

J. L. Gross. 1986, 17p

Sponsored by American Inst. of Steel Construction, Chicago, IL.

Pub. in Proceedings of AISC National Engineering Conference: Solutions in Steel, Nashville, TN., June 12-14, 1986, p16-1--16-17.

Keywords: *Frames, *Joints(Junctions), *Buildings, Gusset plates, Loads(Forces), Structural design, Steel structures, *Braced frames.

Diagonal bracing systems are frequently employed in steel framed structures to provide stability and to resist both wind and seismic loads. It is common in such bracing systems to use gusset plates to attach the diagonal braces to the main framing members. Analytical studies have shown that the force distribution in a gusseted connection depends upon all of the structural components constituting the connection including the gusset plate, diagonal brace or braces, column, beam, and fasteners (bolts or welds). Research is currently in progress at the National Bureau of Standards (NBS) to determine experimentally the behavior of gusseted connections. Three 3/4-scale braced frame subassemblies, each with a different connection detail will be tested. The objectives of the NBS experimental program on braced frame connections are presented. The selection of the subassembly to be tested, based on prototype behavior, is described. And the details of the proposed test specimens and loading are given.

700,115
PB87-152310 PC A04/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.

Influence of Mortar Bedding on Masonry Prism Behavior.

P. Gaynor, K. Woodward, and C. Scribner. Feb 87,

69p NBSIR-86/3467

Keywords: *Mortars(Materials), *Masonry, Concrete blocks, Compression tests, Ultimate strength, Prisms.

The results from compression tests of seventy ungrouted, hollow, concrete block masonry prisms are presented. The prisms are three-high, stack-bonded

assemblages. The varied parameters in the investigation include block strength, mortar type, and mortar bedding type (area). The resulting data include the ultimate strength of the prisms and strains measured at various locations on each prism. Major observations of prism behavior are that mortar type has a negligible influence on prism behavior, block strength affects prism ultimate strength in proportion to its own ultimate strength variation, and mortar bedding type significantly affects ultimate strength, its variability, strain distributions, and mode of failure. It is recommended that faceshell bedded prisms not be used as quality control samples for masonry construction because of their disturbed strain fields and higher variability of test data.

700,116
PB87-153094 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.

Service Life Prediction from Accelerated Aging Test Results Using Reliability Theory and Life Testing Analysis.

Final rept.,

J. W. Martin. 1985, 21p

Pub. in Proceedings of NATO Advanced Research Workshop on Problems in Service Life Prediction of Building and Construction Materials, Paris, France, September 10-12, 1984, p191-211 1985.

Keywords: *Construction materials, *Accelerated tests, Service life, Cost analysis, Reliability, Risk, Life tests.

Accelerated aging test procedures used in high technology industries were applied to building products. The emphasis in these procedures is in the mathematical analysis of the life data. One of the more successful mathematical procedures is reliability theory and life testing analysis. In the paper, the basic format of this analysis procedure is outlined and several applications are presented in which these techniques were applied to predicting the service life of building materials and products. The results of these analyses are very promising and it is concluded that reliability theory and life testing analysis techniques should be readily adaptable for predicting the service lives of a wide range of building products and materials.

700,117
PB87-157145 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Glass Strength Degradation under Fluctuating Loads.

Final rept.,

D. A. Reed, and E. R. Fuller. Jul 85, 8p

Pub. in Jnl. of Structural Engineering III, n7 p1460-1467 Jul 85.

Keywords: *Glass, Buildings, Loads(Forces), Cladding, Aerodynamics, Deformation, Mechanics, Failure, Probability theory, Reprints, Wind loads.

An alternative approach for estimating the strength degradation, and ultimately, the failure of glass cladding subjected to fluctuating loadings is proposed. The procedure is formulated using fracture mechanics concepts employed previously by Evans and Fuller (1973). This approach is simple computationally and does not require time integration of fluctuating stress or pressure loading time histories.

700,118
PB87-180873 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.

Durability Performance Criteria for Building Materials.

Final rept.,

G. Frohnsdorf, and L. Masters. 1984, 10p

Pub. in Durability of Concrete Structures, p317-326 Apr 84.

Keywords: *Concrete structures, *Construction materials, Service life, Durability, Accelerated tests, Predictions, *Building materials.

Performance criteria for the durability of building materials are needed if innovation is not to be unnecessarily inhibited. The criteria must be relatable to the required service lives of the materials in given applications. The relationships will often have to be established by predicting the service life from a combination of expert knowledge and the results of properly structured short-term tests. In view of the importance of the predictions,

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It is essential that a standard methodology be established for making and reporting the predictions and for assessing their reliability. A methodology for developing tests for use in predicting service lives of building materials and components has been standardized by ASTM. It is ASTM E-632, Standard Practice for Developing Accelerated Tests to aid Prediction of the Service Life of Building Components and Materials. Whereas, in the past, predictions of service life have often been made by individual experts, computer-based expert systems could be used as a way of sharing expert knowledge in the future to make decisions of improved quality. It is conceivable that standard expert systems could be developed and maintained by standards committees.

700,119
PB87-214110 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Interim Procedure to Measure the Thermal Performance of Window Systems,
M. E. McCabe, and W. P. Goss. Jun 87, 124p
NBSIR-87/3569
Sponsored by Bonneville Power Administration, Portland, OR.

Keywords: *Windows, *Heat transfer, Architecture, Skylights, Convection, Heat loss, Commercial buildings, Residential buildings, Window glass, Double glazing, U-values, Energy conservation.

The purpose of the report is to review the current sources of information on U-values and to describe the state of thermal test methods used for windows in order to provide the Bonneville Power Administration with some general guidelines in the application of thermal test data for use in the Model Conservation Standards (MCS) by the Northwest Power Planning Council. At present, considerable controversy exists in the window industry regarding the thermal testing of windows, therefore no consensus-based standards are available.

700,120
PB87-231007
(Order as PB87-230975, PC A04/MF A01)
National Bureau of Standards (NEL), Gaithersburg, MD.
Finite Element Study of Transient Wave Propagation in Plates,
M. Sansalone, N. J. Carino, and N. N. Hsu. 25 Mar 87, 12p
Included in Jnl. of Research of the National Bureau of Standards, v92 n4 p267-278 Jul-Aug 87.

Keywords: *Wave propagation, *Concrete, *Failure, *Nondestructive tests, Impact, Stresses, Displacement, Plates (Structural members), Finite element analysis, Impact-echo method, Green's function.

Studies of transient wave propagation in plates were carried out to establish a basis for the impact-echo technique as a nondestructive test for flaw detection in concrete. The surface displacements caused by stress waves generated by point impact on a plate were calculated using both the Green's function solution and the finite method; displacement waveforms obtained by the two approaches showed good agreement. Displacement and stress fields in a plate were studied using finite element analysis. It was shown that transient point load applied normal to a stress-free boundary gives rise to P- and S'-waves-disturbances trailing the P- and S-waves. The displacement and stress fields in each wake resemble those in the preceding wave.

700,121
PB87-231015
(Order as PB87-230975, PC A04/MF A01)
National Bureau of Standards (NEL), Gaithersburg, MD.
Finite Element Study of the Interaction of Transient Stress Waves with Planar Flaws,
M. Sansalone, N. J. Carino, and N. N. Hsu. 25 Mar 87, 12p
Included in Jnl. of Research of the National Bureau of Standards, v92 n4 p279-290 Jul-Aug 87.

Keywords: *Wave propagation, *Concrete, *Failure, Nondestructive tests, Impact, Displacement, Stresses, Plates (Structural members), Finite element analysis, Green's function, Impact-echo method.

The paper presents a finite element study of transient wave propagation in plates containing planar flaws.

The effects on displacement waveforms caused by waves diffracted from the sharp edges of a flaw are determined. Displacement fields within a plate containing a flat-bottom hole show the interaction of transient stress waves with a planar flaw. Waveforms obtained from the finite element analysis were compared with experimentally obtained waveforms.

700,122
PB87-231718 CP T05
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
FAST: A Model for the Transport of Fire, Smoke and Toxic Gases. Version 17.
Model-Simulation,
W. W. Jones. 1985, mag tape NBS/SW/MT-87/008
Supersedes PB85-150555.
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, PB85-109130, and PB86-153491.

Keywords: *Models-simulation, Computer programs, Smoke, *Compartment fires, *Toxic substances.

A numerical implementation of a zone model which will transport fire, smoke and toxic gases in a multi-compartment structure. The model includes the calculations necessary for a toxic hazard evaluation of materials...Software Description: The model is written in the FORTRAN programming language for implementation on a PERKIN-ELMER 3200 computer using the OS32/6.2 operating system. Memory requirement is 128 K bytes.

700,123
PB87-233540 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
RILEM: Reunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions.
Final rept.,
J. R. Wright. 1983, 4p
Sponsored by American Concrete Inst., Detroit, MI.
Pub. in Concrete International, p47-50 May 83.

Keywords: *Construction materials, *Standards, *Meetings, Civil engineering, Reprints, *Foreign technology.

The paper is a review of the International Union of Testing and Research Laboratories for Materials and Structures (RILEM). The paper describes the formation and development of RILEM, its scope of work, current activities and possible future directions. The work of RILEM is to bring experts in the field of building materials, structural components, and civil engineering structures together in order to evaluate research results, evaluate testing methods, stimulate and promote research, and make the results of research accessible by publishing state-of-the-art reports, technical recommendations, and other technical documents. RILEM carries out its work through 38 technical committees, more than half of which have members from the United States. Some committees are cosponsored by other international organizations. Technical committees in turn sponsor technical symposia and seminars. In addition, they prepare technical recommendations which serve as the scientific or engineering basis for national and international standards. The paper presents the organizational structure of RILEM, a listing of current officers, a description of RILEM's long-range planning effort for the 1980's.

700,124
PB88-110820 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Properties of Weathered Uncoated and 'Restaurant'-Coated Bituminous Built-Up Roofing Membranes.
Final rept.,
R. G. Mathey, and W. J. Rossiter. 1983, 20p
See also AD-A130 563. Sponsored by Naval Civil Engineering Lab., Port Hueneme, CA., and Department of Energy, Oak Ridge, TN.
Pub. in Durability of Building Materials 2, p59-78 1983.

Keywords: *Roofs, Bitumens, Felts, Performance evaluation, Reprints, *Foreign technology.

A study to compare the performance properties of weathered built-up membranes which had and had not

been subjected to an application of 'resaturant'-type coatings has been conducted. The membrane samples (asphaltic and coal-tar pitch) which were taken from roofs of buildings ranged in age from 14 to 26 years. Sections of these roofs had been treated with one of three proprietary 'resaturant' type coatings. The age of the coatings ranged from 12 to 29 months. The membrane samples removed from the roofs were visually examined in the laboratory to determine their general condition, the extent of adhesion between plies of felts, the number of plies, and the thicknesses of the interply bitumen.

700,125
PB88-134531 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Single-Ply Standards on the Way.
Final rept.,
W. J. Rossiter. 1983, 1p
Pub. in Roof Design 1, n4 p12 Dec 83.

Keywords: *Roofing, Standards, Elastomers, Bitumens, Reprints, Single ply roofing.

No abstract available.

700,126
PB88-147723 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Nondestructive Evaluation Methods for Assessing the Quality of Seams in Single-Ply Membranes.
Final rept.,
J. R. Clifton, J. L. Pizzutti Dos Santos, and W. J. Rossiter. 1985, 5p
Sponsored by Naval Civil Engineering Lab., Port Hueneme, CA.
Pub. in A Decade of Change and Future Trends in Roofing, Proceedings of the International Symposium on Roofing Technology (2nd), Gaithersburg, MD., September 18-20, 1985, p433-437.

Keywords: *Roofing, *Nondestructive tests, Ultrasonic tests, Infrared thermal detectors, Voids, Defects, Delaminating, Reprints.

The feasibility of using the ultrasonic pulse echo method and the infrared thermography method for detecting the presence of voids and delaminations in adhesive-bonded seams in single-ply membranes was investigated in laboratory and field exploratory studies. Preliminary results suggest that these methods could be used to locate voids and delaminations in seams.

700,127
PB88-152541 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.
NVLAP (National Voluntary Laboratory Accreditation Program) and the Thermal Insulation Proficiency Testing Program.
Final rept.,
J. Horlick, and H. W. Berger. 1985, 20p
Pub. in Jnl. of Thermal Insulation 8, p278-297 Apr 85.

Keywords: *Laboratories, *Thermal insulation, Flammability, Combustion, Tables(Data), Reprints, NVLAP(National Voluntary Laboratory Accreditation Program), US NBS.

The paper describes the National Voluntary Laboratory Accreditation Program (NVLAP), administered by the National Bureau of Standards, and summarizes the proficiency testing program for the Thermal Insulation Materials Laboratory Accreditation Program (Insulation LAP). NVLAP and its procedures for assessing, evaluating, and accrediting laboratories are presented briefly. The scope of the Insulation LAP is described. The results of the proficiency testing program over a four year period of testing are given. Eight tables show the statistical results of data submitted by participating laboratories for thermal transmission properties, thermal conductance, surface flammability, settled density, critical radiant flux, and smoldering combustion.

700,128
PB88-153739 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.

BUILDING INDUSTRY TECHNOLOGY

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Standards for Building Materials, Equipment and Systems Used in Detention and Correctional Facilities.

Final rept.,
R. D. Dikkers, and B. C. Reeder. Nov 87, 116p
NBSIR-87/3687
Sponsored by National Inst. of Corrections, Washington, DC.

Keywords: *Construction materials, *Prisons, Fire safety, Security, Standards, Jails.

Because of equipment and system performance problems which have occurred in jails and prisons, the National Institute of Corrections (NIC), U.S. Department of Justice, initiated a study at the Center for Building Technology, National Bureau of Standards (NBS) in September 1986. The general objective of the study is to develop guidelines, test methods and the technical bases for standards which would assist in the selection, application, and maintenance of building materials, equipment and systems for use in detention and correctional facilities.

700,129

PB88-15587 PC A06/MF A01
Portland Cement Association, Skokie, IL.
Flexural and Shear Behavior Reinforced Concrete Beams during Fire Tests.

Final rept.,
T. D. Lin, B. Ellingwood, and O. Piet. Nov 87, 104p
NBS/GCR-87/536
Grant NBS-G8-9027
Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Reinforced concrete, *Beams(Supports), *Fire resistance, Flexural strength, Shear strength, Thermal analysis.

The results of fire resistance tests of six reinforced concrete beams exposed to the standard ASTM E119 test conditions and to a short duration high intensity fire are described and summarized. The measured temperatures, deflections, expansions and slopes together with the thermal and structural properties of concrete and steel were used to validate predictive thermal structural analysis computer programs.

Structural Analyses

700,130

NUREG/CR-4328 PC A03/MF A01
Brookhaven National Lab., Upton, NY.
Probability Based Load Combination Criteria for Design of Shear Wall Structures,

H. Hwang, K. Nakai, M. Reich, B. Ellingwood, and M. Shinozuka. Jan 86, 43p
BNL-NUREG-51905
Contract DE-AC02-76CH0016

Errata sheet inserted. Prepared in cooperation with National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology, and Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics. Sponsored by Nuclear Regulatory Commission, Washington, DC. Office of Nuclear Regulatory Research, and Department of Energy, Washington, DC.

Keywords: *Earthquake resistant structures, *Reinforced concrete, Shear loads, Earthquakes, Design, Reliability, Nuclear power plants, *Shear walls.

The report describes the development of probability-based load combination criteria for the design of reinforced concrete shear wall structures subjected to dead load, live load and earthquake. The proposed design criteria are in the load and resistance factor design (LRFD) format. The load and resistance factors are determined for flexure and shear limit states and target limit state probabilities. The flexure limit state is defined according to the ACI ultimate strength formula. The shear limit state is established from experimental results.

700,131

PB87-150520 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

Planning and Conduct of Full Scale Measurements of Wind Loads.

Final rept.,
R. D. Marshall. 1985, 12p
Pub. in Proceedings of India-U.S. Workshop on Wind Disaster Mitigation, Madras, India, December 17-20, 1985, p125-136.

Keywords: *Buildings, *Wind pressure, Instrumentation, Wind engineering.

The paper describes the types of measurements required for the study of wind effects on buildings and other structures in full scale. Also described are the types of instruments commonly used to obtain these measurements, their physical characteristics, and their limitations. The paper considers sources of measurement errors and describes certain hardware configurations and measurement techniques that have proved useful in conducting full-scale studies.

700,132

PB87-150546 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Recent Developments and Applications in Wind Engineering.

Final rept.,
E. Simiu. 1986, 18p
Sponsored by National Science Foundation, Washington, DC.
Pub. in Proceedings of U.S. PRC Japan Trilateral Symposium Workshop on Engineering for Multiple Natural Hazards Mitigation, Beijing, China, January 7-12, 1985, pW-1-1--W-1-18 1986.

Keywords: *Building codes, Structural engineering, Aerodynamics, Aeroelasticity, Dynamic structural analysis, Wind engineering.

The paper presents a review of recent developments in wind engineering that have influenced or are expected to influence building code provisions and design practice in the United States. Developments are reviewed in the following areas: micrometeorology, extreme wind climatology, aerodynamics, structural dynamics, aero-elasticity, and structural reliability. Also presented in the paper is a review of applications of these developments to various practical design problems.

700,133

PB87-151304 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Recent Investigations into Wind Effects on Cladding Glass.

Final rept.,
E. Simiu, and E. M. Hendrickson. 1985, 8p
Grant NSF-CEE83-0829
Sponsored by National Science Foundation, Washington, DC.
Pub. in Proceedings of U.S. National Conference on Wind Engineering (5th), Lubbock, TX., November 6-8, 1985, p2A-17--2A-24.

Keywords: *Glass, *Buildings, *Wind loads.

The paper describes investigations conducted in four areas: estimating the 60-sec constant load equivalent, from the point of view of the panel behavior, to a wind load with any specified time history; estimating the 60-sec load capacity of a glass panel of any given size, given the probabilistic description of the basic strength properties of the glass; estimating the probabilistic description of the basic strength properties of glass from the analysis of results of tests conducted on small samples by the ring-on-ring test method; designing window glass facades on a risk-consistent basis to meet safety-related design criteria acceptable to the building official. Main results reported include the following: the two-parameter Weibull distribution, heretofore employed in the literature to describe the behavior of cladding glass, is an unacceptable model; the estimated 60-sec load capacity of glass panels depends significantly upon aspect ratio; and the reliability-based analysis and design of glass cladding can result in considerable cost reductions at equal safety levels or in considerably improved safety levels at equal costs.

700,134

PB87-151312 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

Environmental Load Direction and Reliability Bounds.

Final rept.,
E. Simiu, S. D. Leigh, and W. A. Nolan. May 86, 5p
Sponsored by Minerals Management Service, Reston, VA.
Pub. in Jnl. of Structural Engineering 112, n5 p1199-1203 May 86.

Keywords: Multivariate analysis, Structural analysis, Reliability, Reprints, *Wind loads.

The probability of failure of a structure or member subjected to directional environmental loads depends upon the correlations between data characterizing the loads in any two directions. The purpose of this note is to investigate the extent to which the simplifying assumption that all these correlations are zero is acceptable in practical structural reliability. Numerical examples are presented from which it is concluded that in the case of wind loads, for both well-behaved and hurricane-prone climates, neglecting the effect of the correlations results in the overestimation of failure probabilities by a factor of about two or less.

700,135

PB87-151981 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Wind Engineering: A Review of Recent Work.

Final rept.,
E. Simiu. 1986, 10p
Pub. in Interdisciplinary Science Reviews 11, n1 p32-41 1986.

Keywords: Micrometeorology, Structural design, Dynamic structural analysis, Reliability, Reprints, *Wind engineering, Wind loads.

The review covers recent developments in wind engineering that have influenced or are expected to influence building code provisions and design practice. Developments are reviewed in the following areas: micrometeorology, extreme wind climatology, aerodynamics, structural dynamics, aeroelasticity, and structural reliability. Also presented in the paper is a review of applications of these developments to various practical design problems.

700,136

PB87-161063 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Dynamic Stability of Structures Subjected to Seismic Shear Waves.

Final rept.,
S. T. Wu, and C. G. Culver. 1984, 7p
Pub. in Proceedings of Annual Technical Session - Structural Stability Research Council: Stability under Seismic Loading, San Francisco, CA, April 10-11, 1984, p169-175.

Keywords: Dynamic response, Structural analysis, *Seismic design, *Earthquake engineering, Nonlinear analysis.

Dynamic stability of structures under periodic load has been investigated extensively. The results from those studies can be applied to problems related to stability of structures subjected to seismic waves without difficulty. However, the previous studies have presupposed that the lateral response is the primary response and the torsional response is the secondary one. In the paper, the lateral and torsional stability will be considered simultaneously by including the corresponding motions at the foundation level directly. The basic equation will thus be different from the ones in previous studies. Discussions on the types of the solutions implied in the governing equations are also given.

700,137

PB87-161089 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Limit State Probabilities for Wood Structural Members.

Final rept.,
E. M. Hendrickson, B. Ellingwood, and J. Murphy. Jan 87, 19p
Pub. in Jnl. of Structural Engineering 113, n1 p88-106 Jan 87.

Keywords: *Building codes, *Timber construction, Wooden structures, Design standards, Limit design

method, Structural analysis, Reliability, Beams(Supports), Reprints.

Estimates of the limit state probability for wood members, where the limit state is failure by creep rupture, must be based on analyses that take into account the temporal characteristics of the applied loads. These estimates require: (1) construction of appropriate load process models; (2) a probabilistic description of wood member strength; and (3) a cumulative damage analysis. Reliability analyses of beams subjected to dead, snow, and live loads were performed to evaluate the effects of using different load duration models and different parameters in the snow and live load process models. It was found that the most important factor determining failure is the duration and magnitude of the extreme load pulses. The choice of load duration model, in contrast, was relatively unimportant. Reliability associated with existing design criteria were evaluated, and resistance factors for use in a proposed load and resistance factor design format were determined, using glulam beams in bending as an example.

700,138
PB87-161204 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Seismic Design Guidelines for Federal Buildings, E. V. Leyendecker. Feb 87, 103p NBSIR-87/3524
Also pub. as Interagency Committee on Seismic Safety in Construction rept. no. ICSSC/RP-1. Prepared in cooperation with Interagency Committee on Seismic Safety in Construction. Sponsored by Federal Emergency Management Agency, Washington, DC.

Keywords: Buildings, Building codes, Standards, *Earthquake engineering, *Government buildings, *Seismic design, *Federal buildings, Guidelines.

The document has been prepared as a coordinated adaptation of existing voluntary standards, model building codes, Federal regulations, and research reports for use by Federal agencies. The technical content is similar to the seismic requirements of the 1985 Uniform Building Code (UBC). However, there are instances of substantive difference from the UBC. Several important provisions have been incorporated from other sources considered in the adaptation. For example, the seismic zone map is the one in current use in ANSI A58.1-1982 Minimum Design Loads for Buildings and Other Structures. A number of provisions have been added to these guidelines that are based on the current practices and policies of various Federal Agencies. Furthermore, in the spirit of improvement, the document is organized considerably differently from the UBC and many provisions are phrased differently.

700,139
PB87-164059 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Analysis of Shoring Loads and Slab Capacity for Multistory Concrete Construction.
Final rept., J. L. Gross, and H. S. Lew. 1986, 22p
Sponsored by Occupational Safety and Health Administration, Washington, DC.
Pub. in Proceedings of International Conference on Forming Economical Concrete Buildings (2nd), Chicago, IL, November 28-30, 1984, p109-130 1986.

Keywords: *Concrete slabs, Loads(Forces), Buildings, Concrete construction, Formwork(Construction), Microcomputers, Computer applications.

The paper describes a microcomputer-based program which can be used to assist the contractor in evaluating the safety and economy of alternate construction schemes in cast-in-place multistory concrete building construction. The program, developed at the National Bureau of Standards, assumes that the slabs are supported by evenly distributed, compressible shores or reshores. Forces on the slabs are computed by assuming that superimposed construction loads are distributed to the shoring system and interconnected floors in proportion to their relative stiffnesses. The method takes into account both the stiffness of shores and reshores and any precompression in the reshores. Slab capacity is computed from a maturity-based model of concrete strength prediction. The computed slab loads are compared with the slab capacities to determine whether the load on any slab exceeds the capacity of that slab for any stage of construction. By varying the number of shored and reshored stories, the precompression of reshores, and rate of construction, the optimum casting schedule can be determined. Ex-

amples are given which illustrate how the program can be used to assist the contractor in determining a safe casting schedule and to guide the contractor in formwork removal.

700,140
PB87-164125 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Multivariate Distributions of Directional Wind Speeds.
Final rept., E. Simiu, E. M. Hendrickson, W. A. Nolan, I. Olkin, and C. H. Spiegelman. 1985, 5p
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Structural Engineering-ASCE 111, n4 p939-943 1985.

Keywords: *Wind direction, Structural engineering, Multivariate analysis, Wind velocity, Reprints, *Wind loads.

An extended abstract is presented in which: Existing methods for taking wind directionality into account in structural engineering calculations are reviewed; A new such method is proposed; It is shown that published data issued by the National Oceanic and Atmospheric Administration are sufficient to characterize the directional extreme wind climate.

700,141
PB87-172706 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Building Structural Failures - Their Cause and Prevention.
Final rept., J. G. Gross. Oct 86, 13p
Pub. in Jnl. of Professional Issues in Engineering 112, n4 p236-248 Oct 86.

Keywords: *Buildings, Structural design, Failure, Building codes, Collapse, Foundations, Reprints.

Many recent collapses of U.S. buildings have occurred both during construction and following occupancy. Such failures have received professional and public attention due to the attendant major losses of life and property. Five recommendations resulting from the Engineering Foundation Conference, Building Structural Failures-Their Cause and Prevention, held in Santa Barbara, California, November 6-11, 1983 are highlighted. The recommendations address structural integrity, life safety assurance, peer review, definition and assignment of responsibility, and unified risk insurance. The nature and magnitude of the problem, the design process, the construction process, legal implications, and the regulatory process are covered.

700,142
PB87-187225 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
National Earthquake Engineering Experimental Facility Study. Phase One. Large Scale Testing Needs.
Final rept., C. F. Scribner, and C. G. Culver. Apr 87, 76p NBS/SP-729
Also available from Supt. of Docs as SN003-003-02795-2. Library of Congress catalog card no. 87-619811. Sponsored by Federal Emergency Management Agency, Washington, DC., and National Science Foundation, Washington, DC.

Keywords: *Test facilities, Planning, Structural engineering, Dynamic tests, Buildings, Industrial plants, *Earthquake engineering, High rise buildings, Low rise buildings, Seismic effects.

The report summarizes information obtained during the first year of a four-year feasibility study for a national earthquake engineering experimental facility. A five-year research program is presented for a national facility in which full-scale or large-scale structures or structural components would be subjected to static or dynamic lateral loads. The facility would have applicability to tests in the following areas: low-rise buildings, medium-rise buildings, high-rise buildings, industrial processing facilities, and power facilities. Representatives from a broad spectrum of professional, industrial, and trade organizations and Federal agencies participated in developing the research program. A comparison of existing testing facilities in the U.S. and other countries engaged in seismic testing and a discussion

of international cooperation in large-scale testing are included.

700,143
PB87-199964 PC A99/MF E04
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Wind and Seismic Effects: Proceedings of the Joint Panel Meeting of the U.S.-Japan Cooperative Program in Wind and Seismic Effects (17th), Held at Tsukuba, Japan on May 21-24, 1985.
N. J. Raufaste. May 86, 740p NBSIR-86/3364

Keywords: *Meetings, Soils, Pipelines, Buildings, Bridges, Tsunamis, *Wind loads, *Seismic effects, Storm surges, Earthquake engineering.

The publication, the proceedings of the Joint Meeting, includes the program, list of members, formal resolutions, and technical papers. Papers were presented under five themes: Wind engineering, earthquake engineering, storm surge and tsunamis, U.S.-Japan cooperative research program, and reports on the Nihonkai-Chubu earthquake and the Naganoken-Seibu earthquake. Subjects covered in the papers presented include: (1) characteristics of strong winds; (2) wind loads on structures and design criteria; (3) earthquake ground motions; (4) soil liquefaction studies and methods to improve liquefaction resistance; (5) seismic loads on structures and design criteria; (6) stress analyses of pipelines during earthquakes; (7) full-scale seismic experiments; (8) earthquake hazard reduction program; (9) use of the microcomputer for earthquake studies; (10) quantitative evaluation of damages caused by winds and earthquakes; and, (11) tsunami research projects.

700,144
PB87-199972 PC A22/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Wind and Seismic Effects: Proceedings of the Joint Meeting of the U.S.-Japan Cooperative Program in Natural Resources Panel on Wind and Seismic Effects (18th), Held at Gaithersburg, Maryland on May 12-15, 1986.
Final rept., N. J. Raufaste. Apr 87, 515p NBSIR-87/3540

Keywords: *Meetings, Storms, Pipelines, Accelerometers, Bridges, Tsunamis, Soils, *Wind loads, *Earthquake engineering, Seismic effects, Storm surges.

Subjects covered in the papers presented include: (1) characteristics of strongwinds; (2) wind loads on structures and design criteria; (3) earthquake ground motions; (4) soil liquefaction studies and methods to improve liquefaction resistance; (5) seismic loads on structures and design criteria; (6) stress analyses of pipelines during earthquakes; (7) full-scale seismic experiments; (8) earthquake hazard reduction program; (9) use of the microcomputer for earthquake studies; (10) quantitative evaluation of damages caused by winds and earthquakes; and, (11) tsunami research projects.

700,145
PB87-210191 PC A11/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Engineering Aspects of the September 19, 1985 Mexico Earthquake.
Final rept., W. C. Stone, F. Y. Yokel, M. Celebi, T. Hanks, and E. V. Leyendecker. May 87, 228p NBS/BSS-165
Also available from Supt. of Docs as SN003-003-02803-7. Library of Congress catalog card no. 87-619819. Prepared in cooperation with Geological Survey, Menlo Park, CA., and Geological Survey, Golden, CO.

Keywords: Earthquakes, Building codes, Foundations, Mexico, *Earthquake engineering, Seismic design, Ground motion, Mexico City(Mexico).

Following the September 19, 1985 Mexico earthquake, a team consisting of four engineers and one seismologist from the National Bureau of Standards (NBS) and the United States Geological Survey (USGS) was dispatched to Mexico City to provide technical advice to the US rescue effort and to assess structural damage. The report is primarily based on data gathered by the team, but it also contains a compilation of other available information. The report addresses the origin and characteristics of the observed ground motion, the

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ability of buildings designed in accordance with present and proposed seismic design provisions to resist this type of ground motion, and observed data on structural and foundation failures.

700,146
PB87-219028 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Construction Failures: Legal and Engineering Perspectives.
Final rept.,
H. S. Lew. 1983, 15p
Sponsored by American Bar Association, Chicago, IL., and American Society of Civil Engineers, New York. Pub. in *Construction Failures: Legal and Engineering Perspectives*, 15p 1983.

Keywords: *Concrete construction, *Failure, Collapse, Errors, Design, Safety, Engineering drawings, Structural engineering, Reprints, Falsework.

Common causes of construction failures are examined with examples drawn from a number of recent catastrophic concrete construction failures. They are identified as those resulting from (1) errors in design of permanent structures, (2) errors in design of falsework, (3) lack of communication between designer and constructor, and (4) poor construction practices. In order to improve construction safety, it is recommended that the constructor develop a basic construction plan. The plan should include, but not be limited to, (1) design loads for construction, (2) design calculations for falsework, (3) criteria for falsework removal and imposition of construction loads, (4) establishment of bench marks for each stage of construction and (5) personnel training in construction operation.

700,147
PB88-129002 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
Preliminary Performance Criteria for Stone Treatments for the United States Capitol,
J. R. Clifton. Oct 87, 42p NBSIR-87/3542

Keywords: *Renovating, Reconditioning, Limestone, Performance, Criteria, Treatment, Paints, Weathering, *United States Capitol.

The West Central Front of the United States Capitol is being restored, including cleaning and repainting the sandstone, and replacing badly deteriorated sandstone with Indiana limestone. Application of stone treatments was proposed as a way of extending the lives of the sandstone and paint. However, without adequate selection criteria there was no certainty of effective performance by stone treatments. The purpose of the study was to develop performance criteria to assist in the selection of stone treatments. Based on an analysis of expected deterioration processes, it is concluded that deterioration of the sandstone was most likely associated with water penetration into the exposed outer surface. Therefore, if a treatment is to be used, it should protect the outer surface of the sandstone from rain penetration. In addition, the treatment should penetrate and consolidate any deteriorated stone. Also, treatment should not cause premature failure of the paint. Based on these requirements, four preliminary performance criteria were developed, but have not been verified by long-term studies. Of five stone treatments evaluated, one met the four criteria. It is recommended that treatment be used on areas of deteriorated sandstone needing consolidation and on stone in areas subjected to the most severe weathering locations.

700,148
PB88-130331 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Whittier Narrows Earthquake of October 1, 1987. A Reconnaissance Report.
H. S. Lew. Nov 87, 36p NBSIR-87/3667

Keywords: *Earthquakes, *Reporting, *Bridges(Structures), Buildings, Houses, Damage assessment, Photographs, *Seismic design, Earthquake engineering, Whittier(California).

Within hours following the Whittier Narrows earthquake of October 1, 1987, a structural engineer from the Center for Building Technology, National Bureau of Standards surveyed the damage to buildings and other structures. The area investigated covers Los Angeles and other communities including Whittier, Alhambra, and Pasadena. The report consists of photographs, all

of which were taken by the NBS team. The photographs presented herein are intended to serve as (1) documentation of the damage resulting from the earthquake and (2) as a source document for further studies, research and recommendations.

700,149
PB88-147319 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Serviceability Limit States: Deflection.
Final rept.,
T. V. Galambos, and B. Ellingwood. 1986, 18p
See also PB85-196095.
Pub. in *Jnl. of Structural Engineering* 112, n1 p67-84 1986.

Keywords: *Reliability, *Deflection, Roofs, Floors, Wind loads, Snow, Frames, Reprints.

The paper examines the reliability of floor and roof deflections due to occupancy and snow loads, respectively, and of lateral frame deflections due to wind loads. These deflections are determined for unfactored code-specified loads, and they are not to exceed professionally established deflection limits. First-order, second-moment probabilistic theory is used in the analysis. Values of the reliability index are calculated for eight and one year reference periods. Recommendations are made with regard to load levels to be used in the serviceability analysis of deflection-sensitive and deflection-insensitive structures.

General

700,150
PB87-150538 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Wind Forces on a Mobile Home: An Assessment of Wind Tunnel Simulations.
Final rept.,
R. D. Marshall. 1985, 8p
Pub. in *Proceedings of U.S. National Conference on Wind Engineering* (5th), Lubbock, TX., November 6-8, 1985, p3B-9-3B-16.

Keywords: *Buildings, *Wind pressure, Wind tunnels, Simulation, Aerodynamics, *Mobile homes.

The paper presents a brief review of the experimental technique used and the results obtained from a wind loading study carried out on a full-scale mobile home. Subsequent to the completion of the study, several wind tunnel establishments have conducted model simulations of the mobile home with various degrees of success. The paper examines two of these simulations and offers some suggestions which may result in improved agreement between model and full-scale results for future simulations.

700,151
PB87-152252 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
How Accurate Is Mathematical Fire Modeling.
H. E. Mitler, and J. A. Rockett. Dec 86, 51p NBSIR-86/3459

Keywords: *Fire tests, *Fire safety, Mathematical models, *Room fires, Fire codes.

It is important to be able to predict the development of a fire in an enclosure of arbitrary complexity. A mathematical model valid for a single room, with multiple vents and objects in it has been developed. The fifth version of the model has just been completed; it is the Harvard Computer Fire Code V, or Mark 5 for short. In 1977, Factory Mutual Research Corporation carried out a series of eight well-instrumented full scale room fires, against which the single room model can be tested. The test fire room was 2.4 m x 9.6 m x 2.4 m high, with an open doorway; a slab of polyurethane foam in one corner, and a polyurethane foam target in a facing corner. The primary slab was ignited at its center, and the fire followed. The other tests were variants of this one. The authors compare the results of the calculations with the results of two of the experiments: the standard configuration and the case with a window replacing the doorway. The model 'predictions' are in good to excellent agreement for most of the variables. The disagreements are discussed.

700,152
PB87-157087 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
Some Factors Influencing Fire Spread Over Room Linings and in the ASTM (American Society for Testing and Materials) E-84 Tunnel Test.
Final rept.,
J. Quintiere. 1985, 10p
Pub. in *Fire and Materials* 9, n2 p65-74 1985.

Keywords: *Flammability testing, Reprints, *Room fires, Flame spread.

An examination of the correlative relationship between room fire intensity (temperature) and flammability data for materials, ASTM E-84 flame ratings and energy release rate from calorimetry devices, is presented. The results of the analysis show the significance of several modes of flame spread-wind aided and opposed flow spread. The factors important in these spread modes are considered from approximate solutions developed for turbulent flows. Also the importance of energy release rate in the tunnel test (E-84) and in upward or wind aided spread is illustrated. The results suggest the cause of extensive fire spread over very low density room lining materials and as the ASTM E-84 ratings may not be applicable.

700,153
PB87-165569 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Plan for the Development of the Generic Framework and Associated Computer Software for a Consolidated Compartment Fire Model Computer Code.
G. P. Forney, and L. Y. Cooper. Jan 87, 27p NBSIR-86/3500

Keywords: *Fire tests, Smoke, Fire hazards, Computerized simulation, *Room fires.

A plan is presented for the development of computer software to support the generic framework of a Consolidated Compartment Fire Model (CCFM) computer code. The several software modules which will make up particular application versions of the CCFM are identified. These modules are then classified as either generic or application-specific. The characteristics and a detailed plan for the development of the generic modules are outlined. Descriptions of the CCFM application products which will use the generic framework were presented. All of these will be designed in response to clear needs of the fire science and technology community. In terms of modeling sophistication of CCFM products, the prototype application will be at the simple end of the spectrum. It will provide simple guidance for engineering fire safety design. At the other extreme will be a benchmark-like compartment fire model computer code. At an intermediate level of sophistication will be an Application product which will be useful as an updated tool for Fire Hazard Assessment.

700,154
PB87-181996 PC A08/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Summaries of Center for Fire Research (of the National Bureau of Standards) Grants and In-House Programs - 1986.
S. M. Cherry. Dec 86, 154p NBSIR-86/3498
See also report for 1985, PB86-139680.

Keywords: *Fire tests, Abstracts, Fire control, Combustion, Flame propagation, Toxicity, Smoke, Soot, *Fire studies, Fire models, US NBS.

The report contains extended abstracts of grants 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.

700,155
PB87-199956 PC A09/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Thermal Performance of Masonry Chimneys and Fireplaces.
Final rept.,
R. D. Peacock. Apr 87, 176p NBSIR-87/3515
Sponsored by Consumer Product Safety Commission, Bethesda, MD.

Keywords: *Chimneys, *Fire tests, Masonry, Fireplaces, Flues, Wood, Stoves, Fire safety, Residential buildings, Linings, Standards, Solid fuels.

A series of tests was conducted in a masonry chimney and a masonry fireplace both constructed to current national standards in order to evaluate the effectiveness of recent changes to the building code requirements for residential masonry construction. Firing rates typical of normal homeowner use and of overfire condition resulted in temperature levels close to recommended limits established in nationally recognized standards for properly constructed solid fuel heating systems. In addition, several lining techniques for the masonry chimney and for the fireplace chimney connected to solid fuel burning fireplace inserts showed reductions in thermal hazard to exposed combustible construction when compared to the masonry construction alone. The results of these tests point out some areas where the codes and standards could be updated to provide for safer masonry chimneys and fireplaces.

700,156
PB87-201810 PC A06/MF A01
 Maryland Univ., College Park. Dept. of Mechanical Engineering.
Transient Characteristics of Unconfined Fire-Plume-Driven Ceiling Jets.
 Annual rept.,
 C. H. Marks, and V. Motevali. Apr 87, 115p NBS/GCR-87/529
 Grant NANB-5H0551
 Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Ceilings, *Fire tests, Flames, Temperature measurement, Velocity measurement, Plumes, Room fires.

An instrumentation system to measure temperatures and velocities in ceiling jets has been constructed. This system employs thermocouples to measure both temperatures and velocities at eight locations from the ceiling simultaneously. In this way, velocity and temperature profiles can be obtained in the ceiling jet as a function of time. The velocities are obtained by using pairs of thermocouples, one located downstream of the other, and cross correlating their temperature-time records to obtain the length of time that it takes for fluid to flow from one thermocouple to the other. Preliminary results indicate that the system works well; measurements made thus far compare favorably with steady-state data in the literature. Calibration work on the instrument is continuing and further transient ceiling jet measurements will be obtained.

700,157
PB87-201828 PC A06/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Engineering Analysis of the Early Stages of Fire Development - The Fire at the Dupont Plaza Hotel and Casino - December 31, 1986.
 H. E. Nelson. Apr 87, 114p NBSIR-87/3560

Keywords: Flashover, Burning rate, Smoke, *Building fires, Puerto Rico.

The report presents the methods and results of an analytical analysis of the fire development through the first and second floors during the December 31, 1986 fire in the Dupont Plaza Hotel and Casino, San Juan, Puerto Rico. The analysis involved the use of fire growth models, engineering formula, and technical data. The report details the procedures and data used, the reason for those selected, and the results obtained. The analysis addressed mass burning rate, rate of heat release, smoke temperature, smoke layer depth, velocity of smoke/ flame front, mass products in smoke layer, oxygen concentration in smoke layer, visibility in smoke layer, flame length/extension, flame spread, sprinkler response, smoke detector response, and fire duration. The areas of the building analyzed include the ballroom complex to the areas where most of the deaths occurred. The report does not address smoke movement above the first floor, the conditions that caused the deaths of three persons caught in an elevator, or the conditions that caused the death of one victim in a guest room on the fourth floor.

700,158
PB87-203006 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Measurements of the Transient Temperature and Velocity Profiles in Ceiling Jets (Extended Abstract).

Final rept.,
 V. Motevali, C. H. Marks, B. McCaffrey, and L. Y. Cooper. 1986, 4p
 Pub. in Proceedings of Fall Technical Meeting Eastern Section of the Combustion Institute, San Juan, Puerto Rico, December 15-17, 1986, p38-1-38-4 1986.

Keywords: Ceilings(Architecture), Temperature measurement, Velocity measurement, *Room fires.

Experimental data is needed to support the development and verification of compartment fire models, especially models concerned with the early stages of fires. The research described herein constitutes the initial phase of an attempt to obtain the transient temperature and velocity distributions in ceiling jets above small fire (up to 2 kW). Some data exists for steady-state temperature distributions (1,2) and for transient temperature profiles in ceiling jets (3,4). There appears to be no data for the transient velocity profiles in these jets and the existing temperature data is insufficient.

700,159
PB87-203873 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
Ceiling Jet-Driven Wall Flows in Compartment Fires (Extended Abstract).
 Final rept.,
 L. Y. Cooper. 1986, 4p
 Pub. in Proceedings of the Fall Technical Meeting Eastern Section of the Combustion Institute, San Juan, Puerto Rico, December 15-17, 1986, p39-1-39-4 1986.

Keywords: Ceilings(Architecture), Fire tests, Walls, Models, *Room fires, Fire plumes.

Analytic estimates are developed for the early depth of penetration of and the lateral entrainment into negatively buoyant, ceiling jet-driven wall flows which are generic to compartment fire scenarios. When walls are not too far from the fire source, of the order of the fire-to-ceiling distance, it is found that the penetration of the downward flow near such walls is a large fraction of the fire-to-ceiling distance itself, and that this fraction is relatively independent of the details of fire size, spacings, etc. Also, net rate of entrainment into the wall flow as it is buoyed back upward to the ceiling elevation is found to be several times larger than the flow rate of the driving ceiling jet flow immediately upstream of ceiling jet - wall impingement. Data from five studies reported in the literature are being reviewed relative to the analytic results obtained. One of these involves numerical experiments with a field model of the problem of a buoyant source in an enclosure. Two laboratory experimental studies involve fires in enclosures with characteristic dimensions of the order of several meters. Two others involve saltwater plumes in freshwater tanks with characteristic dimensions of the order of several tenths of a meter.

700,160
PB87-203881 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
ASKBUDr: A Precursor of an Expert System for the Evaluation of Fire Hazard.
 Final rept.,
 R. L. Smith. 1987, 14p
 Pub. in Fire Technology 23, n1 p5-18 Feb 87.

Keywords: *Fire safety, Computerized simulation, Reprints, *Building fires, Expert systems.

The Center for Fire Research (CFR) has a long-term project to develop expert systems as a technology transfer mechanism. The goal of the project is to develop a computer program which will make an expert estimate of the firesafety of a building based on CFR's deterministic physical models, technical data, and the expert judgment of its staff. The first significant computer program to be developed by this project will be based on the expertise of Harold E. (Bud) Nelson. Thus, it will be called ASKBUD. In this article, the first exploratory steps taken to develop this program are described. Also, the progress made to date, as well as some of the major problems that must be solved, will be discussed. Since the system described in this article is in its infancy, the authors call it ASKBUDr.

700,161
PB88-109863 PC A05/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.

Building Technology Project Summaries 1987,
 N. J. Raufaste. May 87, 90p NBSIR-87/3565
 See also report for 1986, PB87-140216.

Keywords: Concretes, Construction materials, Technology, Projects, Buildings, Roofing, *Building technology, Earthquake engineering, Seismic design, Computer aided design.

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. The 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. The report summarizes the projects underway in the Center during 1987.

700,162
PB88-110572 PC A03/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Overview of Smoke Control Technology,
 J. H. Klotz. Sep 87, 28p NBSIR-87/3626
 Sponsored by Public Buildings Service, Washington, DC.

Keywords: *Smoke abatement, *Fire protection, Air conditioning, Computerized simulation, Elevators, Stairways.

Considerable advances in smoke control technology occurred in the last few decades. However, smoke control is just beginning to take its proper place as a fire protection tool. The paper provides an overview of this technology, including discussions of the fundamental principles, stairwell pressurization, zones smoke control, elevator smoke control, system activation and acceptance testing. In addition the problems of smoke purging are addressed.

700,163
PB88-110663 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
Experimental Study of the Transient Thermal Response of Unconfined Ceilings above Fire Plumes.
 Final rept.,
 A. Woodhouse, C. H. Marks, and L. Y. Cooper. 1987, 8p
 Pub. in Proceedings of ASME/JSME Thermal Engineering Conference Sessions on Heat and Mass Transfer in Compartment Fires, Honolulu, HI., March 22-27, 1987, p387-394 1987.

Keywords: Ceilings(Architecture), Heat transfer, Convection, Plumes, Fire tests, Reprints, *Foreign technology, *Room fires.

A database was developed for the transient thermal response of unconfined ceilings above small (up to 2kW) fires. The investigation concentrated on the response of ceilings under conditions of heating when convection is the main mode of heat transfer to the ceiling. The data obtained were the ceiling temperature as a function of time and position from the fire plume stagnation point. Three ceiling materials were used: Marinite-XL, fiberboard and cold-rolled steel.

700,164
PB88-110812 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Research Needs Identified by the NBS (National Bureau of Standards) Building Rehabilitation Technology Program.
 Final rept.,
 J. H. Pielert. 1983, 10p
 Pub. in Proceedings of the American Society of Civil Engineers Conference Research Needs for Rehabilitation of Structures, Philadelphia, PA., May 18, 1983, 10p.

BUILDING INDUSTRY TECHNOLOGY

General

Keywords: *Buildings, *Rehabilitation, Research management, Standards, Reprints, *Foreign technology.

The rehabilitation of existing buildings has been given special consideration in the research program of the Center for Building Technology of the U.S. National Bureau of Standards. The identified needs and research results are discussed and tied to the formation of the ASCE Standards Committee on Condition Assessment of Existing Buildings. The Committee is developing consensus standards for determining the condition of materials in existing buildings and in other areas related to structural performance. Other related standards development activities currently underway will also be discussed. The paper will provide an overview of the latest thinking on structural research needs for building rehabilitation based on a three year program at NBS.

700,165
PB88-110861 PC A10/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Catalog of Compartment Fire Model Algorithms and Associated Computer Subroutines.
D. W. Stroup. Aug 87, 204p NBSIR-87/3607

Keywords: *Fires, *Buildings, Subroutines, Algorithms, Catalogs(Publications), Fortran, Computerized simulation, *Compartment fire models.

The Compartment Fire Modeling Research group of the Center for Fire Research, National Bureau of Standards has been charged with the development of a 'benchmark' compartment fire model. As part of this activity, a catalog of available fire model algorithms has been compiled. The catalog contains algorithms which calculate various physical/chemical fire phenomena. The description of each algorithm includes the input(s), output(s), and calculations performed. In addition, each algorithm has a computer subroutine written for it in FORTRAN 77. The variables used as input and output throughout the catalog are cross-referenced. This enables a catalog user to determine which routines would be required to calculate a particular fire phenomena.

700,166
PB88-110911 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Building Technology Publications, Supplement 10: 1985-86.
Final rept.,
K. Hockey. Sep 87, 114p NBSIR-87/3631
See also report for 1984, PB86-110905.

Keywords: *Construction industry, *Buildings, Bibliographies, Abstracts, Structural engineering, Solar heating, Construction materials.

The report presents NBS' Center for Building Technology (CBT) publications for 1985-86. It is the tenth supplement to NBS' Building Technology Publications, and lists (CBT) reports issued during 1985-86. It includes titles of each CBT publication and those papers published in non-NBS media, keyword and author indexes, and general information and instructions on how to order CBT publications.

700,167
PB88-112438 PC A14/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Investigation of L'Ambiance Plaza Building Collapse in Bridgeport, Connecticut.
C. G. Culver, C. F. Scribner, R. D. Marshall, F. Y. Yokel, and J. L. Gross. Sep 87, 318p NBSIR-87/3640
Sponsored by Occupational Safety and Health Administration, Washington, DC.

Keywords: *Buildings, *Collapse, Investigations, Lift slab construction, Bridgeport(Connecticut).

Results from an investigation to determine the cause of the collapse of the L'Ambiance Plaza building on April 23, 1987 are presented. The building was being constructed using the lift-slab method; collapse occurred during construction. The investigation included on-site inspections immediately following the collapse, review of eyewitness accounts of the collapse, review of project documentation, laboratory and field tests and analyses of the structure. Several potential failure mechanisms were investigated. The most probable cause of the collapse was determined to be loss of

support at a lifting jack in the west tower during placement of an upper level package of three floor slabs.

700,168
PB88-113741 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Test Results and Predictions for the Response of Near-Ceiling Sprinkler Links in a Full-Scale Compartment Fire.
L. Y. Cooper, and D. W. Stroup. Sep 87, 46p NBSIR-87/3633
Sponsored by Fire Administration, Emmitsburg, MD.

Keywords: *Fire tests, *Automatic sprinkler systems, Plumes, Smoke, Compartment fires.

The paper presents and analyzes a portion of the data acquired during a test program which involved full-scale, sprinklered, compartment fires. The work here focuses attention specifically on key features of the typical sprinkler link deployment/response problem. It is found that the elevated temperature, upper smoke layer which develops inevitably in compartment fires can have a major impact on the thermal response of sprinkler links. It is shown that traditionally accepted methods of predicting sprinkler link response which do not account for this upper layer can be totally inadequate. Link response predictions used here involve a new method of calculation which does take account of the smoke layer environment.

700,169
PB88-117726 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
In Case of Fire--Use the Stairwells, Elevators Aren't Safe.
Final rept.,
W. Schmidt, and J. Klote. 1982, 5p
Pub. in Specifying Engineer 47, n5 p82-86 May 82.

Keywords: *Fire safety, *Stairways, Elevators(Lifts), Reprints, *Foreign technology, Building fires.

No abstract available.

700,170
PB88-129895 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Economics of Fire Protection: Fast-Response Residential Sprinklers.
Final rept.,
R. T. Ruegg, and S. K. Fuller. 1985, 15p
Pub. in Construction Management and Economics 3, p43-57 1985.

Keywords: *Fire losses, *Benefit cost analysis, *Sprinkler systems, Residential buildings, Fire protection, Reprints.

The paper develops and applies in selected cases a benefit-cost model for evaluating the economic efficiency of providing fire loss mitigation through the use of a newly adapted technology: fast-response, residential sprinkler systems. The model calculates present value net benefits as they would accrue to the owner of a system. The nine selected hypothetical cases pertain to new, single-family dwellings in the United States. The results that are presented here, though based on hypothetical cases, have implications of interest to members of the research and building communities who are concerned about the economics of home fire protection.

700,171
PB88-137096 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
USA Adopts Standard Economic Analyses.
Final rept.,
H. E. Marshall. 1982, 1p
Pub. in Building Research and Practice/Research World, p336 Nov/Dec 82.

Keywords: *Buildings, *Economic analysis, Reprints.

No abstract available.

700,172
PB88-137104 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.

Subcommittee E06.81 on Building Economics.
Final rept.,
H. E. Marshall. 1982, 5p
Pub. in ASTM (American Society for Testing and Materials) Standardization News 10, n10 p26-30 Oct 82.

Keywords: *Buildings, *Cost effectiveness, Benefit cost analysis, Economic analysis, Reprints.

Subcommittee E06.81 on Building Economics was formed by ASTM in April 1979 to respond to a need by the building community for standard economic methods that would help make buildings more cost effective. The article gives an overview of the subcommittee, including its historical development and objectives, and describes through the words of subcommittee members how economic standards being developed by E06.81 are being used by their organizations.

700,173
PB88-138870 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
Heat Transfer in Compartment Fires near Regions of Ceiling Jet-Wall Impingement.
Final rept.,
L. Y. Cooper. 1987, 5p
Sponsored by American Society of Mechanical Engineers, New York.
Pub. in Proceedings of National Heat Transfer Conference (24th), Pittsburgh, PA., August 9-12, 1987, p57-61.

Keywords: *Heat transfer, Ceilings(Architecture), Walls, Jets, Reprints, *Room fires.

The problem of heat transfer to walls from fire plume-driven ceiling jets during compartment fires is introduced. Estimates are obtained for the mass, momentum and enthalpy flux of the ceiling jet immediately upstream of the ceiling-wall junction. An analogy is drawn between the flow dynamics and heat transfer at ceiling jet-wall impingement and at the line impingement of a wall and a two-dimensional, plane, free jet.

700,174
PB88-147764 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Free Burning Fires.
Final rept.,
V. Babrauskas. 1986, 19p
Pub. in Fire Safety Jnl. 11, n1-2 p33-51 1986.

Keywords: Flammability testing, Fabrics, Bedding equipment, Reprints, *Building fires, Room fires.

A review is made of the data available for estimating the burning rates of free-burning fires. Free-burning, in the context, is taken to mean fires in an ambient, wind-free atmosphere, or in a room, but under such conditions that the presence of the room walls and air flow restrictions do not appreciably influence the burning rate. The scope is restricted to combustibles which burn at a sufficient rate to be hazardous in building fires.

700,175
PB88-153333 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Analytical Methods for Fire Safety Design.
J. G. Quintiere. Nov 87, 37p NBSIR-87/3675

Keywords: *Fire safety, *Buildings, Design, Models, Bibliographies, Reviews, Predictions.

The ability to predict aspects of fire and its impact on a building's structure, contents and people is discussed in terms of its application to safety design. It is presented from the perspective of how research has addressed the prediction of fire phenomena. A review of the state of the art on the capability for predicting the fire, its impact and response, is given. Examples are cited to illustrate the scope and accuracy of predictive methods and how they are being incorporated into some codes and standards.

700,176
PB88-153804 PC A09/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Summaries of Center for Fire Research (of the National Bureau of Standards) In-House Programs and Grants - 1987.

S. M. Cherry. Oct 87, 180p NBSIR-87/3650
See also report for 1986, PB87-181996.

Keywords: *Combustion, Research, Programs, Grants, Smoke, Soot, Toxicity, Cellulose, Charring, Fire models, Flame spread, *Fire research, National Bureau of Standards.

The report was prepared for distribution at the Combined Meetings of the Eastern Section: The Combustion Institute and the Annual Conference on Fire Research, November 2-5, 1987. It contains descriptions of the internal programs of the Center for Fire Research as well as extended abstracts of grants for fire research sponsored by the Center for Fire Research.

700,177
PB88-153812

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Algorithm for the Mass-Loss Rate of a Burning Wall,
H. E. Mitler. Dec 87, 27p NBSIR-87/3682

Keywords: *Algorithms, *Burning rate, *Walls, *Fires, Computerized simulation, Room fires.

A derivation is given for a simple algorithm which yields the quasi-steady burning rate of a vertical panel of non-charring, non-melting material in an enclosure with stratification of temperature and oxygen concentration. The algorithm requires the solution of a transcendental equation; it is suggested that this be done by successive approximations. Among the thermophysical data which are needed, are the mean flame temperature and the height-dependent absorption coefficient $K(Z)$. It is found from experiment that $K(Z)$ is well described by PMMA by a two-parameter expression linear in $1/Z$. Comparison with a transient experiment yields good agreement over much of the ranges.

700,178
PB88-156088

PC A05/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

EXITT - A Simulation Model of Occupant Decisions and Actions in Residential Fires: Users Guide and Program Description,
B. M. Levin. Jul 87, 81p NBSIR-87/3591

Keywords: *Decision making, Behavior, Computerized simulation, Escape(Abandonment), Smoke, Human behavior, Response time, Residential buildings, *Building fires.

EXITT is a computer model that simulates the decisions and actions of occupants in a residence. This model can be used to determine the locations of the occupants during the progress of a given fire. The rules for the action choices of the occupants are based largely on studies of residential fires and to a lesser extent on relevant controlled experiments. These rules involve consideration of the smoke conditions, and the characteristics, capabilities and locations of the occupants. EXITT can be run on a personal computer and does not require user training-- the user controls the model by answering simple questions that appear on the screen. It can be run with pre-selected scenarios and, also, with buildings, fires and occupants selected by the user.

The index summarizes information contained in a database on programs under which each of the 50 states regulates products sold within its borders. It can be used as the basis for requesting additional information contained in the database. Development of the database on state regulation of products was part of a continuing NBS effort to establish and maintain comprehensive information on standards, regulations, certification programs and related information. The material has been compiled to meet the needs of government, industry, and the public for information on programs operated by state agencies to regulate products sold to the public.

700,180
PB88-123740

PC A15/MF A01

National Bureau of Standards, Gaithersburg, MD.
Report of the National Conference on Weights and Measures (72nd), 1987.

Special pub. (Final).

A. D. Tholen, C. S. Brickenkamp, and A. P. Heffernan. Sep 87, 328p NBS/SP-734

See also PB87-118840. Also available from Supt. of Docs. as SN003-003-02828-2.

Keywords: *Weight measurement, *Metrology, *Meetings, *Consumer affairs, Automotive fuels, Specifications, Tolerances(Mechanics), Education, Law(Jurisprudence), Regulations, Weights and measures.

These are the proceedings of the 72nd Annual Meeting of the National Conference on Weights and Measures, sponsored by the National Bureau of Standards, held in Little Rock, Arkansas July 19 through July 24, 1987, and attended by state, county and city weights and measures officials, and representatives of the Federal Government, business, industry and consumer organizations. Reports by the several standing and annual committees of the Conference comprise the major portion of the publication. Included also are papers presented by Conference officials and others. Major issues discussed at the Conference included the National Type Evaluation Program, the National Training Program, compliance test methods for products subject to moisture loss, and a new motor fuel inspection law and regulation.

Domestic Commerce, Marketing, & Economics

700,181
PB87-224309

PC A02/MF A01

National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.

ABC's of Standards-Related Activities in the United States.

Final rept.,

M. A. Breitenberg. May 87, 24p NBSIR-87/3576

Keywords: *Standards, *Standardization, Laboratories, Inspection, Tests, United States, Accreditation, Certification.

The report provides an introduction to voluntary standardization, product certification and laboratory accreditation for a reader who is not fully familiar with these topics. It highlights some of the more important aspects of these fields; furnishes the reader with both historical and current information on these topics; describes the importance and impact of the development and use of standards; and serves as background for using available documents and services.

International Commerce, Marketing, & Economics

700,182
PB87-173415

PC A03/MF A01

National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.

GATT (General Agreement on Tariffs and Trade) Standards Code Activities of the National Bureau of Standards 1986.

Annual rept.,

J. R. Overman. Mar 87, 34p NBSIR-87/3538

See also report for 1985, PB86-213675.

Keywords: *Standards, *International trade, Technical assistance, Regulations, US NBS, General Agreement on Tariffs and Trade, GATT standards, Foreign.

The report describes the GATT Standards Code activities conducted by the Standards Code and Information program, National Bureau of Standards (NBS), for calendar year 1986. NBS responsibilities include operating 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 might significantly affect trade; assisting U.S. industry with standards-related trade problems; and responding to inquiries about proposed foreign and U.S. regulations.

700,183

PB87-214128

PC A06/MF A01

National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.

Proceedings of Conference of Standards and Trade, May 5, 1987,

W. G. Leight. Jun 87, 110p NBSIR-87/3573

Keywords: *International trade, *Meetings, Standards, Exports, Competition, Marketing, Requirements, Foreign trade.

The International Trade Administration and the National Bureau of Standards sponsored a one-day Conference on Standards and Trade on May 5, 1987. These Proceedings contain the texts of speeches by Government officials and representatives of the business and standards communities; summaries of question-and-answer periods; and reports of working groups that addressed participation in International standardization activities; test data acceptance; and adoption of U.S. standards.

700,184

PB88-153630

PC A04/MF A01

National Bureau of Standards, Gaithersburg, MD. Associate Director of Industry and Standards.

Barriers Encountered by U.S. Exporters of Telecommunications Equipment,

T. N. Troy. Oct 87, 65p NBSIR-87/3641

Keywords: *Telecommunication, *Equipment, *International trade, *Export, *Barriers, United States, Regulations, Standards, Licenses, Assessment, *Foreign technology, *Foreign trade, European economic community, Europe, Technical assistance, Businesses, Certification, Accreditation.

The report addresses the perceived institution of unreasonable technical trade barriers by major European trading partners to the export of telecom products and systems by U.S. companies. The DOC GATT technical office, which has responsibilities to assist U.S. exporters to take advantage of trade opportunities, informally contacted over a period of six months, telecom companies and agencies to assess the extent of unreasonableness in foreign national standards, regulations, testing and certification requirements, and accreditation procedures. In each country, examples of requirements and practices were identified that allegedly blocked U.S. exports and other non-domestic products. Promises from the authors trading partners to revise their systems have yielded little, and each country continues to support unique requirements and practices that constitute trade barriers. Many trade barriers instituted by EC countries would be eliminated if EC regional and international telecom standards were harmonized, their adoption made mandatory for all EC countries, and results of testing for conformity from one government accredited laboratory were required to be accepted throughout the Community. Consequently, the United States should consider as an option supporting the development and implementation of European regional requirements and practices that promote uniformity.

BUSINESS & ECONOMICS

Consumer Affairs

700,179
PB88-118484

PC A03/MF A01

National Bureau of Standards, Gaithersburg, MD.

Index of Products Regulated by Each State,
M. Breitenberg. Aug 87, 29p NBSIR-87/3608

Keywords: *Certification, Grading, Inspection, State regulation, Testing, *Approved products.

CHEMISTRY

Analytical Chemistry

700,185
PATENT-4 631 414 Not available NTIS
 Department of the Army, Washington, DC.
Radiological Instrument.
 Patent,
 S. Kronenberg, W. L. McLaughlin, and C. R.
 Seibentritt. Filed 20 Sep 85, patented 23 Dec 86, 8p
 PB87-150843, PAT-APPL-6-778 120
 Supersedes AD-D011 946.
 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: *Radiation measuring instruments, *Pat-
 ents, Angle of incidence, Radiation, Sensitivity, Trans-
 parency, Exposure(General), Refractive index, Ratios,
 *Critical angle effect, PAT-CL-250-474.1

The invention relates generally to instruments for
 measuring radiation and more particularly to such in-
 struments which operate in accordance with changes in
 the refractive index of radiochromic materials as a
 result of anomalous dispersion upon being exposed to
 nuclear radiation. A radiological measuring instrument
 including an angularly variable radiation sensitive
 structure comprised of two blocks of material having a
 different index of refraction with one of the materials
 comprising a radiochromic substance whose refractive
 index changes through anomalous dispersion as a
 result of being exposed to radiation is described.

700,186
PB87-149498 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Ceramics Div.
**GFAAS (Graphite Furnace Atomic Absorption
 Spectroscopy) Determination of Ultratrace Quanti-
 ties of Organotin in Sea-Water by Using Enhance-
 ment Methods.**
 Final rept.,
 E. J. Parks, W. R. Blair, and F. E. Brinckman. 1985,
 7p
 Pub. in Talanta 32, n8A p633-639 1985.

Keywords: Spectroscopic analysis, *Tin organic com-
 pounds, *Sea water, Chemical analysis,
 Concentration(Composition), Accuracy, Reprints,
 Graphite furnace atomic absorption spectroscopy.

Triorganotin species in sea water are of anthropomor-
 phic origin, introduced increasingly in trace quantities
 but to unknown extent with increasing Naval use of
 controlled-release antifouling agents. The paper ad-
 dresses the problems of extraction of organotin spe-
 cies from sea water and their quantitation by means of
 signal-enhanced Graphite Furnace Atomic Absorption
 Spectroscopy. Both tributyltin and dibutyltin are ex-
 tracted quantitatively by toluene from spiked samples
 of sea water. Monobutyltin extraction requires the aid
 of a complexing agent such as tropolone. Signal en-
 hancement is effected by adding ammonium dichro-
 mate either to aqueous or organic solutions of organo-
 tin, and supplemented by use of L'vov furnace tubes.
 These complementary techniques are approximately
 additive and allow detection limits of 0.1 ng, or 0.2
 parts per billion of sea water, a concentration consid-
 erably lower than that at which sensitive sea orga-
 nisms are affected by tributyltin.

700,187
PB87-149829 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Inorganic Analytical Research Div.
Activation Analysis of Electronics Materials.
 Final rept.,
 R. M. Lindstrom. 1986, 14p
 Pub. in American Chemical Society Symposium Series
 295, p294-307 1986.

Keywords: *Neutron activation analysis, Chemical
 analysis, Semiconductor(Materials), Silicon, *Electron-
 ics materials.

Small quantities of impurity elements in semiconduc-
 tors can have profound effects on device characteris-
 tics. Neutron activation analysis is one of a small
 number of methods capable of multi-elemental analy-
 sis of subnanogram quantities of contaminants. The
 principles and procedures involved in activation analy-
 sis are described, with stress placed on detectability in
 real samples and on the limits to accuracy which may
 be expected in practice. Milligram to gram-sized sam-
 ples of silicon, quartz, graphite, or organic materials
 are nearly ideal for the method. The physics of the
 processes involved is simple, and qualitative analysis
 is automatic. Except for the need for access to a nucle-
 ar reactor (or isotopic neutron source, at much lower
 sensitivity) the equipment required is readily available
 commercially, and is comparable in cost and complex-
 ity to that used in other advanced analytical tech-
 niques.

700,188
PB87-149837 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Inorganic Analytical Research Div.
**Analytical Neutron-Capture Gamma-Ray Spectro-
 scopy: Status and Prospects.**
 Final rept.,
 R. M. Lindstrom, and D. L. Anderson. 1985, 10p
 Pub. in American Institute of Physics Conference Pro-
 ceedings 125, p810-819 1985.

Keywords: *Neutron activation analysis, Chemical
 analysis, Sensitivity, Gamma spectroscopy.

The use of neutron-capture gamma rays for elemental
 analysis has become an established technique, appli-
 cable for the measurement of a list of elements which
 complements conventional delayed-gamma neutron
 activation analysis. Three distinct areas of application
 of the prompt method have been laboratory-based
 analysis using reactor neutrons, field measurements
 (especially borehole logging for mineral exploration),
 and industrial process stream analysis, the latter two
 using neutron generators or isotopic neutron sources.
 Continued improvements in detector systems and the
 increasing availability of clean, high-intensity beams
 from cold-neutron guide tubes are opening quantita-
 tively and qualitatively new analytical possibilities. This
 will increase the productivity of these facilities by a
 similar factor, and will make the use of capture gamma
 rays more nearly comparable in sensitivity to conven-
 tional neutron activation analysis whenever the sam-
 ple may be brought to the neutrons.

700,189
PB87-149845 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Inorganic Analytical Research Div.
**Use and Abuse of Quantitative Wavelength Disper-
 sive X-ray Microanalysis.**
 Final rept.,
 R. B. Marinenko. 1984, 4p
 Pub. in Proceedings of the Annual Conference - Micro-
 beam Analysis Society (19th), Bethlehem, PA., July
 16-20, 1984, p201-204.

Keywords: *Microanalysis, *X rays, Data reduction,
 Chemical analysis.

A few interesting electron microprobe quantitative
 analyses using wavelength dispersive procedures are
 described. These particular analyses were selected
 because of the unexpected erroneous results obtained
 from such problems as charging, peak shifts, and data
 reduction procedures. The reasons for the errors and
 the solutions to the problems are discussed. The pur-
 pose of the paper is to bring such situations to the at-
 tention of the novice or unsuspecting analyst thus
 making them aware of precautions required when ac-
 curate results are desired.

700,190
PB87-149860 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Inorganic Analytical Research Div.
**Stable Isotope Measurements with Thermal and
 Resonance Ionization Mass Spectrometry.**
 Final rept.,
 L. J. Moore. 1984, 26p
 Pub. in American Chemical Society Symposium Series,
 Stable Isotope Nutrition 258, p1-26 1984.

Keywords: *Mass spectroscopy, Chemical analysis,
 Isotopes, Ionization, Isotope dilution.

Stable isotopes are being used increasingly to trace
 metabolic processes in humans and to determine

ultra-trace concentrations of nutritionally important
 elements in tissues and biological fluids. Recent and
 ongoing developments in high sensitivity thermal ion-
 ization mass spectrometry (TIMS), and resonance ion-
 ization mass spectrometry (RIMS) and chemical sepa-
 rations suggest that studies of trace element metabo-
 lism, bioavailability and many related problems will be
 addressable at levels of precision and sensitivity not
 previously possible. The current state of the technol-
 ogy is summarized for positive and negative ion TIMS,
 for RIMS, and for element- and elemental group -spe-
 cific chemical separations. The collective impact of
 this technology is assessed for stable isotopes in nutri-
 tion, and examples are presented for typical isotope
 ratios and isotope dilution measurements.

700,191
PB87-150652 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Gas and Particulate Science Div.
**X-Ray Spectrometric Analysis of Ceria-Yttria Mix-
 tures After Borate Fusion.**
 Final rept.,
 P. A. Pella, G. Y. Tao, A. L. Dragoo, and J. M. Epp.
 1985, 3p
 Pub. in Analytical Chemistry 57, n8 p1752-1754 1985.

Keywords: *X ray fluorescence analysis, *Cerium, *Yt-
 trium, Spectroscopic analysis, Binary mixtures, Fuel
 cells, Reprints.

X-ray fluorescence analysis after automated borate
 fusion of the analyte with lithium tetraborate was in-
 vestigated as a potentially fast and accurate method to
 characterize ceria-yttria rare earth mixtures for fuel cell
 applications. Because ceria-yttria powder mixtures can
 be prepared in several ways which can lead to prod-
 ucts of different particle sizes, fusion of the sample
 was chosen as a sample preparation method. In the
 way, x-ray analysis can be used to characterize the ho-
 mogeneity as well as the chemical composition of the
 oxide mixture which is important to control in fuel cell
 applications. For best results the sample-to-flux ratio
 should be held constant, and a correction for infinite
 thickness should be applied if the Y-K alpha line is
 chosen for measurement. Analysis of Y₂O₃ (12-85%)
 and CeO₂ (15-88%) in these mixtures was performed
 with a relative error of less than + or -1 %.

700,192
PB87-150678 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Gas and Particulate Science Div.
**Observations on the Calculation of k(sub AB) Fac-
 tors for Analytical Electron Microscopy.**
 Final rept.,
 D. E. Newbury, D. B. Williams, J. I. Goldstein, and C.
 E. Fiori. 1984, 3p
 Pub. in Anal. Electron Microsc., p276-278 1984.

Keywords: Chemical analysis, *Electron spectroscopy,
 Energy dispersive x ray spectroscopy.

Two methods exist for calculating elemental sensitivity
 factors, k(sub AB), used for quantitative analysis in an-
 alytical electron microscopy: The first method relies on
 the fit to experimentally determined k(sub AB) values
 to select the most appropriate parameters for the
 physical equations which describe the physics of x-ray
 generation and detection. The second method relies
 on 'first principles' calculation of the parameters. Due
 to uncertainties in ionization cross sections, fluores-
 cence yields, and detector response, it is concluded
 that the first method offers better accuracy for practi-
 cal analysis.

700,193
PB87-150769 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD.
Analytical Methods.
 Final rept.,
 C. W. Reimann, and R. A. Velapoldi. 1984, 22p
 Pub. in Encyclopedia of Chemical Technology, p43-64
 1984.

Keywords: *Chemical analysis, Trends, Accuracy,
 Chemometrics.

The article is a supplement to the chapter on Analytical
 Methods in Volume 2 of the Encyclopedia of Chemical
 Technology, published in 1978. It addresses recent
 developments in analytical chemistry as well as sev-
 eral topics not included in that chapter. Trends in chemi-
 cal analysis such as improved sensitivities, determina-

tion of species information, spatial resolution on a micrometer scale, and chemical profiling of multicomponent samples are described in general outline. Also discussed are the powerful tools such as lasers used both as light sources and sample excitation devices, computers used for data accumulation and analysis, techniques such as coupled instrumentation used for separation and detection, and mathematical methods, 'chemometrics' used for optimization of analytical information. Ten specific methods reflecting recent developments in analytical chemistry are described along with areas of application of these methods.

700,194
PB87-150892 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
Measurement and Calibration.
Final rept.,
J. K. Taylor, Dec 86, 8p
Pub. in CHEMTECH, p756-763 Dec 86.

Keywords: *Chemical analysis, Calibrating, Reprints.

Reliable chemical measurements require the use of appropriate methodology that has been adequately calibrated. Ways to judge validity and to select methodology that is appropriate for a given use are described. The important subject of adequate calibration and pitfalls that can be encountered are discussed. Guidelines are suggested for the selection of specific instrumentation and criteria are listed for use in deciding the feasibility of making measurements in-house as opposed to contracting them out to specialist laboratories.

700,195
PB87-150900 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Isotopic Measurement of Subnanogram Quantities of Rhenium and Osmium by Resonance Ionization Mass Spectrometry.
Final rept.,
R. J. Walker, and J. D. Fassett, Dec 86, 5p
Pub. in Analytical Chemistry 58, n14 p2923-2927 Dec 86.

Keywords: *Chemical analysis, *Osmium, *Rhenium, Concentration(Composition), Reprints, Resonance ionization mass spectroscopy, Isotope dilution.

Resonance ionization mass spectrometry has been used to measure the isotopic compositions of microgram and picogram quantities of Re and Os. The high sensitivity required for these measurements was achieved through the optimization of sample atomization and efficient ionization from the resulting gas-phase reservoir. Re and Os are absorbed from chloride solutions onto anion exchange beads as a means of purifying and concentrating the sample and then loaded onto a miniaturized Ta filament. Measurements of microgram quantities of spike-standard mixtures are reported to precisions and accuracies of about 1%. Measurement precision and accuracy of picogram quantities of Os range from 1 to 5% and are primarily limited by counting statistics.

700,196
PB87-151486 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
Tools for the Automated Handling of Evaluated Data.
Final rept.,
B. B. Molino, 1985, 6p
Pub. in the Role of Data in Scientific Progress, p489-494 1985.

Keywords: *Data processing, Automation, Data retrieval.

Advances in the computer industry have affected all aspects of automated handling of evaluated data, from the early stages of data acquisition through the final stages of data dissemination. These technological advances have provided many tools with obvious advantages in the handling of these unique data. At the same time, however, problems have arisen during the automation process, many of which are still being solved today. Both the advantages offered and the problems incurred in all phases of automated tools for handling evaluated data will be discussed, with examples presented of projects under way in the Office of Standard Reference Data.

700,197
PB87-152021 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Characterization of the Polycyclic Aromatic Hydrocarbons from Two Standard Reference Material Air Particulate Samples.
Final rept.,
S. A. Wise, B. A. Benner, S. N. Chesler, L. R. Hilpert, C. R. Vogt, and W. E. May, 1986, 11p
Pub. in Analytical Chemistry 58, n14 p3067-3077 Dec 86.

Keywords: *Aromatic polycyclic hydrocarbons, *Chromatographic analysis, Chemical analysis, Reprints, *Standard reference materials, Particulates, Air sampling.

Polycyclic aromatic hydrocarbon (PAH) mixtures were isolated from two air particulate materials, which are available from the National Bureau of Standards as Standard Reference Materials. High-resolution liquid chromatography (LC), gas chromatography (GC), and gas chromatography-mass spectrometry were used to provide a detailed characterization of these two samples. By use of the multidimensional chromatographic approach, quantitative information on over 180 PAH was obtained for these two samples. The extensive qualitative and quantitative information obtained for these two materials is extremely useful because these samples are available to other laboratories for use in the comparison of analytical methods and results.

700,198
PB87-161212 PC A03/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Characterization of Long Term Controlled Release Dynamics and Identification of Butyltin Species Released from OMP (Organometallic Polymers) Impregnated Wood Pilings.
Final rept.,
W. R. Blair, G. J. Olson, and F. E. Brinckman, Jan 87, 27p NBSIR-87/3518
Contract N68305-82-MP-20019
Sponsored by Civil Engineering Lab. (Navy), Port Hueneme, CA.

Keywords: *Chemical analysis, Tin organic compounds, Gas chromatography, Extraction, Concentration(Composition), *Butyltin, *Wood pilings, Leaching.

The report describes a method for determining rates of release of organotin species leaching from wood pilings impregnated with organotin-containing copolymers and discusses short and long term results. The analytical method consists of simultaneous extraction/hydridization of aqueous leachate samples, followed by organotin speciation by gas chromatography coupled with tin selective flame photometric detection (GC-FPD). The detection limit for the butyltin family of organotins is 0.1 to 0.2 ng, depending on the species. The butyltins (mono- through tetrabutyltin) are speciated within a 15 min chromatogram, which also provides speciation of any methylbutyltin compounds that may be present in the sample. Water samples were collected from the leaching tanks immediately upon immersion of the wood pilings and at intervals thereafter for approximately 1 year.

700,199
PB87-161717 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Carbon Determination for the Study of Bonded Phases in Liquid Chromatography.
Final rept.,
B. I. Diamondstone, S. A. Wise, and L. C. Sander, 1985, 6p
Pub. in Jnl. of Chromatography 321, n2 p319-324 1985.

Keywords: *Chromatographic analysis, *Carbon, Liquid chromatography, Chemical analysis, Reprints, Carbon loading.

A procedure is described that permits carbon analyses to be performed on a variety of samples using a carbon analyzer originally intended for use with metal samples. By mixing small quantities of a relatively high carbon sample with low carbon steel, the problems of explosive combustion and inductive coupling are overcome. In addition, the technique permits highly reproducible measurements to be made that might not be

possible using other methods. Several applications of the method are described for the measurement of carbon loading in chemically bonded stationary phases.

700,200
PB87-162038 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
Role of Collaborative and Cooperative Studies in Evaluation of Analytical Methods.
Final rept.,
J. K. Taylor, 1986, 3p
Pub. in Jnl. of Association of Official Analytical Chemists 69, n3 p398-400 1986.

Keywords: *Chemical analysis, Standards, Reprints.

A method proposed as a standard or for use in a regulatory process must be reliable and its typical performance characteristics would be stated and verified. Collaborative testing is the most acceptable way to accomplish the latter but its function should not be misunderstood. Such testing can verify performance characteristics and experimentally demonstrate that the methodology can be used successfully by a representative group of laboratories.

700,201
PB87-162111 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Accuracy of Transmission Electron Microscopy for the Analysis of Asbestos in Ambient Environments.
Final rept.,
E. B. Steel, and J. A. Small, 1985, 5p
Pub. in Analytical Chemistry 57, n1 p209-213 1985.

Keywords: *Chemical analysis, *Asbestos, Accuracy, Chrysotile, Reprints, *Electron microscopy, Air pollution detection.

Errors associated with the analytical electron microscope analysis of trace amounts of chrysotile asbestos in ambient-type samples have been investigated. The microscope can be the source of order-of-magnitude size errors in the reported chrysotile concentration if the mechanical stage, image quality, and electron diffraction capabilities do not meet the demanding requirements of asbestos analysis. Using a verified counting procedure, it was determined that most operators of the microscope have less than approximately a 50% chance of finding and counting chrysotile fibers less than one micrometer in length. But that accuracies, greater than 90% can be achieved on chrysotile fibers longer than one micrometer when using the analytical electron microscope.

700,202
PB87-163986 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Optimization of Secondary Chemical Equilibria in Liquid Chromatography: Theory and Verification.
Final rept.,
J. P. Foley, and W. E. May, 1 Jan 87, 8p
Pub. in Analytical Chemistry 59, n1 p102-109, 1 Jan 87.

Keywords: *Liquid chromatography, Precision, Reprints.

A general theory for the optimization of secondary chemical equilibria in liquid chromatography (SCE-LC) is presented. Equations that predict the optimum mobile phase conditions are derived explicitly for the equilibrium. The selectivity of SCE-LC has been substantially underestimated because nonoptimum mobile phase conditions were employed in previous selectivity estimates. The self-selectivity, or ratio of capacity factors, $K'(\text{sub AX}) / K'(\text{sub A})$, determines the mobile phase optimum and the overall chromatographic selectivity which can be achieved. The theory is experimentally verified for acid-base equilibria.

700,203
PB87-163994 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Optimization of Secondary Chemical Equilibria in Liquid Chromatography: Variables Influencing the Self-Selectivity, Retention, and Efficiency in Acid-Base Systems.

Final rept.,
J. P. Foley, and W. E. May. 1 Jan 87, 6p
Pub. in *Analytical Chemistry* 59, n1 p110-115, 1 Jan 87.

Keywords: *Chemical analysis, Liquid chromatography, Precision, Reprints.

The effects of several chromatographic variables on the self-selectivity, retention, and efficiency in secondary chemical equilibria liquid chromatography (SCE-LC) are reported. The self-selectivities were measured for numerous ionogenic compounds using pH-buffered mobile phases. Only the type of stationary phase employed affected the self-selectivity by more than a factor of 2. Data from the plots used to measure the self-selectivities are included and serve as additional verification of the SCE-LC retention model discussed in the preceding paper. When greater than or equal to 4% 1-propanol is used, the resulting efficiencies are equal to those obtained in conventional liquid chromatography. An approach for the optimization of resolution is summarized.

700,204

PB87-164133 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Determination of Phenols in Petroleum Crude Oils Using Liquid Chromatography with Electrochemical Detection.

Final rept.,
W. A. MacCrehan, and J. M. Brown-Thomas. 1 Feb 87, 3p
Pub. in *Analytical Chemistry* 59, n3 p477-479, 1 Feb 87.

Keywords: *Chromatographic analysis, *Phenol, *Crude oil, Chemical analysis, Liquid chromatography, Accuracy, Concentration(Composition), Reprints.

A new method for the determination of phenolic compounds in unrefined petroleum products is presented. The method is based on alkaline solvent extraction of the oil, purification with a solid-phase extraction column, and determination by reverse-phase liquid chromatography with oxidative electrochemical detection. Phenol and 2-methylphenol, as well as 1- and 2-naphthol, have been determined in two National Bureau of Standards (NBS) Standard Reference Materials: SRM 1582 petroleum crude oil and SRM 1580 organics in shale oil. Agreement between the new liquid chromatography (LC) method and independent (gas chromatography (GC) and gas chromatography/mass spectrometry (GC/MS)) methods is good. The detection limits are below 100 ng/g for the phenols/naphthols in the oil.

700,205

PB87-164158 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Effects of Resistance and Capacitance on the Chronoamperometry of Polymer-Coated Electrodes as Modeled by a Finite Elements Digital Simulation.

Final rept.,
W. T. Yap, and R. A. Durst. 1987, 9p
Pub. in *Jnl. of Electroanalytical Chemistry* 216, p11-19 1987.

Keywords: Electrochemistry, Chemical analysis, Electrodes, Reprints, *Chronoamperometry.

A finite elements digital simulation of chronoamperometry with polymer-coated electrodes is presented. The model takes account of mass transport by diffusion and migration, and the effects of the uncompensated resistance and capacitance of the system. A graphical method for the analysis of experimental data was introduced and applied to electrodes coated with poly(Ru(II)(bipy)2(4-vpy)2)(1+) PF6(1-).

700,206

PB87-167193 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.

Survey of Elements Detected Using Resonance Ionization Mass Spectrometry with Thermal Vaporization.

Final rept.,
J. C. Travis, J. D. Fassett, and L. J. Moore. 1984, 10p
Pub. in *Institute of Physics Conference Series* 71, p97-106 1984.

Keywords: *Chemical analysis, Mass spectroscopy, Reprints, Photoionization, Multielement analysis.

Since its inception, resonance ionization spectroscopy has held the promise of applicability to nearly every element of the periodic table. The rate of experimental verification of this expectation has been greatly accelerated by the independent development, in several laboratories, of a resonance ionization variant of thermal ionization mass spectrometry. Resonance ionization has been observed for at least twenty six elements in resonance ionization mass spectrometry devices employing thermal vaporization. The elemental survey data provide insights into special considerations which accompany the hybridization of resonance ionization and thermal vaporization mass spectrometry. These considerations relate to the composition of the vapor plume above the thermal filament, the energy level distribution of atoms in the plume, the choice of resonance ionization scheme, and the spectral response of the ionization signal.

700,207

PB87-167391 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.

Use of Ionization Cross Sections in Analytical Electron Microscopy.

Final rept.,
D. B. Williams, D. E. Newbury, J. I. Goldstein, and C. E. Fiori. 1984, 10p
Pub. in *Jnl. of Microscopy-Oxford* 136, p209-218 Nov 84.

Keywords: X ray analysis, Reprints, *Electron microscopy, Ionization cross section.

Quantitative analysis by the sensitivity factor method in analytical electron microscopy requires the use of an ionization cross section for the calculation of sensitivity factors which cannot be conveniently measured from multi-element standards. The Williams relativistic version of the Bethe formula with modifications due to Zalzec is considered for use in calculating sensitivity factors.

700,208

PB87-172698 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Improved Procedure for the Determination of Iodide by Ion Chromatography with Electrochemical Detection.

Final rept.,
K. Han, W. F. Koch, and K. W. Pratt. 1 Mar 87, 6p
Pub. in *Analytical Chemistry* 59, n5 p731-736, 1 Mar 87.

Keywords: *Chromatographic analysis, *Iodides, Chemical analysis, Procedures, Reprints, Ion chromatography, Electrochemical detection.

An improved procedure for the determination of iodide using ion chromatography with electrochemical detection has been developed. The advantages of the good selectivity of ion chromatography and the highly sensitive response of iodide at a Pt electrode have been combined to establish a new method with enhanced detection limits and improved linearity. The use of an eluent consisting of nitric acid and sodium nitrate has eliminated the severe tailing of iodide. The detection limit has been estimated to be 10 ng/mL. The effect of other anions in solution has been determined. The method has been applied to the determination of iodide in cadmium sulfide, potassium fluoride, and iodized sodium chloride.

700,209

PB87-179339 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Determination of Sulfide at the Parts-per-Billion Level by Ion Chromatography with Electrochemical Detection.

Final rept.,
K. Han, and W. F. Koch. 1 Apr 87, 5p
Pub. in *Analytical Chemistry* 59, n7 p1016-1020, 1 Apr 87.

Keywords: *Chemical analysis, Absorption, Ion exchanging, Concentration(Composition), Reprints, *Ion chromatography, *Sulfides, Electrochemical detection.

An improved procedure for the determination of sulfide using ion chromatography with electrochemical detection has been developed. Detection limits have been extended down to 0.1 ng/mL, with linear response up to 1000 ng/mL. Several factors affecting the response of the system to sulfide have been investigated, including condition of the columns, the arrangement of the columns, purity of reagents, composition of eluent, condition of the working electrode, stability of sulfide solutions, mechanism of retention, and temperature of the system. The two main sources of error in the determination of sulfide are impurities in the eluent and adsorption of sulfide on the columns. Metal impurities in the eluent and on the column must be removed to achieve sensitivities below 20 ng/mL. To accomplish this, a new column cleaning procedure has been developed and a rearrangement in the positioning of the columns is recommended.

700,210

PB87-179347 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Silver Sulfonates: A Novel Calibration Material for Field Desorption Mass Spectrometry.

Final rept.,
R. Espinosa-Leniz, and E. White. 1987, 4p
Pub. in *Organic Mass Spectrometry* 22, p169-172 1987.

Keywords: *Mass spectroscopy, *Desorption, Precision, Accuracy, Concentration(Composition), Reprints, *Silver methane sulfonate, *Silver trifluoromethanesulfonate, Calibration.

An equimolar mixture of silver methanesulfonate and silver trifluoromethanesulfonate has been investigated as a calibration material for exact mass determination in field desorption mass spectrometry. The mass scale was established using only field desorption by double exposure of the calibration material and the sample on a photographic plate. The precision and the accuracy of the method were tested by recording the mass spectra of a variety of peptides of known composition at a resolution of about 4000. The results indicate that the mass scale established is useful for the determination of the exact masses of field desorbed ions over the mass range examined: m/z 294-1147.

700,211

PB87-181681 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Materials.

Standard Reference Materials. ASTM (American Society for Testing and Materials) and NBS (National Bureau of Standards) Cooperate to Assist Analytical and Testing Labs.

Final rept.,
S. D. Rasberry. Mar 87, 4p
Pub. in *ASTM (American Society for Testing and Materials) Standardization News*, p30-33 Mar 87.

Keywords: Standards, Reprints, *Standard reference materials.

No abstract available.

700,212

PB87-199261 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Ultratrace Elemental and Isotopic Analysis of Osmium and Rhenium Using Resonance Ionization Mass Spectrometry and Thermal Vaporization.

Final rept.,
J. D. Fassett, and R. J. Walker. 1986, 6p
Pub. in *Proceedings of Resonance Ionization Mass Spectrometry Conference*, Swansea, Wales, September 7-12, 1986, p115-120 1986.

Keywords: *Mass spectrometry, Osmium, Resonance ionization, Rhenium, Thermal atomization, *Isotope ratios, *Laser ionization.

Aspects of atomization and optical spectroscopy are described for resonance ionization of the elements osmium and rhenium. Picogram sensitivities have been developed with 1-5% precisions and accuracies in isotopic ratio measurement.

700,213
PB87-202966 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO.
 Time and Frequency Div.
Rotational and Hyperfine Constants of Vibrationally Excited NH (a sup 1 Delta; nu = 1).

Final rept.,
 E. C. C. Vasconcellos, S. A. Davidson, J. M. Brown, K. R. Leopold, and K. M. Evenson. 1987, 4p
 Contract NASA-W-15047
 Sponsored by National Aeronautics and Space Administration, Washington, DC., and Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil).
 Pub. in Jnl. of Molecular Spectroscopy 122, p242-245 1987.

Keywords: *Hyperfine, *Imidogen, Laser magnetic resonance, Reprints, NH singlet delta, Rotational spectroscopy, Vibrationally excited.

The authors report the observation of the lowest rotational transitions of NH (a1 delta; upsilon = 1) using low magnetic resonance spectroscopy. From this spectra the authors obtain rotational and hyperfine constants.

700,214
PB87-202982 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Cross-Linked Poly(vinylferrocene)-Modified Reference Electrode for Nonaqueous Electrochemistry.

Final rept.,
 R. M. Kannuck, J. M. Bellama, E. A. Blubaugh, and R. A. Durst. 1987, 3p
 Pub. in Analytical Chemistry 59, n10 p1473-1475, 15 May 87.

Keywords: Reprints, *Chemically modified electrode, *Nonaqueous electrochemistry, Polymer film electrode, Reference electrode.

A thermally initiated crosslinking procedure is applied to polyvinylferrocene electrodes in order to stabilize these films in organic solvents. The crosslinked film electrodes can then be used as reference electrodes for reporting electromotive force (emf) data in nonaqueous solutions. This type of reference electrode is advantageous for nonaqueous electrochemistry in that it does not give rise to the irreproducible aqueous/nonaqueous liquid junction potential formed when conventional aqueous reference electrodes are used in aprotic solvents.

700,215
PB87-203030 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Far-Infrared Laser Magnetic Resonance Spectrum of the (17)OH Radical: Determination of Nuclear Hyperfine Parameters.

Final rept.,
 K. R. Leopold, K. M. Evenson, E. R. Comben, and J. M. Brown. 1987, 15p
 Contract NASA-W-15047
 Sponsored by National Aeronautics and Space Administration, Washington, DC.
 Pub. in Jnl. of Molecular Spectroscopy 122, p440-454 1987.

Keywords: *Electronic structure, *Far infrared, Hyperfine parameters, Lasers, Magnetic resonance, Reprints, Rotational spectroscopy.

The far-infrared (FIR) Laser Magnetic Resonance (LMR) spectrum of the 17OH radical in the upsilon = 0 level of the X21 state has been studied in detail. The measurements have been analyzed and, in combination with some earlier EPR measurements, subjected to a single least-squares fit using an effective Hamiltonian. A full set of (17)O nuclear hyperfine parameters has been determined. Some implications of these parameter values for the electronic wavefunction of OH are considered.

700,216
PB87-203048 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Far-Infrared Spectrum of Sodium Hydride.
 Final rept.,
 K. R. Leopold, L. R. Zink, K. M. Evenson, and D. A. Jennings. 1987, 7p
 Contract NASA-W-15047
 Sponsored by National Aeronautics and Space Administration, Washington, DC.

Pub. in Jnl. of Molecular Spectroscopy 122, p150-156 1987.

Keywords: *Alkali hydride, Sodium hydride, Reprints, Born Oppenheimer approximation, Dunham coefficients, *Far infrared spectrum, Rotational spectrum.

Rotational spectra in the upsilon = 0, 1, 2, and 3 levels of the ground 1 sigma state of sodium hydride have been observed using tunable far-infrared radiation generated from the difference frequency between two CO2 lasers. The Dunham coefficients, which have been determined without the use of optical data or isotopic scaling relations are Y(01) = 146 999.138(38) MHz, Y(02) = -10.29481(54) MHz, Y(03) = 6.243(49) X 10 to the minus four power MHz, Y(11) = -4109.912(68) MHz, Y(12) = 0.14695(68) MHz, Y(21) = 33.341(34) MHz, Y(22) = -2.69(20) X 10 to the minus three power MHz, and Y(31) = -1.0517(55) MHz. The constants are typically an order of magnitude more accurate than the best values previously available, and where comparison is possible, agreement is found to be excellent.

700,217
PB87-213518 (Order as PB87-213476, PC A05/MF A01)
 National Bureau of Standards (NML), Gaithersburg, MD. Center for Chemical Physics.

Instrument-Independent CAD (Collisionally-Activated Dissociation) Spectral Databases: Absolute Cross-Section Measurements in QQQ (Triple Quadrupole) Instruments.
 R. I. Martinez, and S. Dheandhanoo. 5 Feb 87, 9p
 Included in Jnl. of Research of the National Bureau of Standards, v92 n3 p229-237 May-Jun 87.

Keywords: *Charge-exchange reactions, *Argon ions, *Ion-molecule collisions, Tandem mass spectrometry, Calibration, Data bases.

The energy dependence of the cross section for the symmetric (resonant) charge transfer reaction Ar(1+) (Ar,Ar) Ar(1+) was measured in the triple quadrupole (QQQ) tandem mass spectrometer. Results are discussed.

700,218
PB87-216230 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
Biological Reference Materials from the U.S. National Bureau of Standards--An Update.

Final rept.,
 S. D. Rasberry. 1987, 4p
 Pub. in Fresenius' Zeitschrift fuer Analytische Chemie 326, p609-612 1987.

Keywords: *Chemical analysis, *Food, *Plants, Reprints, *Biological reference materials, *National Bureau of Standards.

The paper provides an update covering the change in availability of NBS Biological Reference Materials between the First and the Second Symposium on Biological Reference Materials. In the intervening 30-month period, 15 new reference materials of biological interest have been issued by NBS and 8 more are being prepared. Newly issued reference materials that are described include: corn kernel, corn stalk, lead in blood, trace elements in human serum, inorganic constituents in bovine serum, PCB's in human serum, blood gases, toxic elements in urine, dioxin in isooctane, ethanol-water solutions, chlorinated pesticides and chlorinated biphenyls in isooctane. Several new Standard Reference Materials have been introduced to aid analysis in testing instrument performance. These are intended to provide a baseline of instrument performance, independent of the matrix analyzed. Described are 36 solution standards for spectrometric methods, a wavelength standard for spectrophotometers, a temperature standard, and one for evaluating GC/MS system performance.

700,219
PB87-230819 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Apparatus for the Rapid Equilibration of Moisture-Sensitive Materials.

Final rept.,
 J. R. Moody, and E. S. Beary. 1987, 3p
 Pub. in Analytical Chemistry 59, n10 p1481-1483, 15 May 87.

Keywords: *Humidity, Environment simulation, Moisture, Equilibrium, Sensitivity, Reprints, *Standard reference materials, Dry weight.

A simple apparatus is described for the rapid testing of Standard Reference Materials for sensitivity to humidity changes. Circulating air with controlled humidity and temperature air can achieve sample equilibration in a few minutes to 1 or 2 hours. A cyclic humidification dehumidification process has been used to achieve in a few hours effects which have been known to take one or more years for SRM 332.

700,220
PB87-230991 (Order as PB87-230975, PC A04/MF A01)
 National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Catalytic Cracking as the Basis for a Potential Detector for Gas Chromatography.
 T. J. Bruno. 18 Feb 87, 5p
 Sponsored by Gas Research Inst., Chicago, IL.
 Included in Jnl. of Research of the National Bureau of Standards, v92 n4 p261-265 Jul-Aug 87.

Keywords: *Detectors, *Catalytic cracking, *Gas chromatography, Catalysts, Silicon dioxide, Aluminum oxides, Zeolites, Hydrocarbons, Temperature measurement, Thermocouples.

The paper describes the design, construction and preliminary experimental results obtained with a potential new detector for the gas chromatographic analysis of hydrocarbon species. The functional principle of the detector is the measurement of the temperature change of a catalyst as catalytic cracking occurs on its surface. The catalyst is a silicon dioxide-aluminum oxide-zeolite mixture similar to the materials used commercially in industrial riser crackers. The temperature drop which occurs at the onset of cracking is measured using two opposed thermocouple junctions. The first prototype, described in the paper, consists of a single pair of junctions. After appropriate signal conditioning (using a commercially available filter-amplifier), the thermocouple output is logged using an electronic integrator.

700,221
PB87-231528 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

High-Resolution Infrared Spectrum of the Fundamental Band of LiCl at a Temperature of 830 C.

Final rept.,
 G. A. Thompson, A. G. Maki, W. B. Olson, and A. Weber. 1987, 9p
 Pub. in Jnl. of Molecular Spectroscopy 124, p130-138 1987.

Keywords: *Infrared, Reprints, *High temperature, Lithium chloride, Molecular spectroscopy, Potential functions.

High-resolution Fourier transform spectra of 6LiCl and 7LiCl have been recorded at 830 C. A total of 2522 lines have been measured at 0.006 per cm resolution in the 500- to 730-per cm region. The data for all four isotopic species have been fit with a standard deviation of 0.00027 per cm using 19 isotopically invariant rovibrational constants including five delta correction terms to the usual Dunham Y terms. Comparison is made with the constants derived from a direct fit of the observed transitions to a Dunham potential function with only 13 coefficients including four delta correction terms. The gas phase band center for the upsilon = 1-0 transition of 7Li35Cl is 634.0753(7) per cm.

700,222
PB88-109087 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Laboratory Design for the Safe Distillation of Acids.

Final rept.,
 E. S. Beary, and J. R. Moody. 1983, 1p
 Pub. in Industrial Hygiene News Report 26, n11 p3 Nov 83.

Keywords: *Distillation, *Exhaust systems, *Polyvinyl chloride, *Laboratories, Design, Safety, Reprints, *Acids.

Two basic requirements governed the design of the laboratory: (1) the provision of high volume, single pass, class 100 air supply through a polyvinyl chloride (PVC) chamber and an all PVC exhaust system, and (2) careful control of the balance of air flows, removing acid fumes at their source without introducing fumes into the laboratory or permitting fumes to escape to the

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area outside the laboratory. The primary concern within the laboratory was to eliminate those materials which contained metal (as a source of contamination) or which could be attacked by contact with acids or their fumes.

700,223
PB88-110788 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Limits of Visibility for Chrysotile Asbestos in the Scanning Electron Microscope.

Final rept.,
J. A. Small, and D. E. Newbury. 1982, 8p
Pub. in Proceedings of International Colloquium on Dust Measuring Technique and Strategy (4th), Edinburgh, Scotland, September 1982, p425-432.

Keywords: *Air pollution, *Asbestos, *Fibers, Serpentine, Resolution, Instruments, Performance evaluation, Claims, *Foreign technology, *Scanning electron microscopy, *Air pollution detection.

Most manufacturers of scanning electron microscopes (SEMs) claim resolutions on the order of 5-10 nm for their instruments. With this level of resolution it appears that these instruments are capable of imaging single-fibril chrysotile which has a diameter range from 10-30 nm. The resolution, however, can only be expected for a high contrast sample with the instrument operating at a beam current and scan speed suitable for high resolution microscopy. In analyzing a low contrast sample such as chrysotile asbestos on a filter, where it may be necessary to search the filter surface for fibers at a rapid scan speed, the parameters which affect the visibility of the fibers are far from ideal. As a result, the best obtainable resolution will be several times that stated by the manufacturer.

700,224
PB88-117510 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Sub-Doppler Infrared Spectrum of the Carbon Dioxide Trimer.

Final rept.,
G. T. Fraser, A. S. Pine, W. J. Lafferty, and R. E. Miller. 1987, 7p
Pub. in Jnl. of Chemical Physics 87, n3 p1502-1508, 1 Aug 87.

Keywords: *Molecular spectroscopy, *Carbon dioxide, Infrared spectra, Van der Waals equation, Reprints, Laser spectroscopy.

A spectrum of the carbon dioxide trimer van der Waals species has been recorded near 3614/cm at sub-Doppler resolution using an optothermal (bolometer-detected) molecular-beam color-center laser spectrometer. A planar, cyclic structure with C_{3h} symmetry has been determined for the complex with a carbon-carbon separation of 4.0382(3) Å. The observed perpendicular band, corresponding to an in-plane E'-symmetry vibration of the trimer, has been attributed to a localized excitation of the 2v₂+v₃ combination mode of a CO₂ subunit by virtue of its small blue shift (approx. 0.98 cm⁻¹) from that of the isolated monomer.

700,225
PB88-117528 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
High-Resolution Measurements of the (nu sub 2) and 2(nu sub 2-nu sub 2) Bands of SO2.

Final rept.,
L. Coudert, A. G. Maki, and W. B. Olson. 1987, 6p
Sponsored by National Aeronautics and Space Administration, Washington, DC.

Pub. in Jnl. of Molecular Spectroscopy 124, p437-442 1987.

Keywords: *Air pollution, *Sulfur dioxide, Infrared spectra, Reprints, High resolution.

Infrared measurements have been made on SO₂ between 450 and 602/cm with a resolution of 0.005/cm. The B-type bands due to the bending mode transitions 010-000 and 020-010 have been assigned and analyzed for the SO₂ molecule. A total of 3007 transitions were measured and fit for SO₂ with a standard deviation of 0.0004/cm. Ro-vibrational constants are given that fit the current measurements and the pure rotational transitions reported in the literature.

700,226
PB88-117835 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Affinity Chromatography and Metal Chelate Affinity Chromatography.

Final rept.,
A. J. Fatiadi. 1987, 44p
Pub. in CRC Critical Reviews in Analytical Chemistry 18, n1 p1-44 1987.

Keywords: *Chromatography, Reprints.

No abstract available.

700,227
PB88-122049 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Collisional Broadening of HCl Rotational Transitions Using Tunable Far-Infrared Radiation.

Final rept.,
K. V. Chance, I. G. Nolt, L. Zink, D. A. Jennings, K. M. Evenson, M. D. Vanek, and J. V. Radostitz. 1986, 3p
Pub. in Proceedings of the International Conference on Infrared and Millimeter Waves (11th), Tirrenia, Pisa, Italy, October 20-24, 1986, p277-279.

Keywords: *Hydrogen chloride, *Hydrochloric acid, Far infrared radiation, *Foreign technology.

Using tunable far-infrared radiation, the authors have measured pressure broadening coefficients and pressure-induced lineshifts for several rotational transitions of HCl. Results are presented here for the 83.39/cm R3 line of H(35)Cl, broadened and shifted by N₂ and O₂.

700,228
PB88-129747 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.
Viscosity Measurements Near Critical Points Using a Novel Torsion Oscillator.

Final rept.,
R. F. Berg, and M. R. Moldover. 1986, 12p
Pub. in International Jnl. of Thermophysics 7, n3 p675-686 May 86.

Keywords: *Liquid phases, *Fluids, *Viscosity, *Viscometers, Measurement, Methanol, Cyclohexane, Reprints.

A torsion oscillator viscometer has been constructed for the measurement of the viscosity of fluids near both liquid-vapor and liquid-liquid critical points. The viscometer was used to measure the temperature dependence of the viscosity anomaly near the consolute point of mixtures of methanol and cyclohexane along paths of constant pressure and paths of constant volume at temperatures spanning the range 0.00001 < ((T-T sub c)/(T sub c)) < 0.01.

700,229
PB88-134572 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Excitation Mechanisms in Vibrational Spectroscopy of Molecules on Surfaces.

Final rept.,
J. W. Gadzuk. 1987, 55p
Pub. in Vibrational Spectroscopy of Molecules on Surfaces, Chapter 2, p49-103 1987.

Keywords: *Vibrational spectra, *Spectroscopy, Molecular vibration, Elementary excitations, Surfaces, Reprints, *Foreign technology.

Under the heading of introductory remarks, the why's of vibrational spectroscopy are considered, followed by a qualitative overview of the various techniques covered in the volume. A number of possible theoretical strategies for understanding the spectroscopies are then introduced. Section 2 deals with simple models of the excitation process. Similarities and differences between direct electron and photon vibrational excitation are presented.

700,230
PB88-134689 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Office of the Director.
Simple Correction Procedure for Continuum Fluorescence.

Final rept.,
K. F. J. Heinrich. 1987, 1p
Pub. in Proceedings of the Annual Conference of the Microbeam Analysis Society (22nd) and the Pacific

Workshop on Analytical Electron Microscopy, Microbeam Analysis, Kona, HI., July 13-17, 1987, p24.

Keywords: *Microanalysis, Fluorescence, Chemical analysis, Data reduction, Errors, *Electron microscopy, X ray fluorescence.

Corrective procedures for fluorescence excited by the continuum have been proposed by Henoc and by Springer. In most analyses the effect of continuum fluorescence does not exceed a few percent and tends to compensate between specimen and standard. However, in the case of high-energy primary radiation, particularly in a matrix of low average atomic number, such as ZnKa in soft biological tissue, its neglect in the data reduction procedure may lead to serious errors. By changing the integration procedure, eliminating the need for sorting edges and entering absorption edge jumps, the system can be simplified without sacrifice in accuracy and used in routine data reduction procedures.

700,231
PB88-134697 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Office of the Director.
General Correction for Fluorescence from Characteristic Lines.

Final rept.,
K. F. J. Heinrich. 1987, 1p
Pub. in Proceedings of the Annual Conference of the Microbeam Analysis Society (22nd) and the Pacific Workshop on Analytical Electron Microscopy, Microbeam Analysis, Kona, HI., July 13-17, 1987, p23.

Keywords: *Microanalysis, Fluorescence, Data reduction, *Electron microscopy, X ray fluorescence.

The fluorescence caused by characteristic lines was first described in Castaing's thesis; it is applied in a complete form in the program COR, but in most other procedures the abbreviated version due to Reed and Long is used. Both versions describe the fraction of radiation absorbed by the element which is secondarily excited by means of the absorption jump ratios, for which expressions exist for some absorption edges only. The version by Reed and Long uses simplifications which further restrict the range of applicability. The algorithm described in the publication permits an automatic application of the exact fluorescent correction to all situations, without the use of the jump ratios.

700,232
PB88-138995 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.
New Experiments on the Langmuir Film Balance.

Final rept.,
G. Morrison, and I. L. Pegg. 1987, 7p
Sponsored by Department of Energy, Washington, DC.

Pub. in Proceedings of Symposium on Energy Engineering Sciences Instrumentation, Diagnostics, and Material Behavior (5th), Argonne, IL., June 17-19, 1987, p45-51.

Keywords: *Materials tests, Instruments, Measurement, Liquids, *Liquid-vapor interfaces.

The authors describe here the design and construction of a wide-range, automated film balance and a set of experiments on a well-documented material to test the instrument during its development. The balance can be operated in the temperature range 5 - 50 degrees C. The measurements of the liquid-expanded (LE)-liquid-compressed (LC) and the liquid-vapor transitions in pentadecanoic acid monolayers on water to confirm recent suggestions that long-standing ideas about these two transitions might be in error and that a thorough re-examination of many 'classic' measurements will be necessary.

700,233
PB88-141288 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Determination of Total Carbon in Biological Materials.

Final rept.,
B. I. Diamondstone, and R. C. Gauer. 1986, 3p
Pub. in Analyst 111, n8 p955-957 1986.

Keywords: *Botany, Carbon, Concentration(Composition), Combustion, Analytical chemistry, Reprints, *Standard reference materials.

Nine botanical Standard Reference Materials (SRM's) from the National Bureau of Standards (NBS) were analyzed for total carbon concentration on combustion analysis instrumentation primarily intended for the determination of carbon and sulfur in metals. 'Combustion Analysis' is a method for elemental analysis that involves the combustion of a sample followed by the measurement of evolved gases by a technique such as infrared absorption photometry. The method is popular for the rapid determination of total carbon in steels and other metal alloys and provides highly sensitive and reliable data when known standards are used for instrument calibration. In some cases metal combustion analysis instrumentation can accommodate non-metallic (organic) samples for carbon analysis. Carbon was determined in the SRM's listed above and the accuracy and precision of the results are compared to values obtained with alternate procedures such as prompt gamma activation analysis, and commercial C, H, and N analyzers. The practicality of using a combustion analyzer intended for metals analysis for the analysis of a variety of botanical materials is discussed.

700,234
PB88-147194 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Complete Assignment of the (13)C NMR Spectra of the Ring Forms of Digitoxose by DEPT Spectrum Editing and Two-Dimensional CH Chemical Shift Correlation Spectroscopy.
Final rept.,
B. Coxon. 1986, 5p
Pub. in *Magnetic Resonance in Chemistry* 24, n11 p1008-1012 1986.

Keywords: *Spectrum analysis, *Proton spectra, Methyl sulfoxide, Editing, Nuclear magnetic resonance, Molecular structure, Chemical bonds, Reprints, *Digitoxose, *Pyranose, Two dimensional, DEPT system, Carbon 13.

The ¹³C chemical shifts of Beta-D-digitoxopyranose and its three isomeric ring forms in dimethylsulfoxide-d(-6) solution have been assigned completed by DEPT (¹³C NMR spectrum editing and two-dimensional CH chemical shift correlation spectroscopy). The (¹³C) chemical shifts are discussed in terms of their dependence on ring size and on anomeric configuration. The equilibrated mixture of four ring forms of D-digitoxose in dimethylsulfoxide-d(-6) solution has been analyzed quantitatively by (¹³C) NMR spectroscopy, and the results compared with those obtained previously by (1)H NMR.

700,235
PB88-147202 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Two-Dimensional DEPT CH J-Resolved (¹³C) NMR Spectrum Editing.
Final rept.,
B. Coxon. 1986, 10p
Pub. in *Jnl. of Magnetic Resonance* 66, n2 p230-239, 1 Feb 86.

Keywords: *Spectrum analysis, Data acquisition, Nuclear magnetic resonance, Editing, Automation, Data processing, Experimentation, Reprints, Computer software, Interactive systems, PASCAL programming language, Computer applications, Two dimensional, DEPT system.

An experimental method has been developed for editing 2D CH J-resolved (¹³C) NMR spectra obtained by the DEPT technique. The method involves the automated acquisition of three phase comparable 2D data matrices using disk interactive software with the proton polarization transfer pulses $\theta = \pi/6$, $\pi/2$, and $5\pi/6$ rad. Two software methods have been investigated for the automated construction of J-resolved sub-spectra from simple linear combinations of the data matrices. In a first approach, a sequence of microprograms has been used to combine the matrices by sequential handling of files. In a more efficient approach, a Pascal program was used to compute the CH₂ and CH₃ 2D sub-spectra within a single compound statement. The method has been tested by generation of CH, CH₂, and CH₃ 2D J-resolved sub-spectra from methyl 2,3-anhydro-4,6-O-benzylidene-alpha-D-mannopyranoside.

700,236
PB88-152715 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Surface Tension of Liquid Gallium.

Final rept.,
S. C. Hardy. 1985, 5p
Pub. in *Jnl. Cryst. Growth* 71, n3 p602-606 May/Jun 85.

Keywords: *Gallium, *Liquid metals, Interfacial tension, Auger spectroscopy, Reprints.

The surface tension of liquid gallium has been measured using the sessile drop technique in an Auger spectrometer. The samples were cleaned by Argon ion sputtering and were free of impurities to the sensitivity of Auger spectroscopy. The Surface tension of liquid gallium is found to decrease linearly with increasing temperature.

700,237
PB88-153697 PC A07/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
System of Hardware and Software Developed for Size Exclusion Chromatography.
B. Dickens, and F. L. McCrackin. Dec 87, 134p
NBSIR-87/3669

Keywords: *Chromatography, User manuals(Computer programs), Computer systems hardware, Data acquisition, Data processing, Quality control, Computer software, IBM PC/XT computers, BASIC programming language.

A series of computer programs to carry out data collection and processing for size exclusion chromatography has been written in BASIC for an IBM XT type computer. The manual documents version 1.0, which uses a single detector. The detector is assumed to measure the concentration of the eluting species. Some provision is provided for quality control by comparing a measured chromatograms with the standard chromatogram for its class immediately after the chromatogram has been measured. There is no limit on the number of classes allowed. The measured chromatogram is automatically processed in the same way as the standard chromatogram was processed.

700,238
PB88-154570 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Silicon Photodiode Detector for Fluorescence EXAFS (Extended X-ray Absorption Fine-Structure).
Final rept.,
C. E. Bouldin, R. A. Forman, and M. I. Bell. 1987, 4p
Pub. in *Review of Scientific Instruments* 58, n10 p1891-1894 Oct 87.

Keywords: *X ray fluorescence, *Photodiodes, Gas ionization, Comparison, Reprints, *X-ray detection.

A large-area silicon diode is used as a fluorescence detector for extended x-ray absorption fine-structure (EXAFS) measurements. A direct comparison of the diode detector relative to a gas ionization fluorescence detector is made. Advantages of the diode detector include: higher signal for a given photon flux (due to higher quantum efficiency), vacuum and cryogenic compatibility, freedom from microphonic noise, good linearity, extremely wide dynamic range, operation without high voltage or gas connections, very simple electronics, and low cost. A brief comparison with other detection methods for fluorescence EXAFS is given. Use of photodiodes for transmission EXAFS is discussed.

Basic & Synthetic Chemistry

700,239
PB87-149399 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Heterodyne Frequency Measurements on the 12(sup 0)0-00(sup 0)0 Band of OCS.
Final rept.,
A. G. Maki, J. S. Wells, and A. Hinz. 1986, 9p
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *International Jnl. of Infrared and Millimeter Waves* 7, n6 p909-917 1986.

Keywords: Reprints, *Carbonyl sulfides, Heterodyne frequency measurements.

Heterodyne frequency measurements have been made on the 12(sup 0)0-00(sup 0)0 band of carbonyl sulfide in the wavenumber range from 1866 to 1915/cm. Frequency measurement techniques reported earlier are used to measure the OCS absorption lines by means of a tunable diode laser, a CO laser local oscillator, and two CO₂ lasers used as secondary frequency standards. A table of calculated absorption frequencies is given for OCS from 1866 to 1919/cm.

700,240
PB87-149431 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Disproportionation-Recombination Rate Ratios for Hydroaromatic Radicals.
Final rept.,
M. J. Manka, and S. E. Stein. 1984, 6p
Pub. in *Jnl. of Physical Chemistry* 88, n24 p5914-5919 1984.

Keywords: *Chemical radicals, *Aromatic hydrocarbons, Chemical reactions, Disproportionation, Reprints, Rate constants.

Relative rates for radical disproportionation and recombination have been determined in the liquid phase at 150 deg C for a series of reactions involving resonance-stabilized hydroaromatic radicals. Self-reactions were studied for the 1-tetralyl, 1-indanyl, 9,10-dihydro-9-phenanthryl and 9,10-dihydro-9-anthryl radicals. Four cross-radical reactions involving benzyl, diphenylmethyl and 1-tetralyl radical as H-atom acceptors were also examined. Results suggest that when disproportionation reaction exothermicity is sufficiently small, -Delta H(sub d) approx < 50 kcal/mol (210 kJ/mol), disproportionation rate constants decrease with decreasing exothermicity.

700,241
PB87-149456 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
One-Electron Redox Reactions Involving Sulfite Ions and Aromatic Amines.
Final rept.,
P. Neta, and R. E. Huie. 1985, 5p
Pub. in *Jnl. of Physical Chemistry* 89, n9 p1783-1787 1985.

Keywords: *Chemical radicals, *Oxidation reduction reactions, *Amines, *Sulfites, Chemical reactions, Reprints, *Chemical reaction kinetics, Peroxysulfite radicals, Sulfite radicals.

The one-electron oxidation of aromatic amines by SO₄(-1) and of sulfite and bisulfite by aromatic amine radical cations have been investigated. p-Phenylenediamine and N,N,N',N'-tetramethyl-p-phenylenediamine were oxidized by SO₃(-1) with rate constants of 5.0 x 10 to the 7th and 5.2 x 10 to the 8th/M s, respectively, in basic solutions. Aniline radical cation also oxidized SO(-2) rapidly (k=4 x 10 to the 9th M s) and HSO₃(-1) less rapidly (k=4.8 x 10 to the 6th/M s). The aniline neutral radical reacted too slowly to measure with either. A secondary product was observed in acid solution of TMPD with an absorption maximum at 455 nm. This was ascribed to a reaction between the SO₃(-1) and TMPD(+1) radicals.

700,242
PB87-151296 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Mg-like Spectrum of Cu XVIII.
Final rept.,
J. Sugar, and V. Kaufman. Nov 86, 1p
Pub. in *Optical Society of America B* 3, p1612 Nov 86.

Keywords: *Atomic energy levels, *Copper, Atomic orbitals, Reprints.

The transition arrays 3p(2) - 3p3d and 3s3d-3p3d were analyzed, and the levels of the 3p3d configurations were derived. This is an extension of the analysis of Cu XVIII reported in a paper by Sugar and Kaufman (*J. Opt. Soc. Am. B* 3,701(1986)).

700,243
PB87-151668 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Basic & Synthetic Chemistry

Stable Hydrogen-Bonded Isomers of Covalent Ions. Association of Carbonium Ions with N-Donors.

Final rept.,
M. Mautner, M. M. Ross, and J. E. Campana. 1985, 7p
Pub. in Jnl. of the American Chemical Society 107, n17 p4839-4845 1985.

Keywords: Clustering, Chemical reactions, Entropy, Reprints, *Carbonium ions.

Association reactions of the oxocarbenium ions $\text{CH}_3\text{CH}^+(\text{OCH}_3)$ and $(\text{CH}_3)_2\text{C}^+(\text{OCH}_3)$ with H_2O and CH_3OH are exothermic by 11-13 kcal/mol. Although the association products could be covalently bonded protonated acetals or hemiacetals, e.g., $\text{CH}_3\text{CH}(\text{OH})\text{OCH}_3^+$, the entropy changes of the association reactions, -19 to -23 cal/mol K are substantially smaller than the -31 to -40 cal/mol K expected for covalent condensation. Therefore, reaction thermochemistry is more consistent with the formation of clusters which in these cases involves (sup sigma(+))...O-type unconventional ionic hydrogen bonds, in analogy with recently observed $\text{N}^+(\text{CH}_3)_4\cdots\text{OH}_2$ clusters. Entropy terms due to the loose structure of the cluster would favor clustering over condensation, even if condensation is more exothermic by 2-4 kcal/mol. Similar considerations may apply to the association of $\text{s-C}_3\text{H}_7^+(\text{H})$ and $\text{t-C}_4\text{H}_9^+(\text{H})$ with H_2O and HCN .

700,244
PB87-152856 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Spectral Intensities in the Fundamental Bands of HF and HCl.

Final rept.,
A. S. Pine, A. Fried, and J. W. Elkins. 1985, 16p
Pub. in Jnl. of Molecular Spectroscopy 109, n1 p30-45 1985.

Keywords: *Hydrogen chloride, *Hydrogen fluoride, *Molecular spectroscopy, Reprints, Tunable lasers.

The transition intensities of the fundamental bands of natural isotopic HF and HCl vapors have been measured with Doppler-limited resolution using a tunable difference-frequency laser spectrometer. Precise values for the band intensities, vibrational moments and Herman-Wallis F-factors have been obtained for $\text{H}(19)\text{F}$, $\text{H}(35)\text{Cl}$ and $\text{H}(37)\text{Cl}$.

700,245
PB87-152872 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
High-Resolution Infrared Spectra of the $\nu(\text{sub } 2)$ and $\nu(\text{sub } 3)$ Bands of HOCl.

Final rept.,
W. J. Lafferty, and W. B. Olson. 1986, 15p
Pub. in Jnl. of Molecular Spectroscopy 120, p359-373 1986.

Keywords: *Infrared spectra, *Oxygen chlorides, Molecular spectroscopy, Reprints.

The infrared spectra of the a-type transitions of the $\nu(\text{sub } 2)$ and $\nu(\text{sub } 3)$ bands of $\text{HO}(35)\text{Cl}$ and $\text{HO}(37)\text{Cl}$ have been obtained under high resolution. Line assignments of both bands have been made, and the spectroscopic constants have been obtained for both bands using a Watson Hamiltonian. Lines of the $\text{K}(\text{sub } a) = 5$ subband of the $\nu(\text{sub } 2)$ band of the $\text{HO}(35)\text{Cl}$ molecule were found to be slightly shifted by an interaction with the $\text{K}(\text{sub } a) = 4$ level of the $2\nu(\text{sub } 3)$ vibrational state. The b-type transitions permitted for both bands were too weak to observe. Relative intensities of selected lines of both bands have been measured, and empirical Herman-Wallis factors have been determined.

700,246
PB87-167227 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Single Pulse Shock Tube Study on the Thermal Stability of Ketones.

Final rept.,
W. Tsang. 1984, 14p
Pub. in International Jnl. of Chemical Kinetics 16, n12 p1543-1556 1984.

Keywords: *Ketones, Decomposition, Reprints, *Chemical reaction kinetics.

5-Methyl-hexanone-2, 3-methyl-pentanone-2 and hexanone-2 have been decomposed in comparative rate single pulse shock tube experiments. The mechanism of decomposition involves the breaking of carbon-carbon bonds as well as molecular processes involving 6-center complexes. The obtained results lead to $\Delta H(\text{sub } f)(\text{CH}_3\text{CO}) = -13.8$ kJ and $\Delta H(\text{sub } f)(\text{CH}_3\text{COCH}_2) = -12.6$ kJ at 300 K. They are compared with existing literature values and some generalizations are made with regard to the stability of carbonyl compounds.

700,247
PB87-167235 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Stability of Alkyl Radicals.

Final rept.,
W. Tsang. 1985, 9p
Pub. in Jnl. of the American Chemical Society 107, n10 p2872-2880 1985.

Keywords: *Chemical radicals, *Stability, Decomposition, Heats of formation, Reprints, *Alkyl radicals.

All the data on the decomposition of simple alkyl radicals have been reviewed. Together with results on the reverse addition reactions, alkyl radical combination rates and the entropies of the alkyl radicals are given. These values are fully consistent with determinations based on the decomposition of aliphatic compounds and combination of radicals. They lead to $D(\text{nC}_3\text{H}_7\text{-H}) = 422.5$ kJ, $D(\text{iC}_3\text{H}_7\text{-H}) = 415.3$ kJ, $D(\text{sC}_4\text{H}_9\text{-H}) = 414.2$ kJ, $D(\text{tC}_4\text{H}_9\text{-H}) = 404.6$ (zero barrier) and $D(\text{tC}_5\text{H}_{11}\text{-H}) = 402.5$ kJ. These numbers are all significantly higher than generally used values recommended in a recent review. It appears that previous rejection of measured alkyl radical decomposition rates is due to an uncritical acceptance of the earlier bond energies.

700,248
PB87-224135 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Synthesis of 2-Amino-1,5-Dihydro-1-(Methyl-(13)C)-4H-Imidazol-4-One-5-(13)C (Creatinine-(13)C2).

Final rept.,
A. Cohen, H. S. Hertz, R. Schaffer, M. J. Welch, and E. White. 1986, 11p
Sponsored by Food and Drug Administration, Rockville, MD.

Pub. in Jnl. of Labelled Compounds and Radiopharmaceuticals 24, n5 p587-597 1986.

Keywords: *Synthesis(Chemistry), *Carbon 13, *Creatinine, Spectrometry, Reprints, Sarcosine, Glycine.

2-Amino-1,5-dihydro-1-(methyl- ^{13}C)-4H-imidazol-4-one-5- ^{13}C (creatinine- $^{13}\text{C}_2$) (8) is synthesized as follows. Glycine-2- ^{13}C (1) is tosylated; the product (2) is treated with iodomethane- ^{13}C ; and the resultant doubly-labeled product (3) is desotylated to yield sarcosine- $^{13}\text{C}_2$ (4). Creatinine- $^{13}\text{C}_2$ (7) is obtained by treating 4 with 2-methylisothiourea monohydride (5) or cyanamide (6). Dehydration of 7 under vacuum sublimation conditions gives 8.

700,249
PB87-224176 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Chemistry of Molecular Growth Processes in Flames.

Final rept.,
K. C. Smyth, and J. H. Miller. 1987, 7p
Pub. in Science 236, p1540-1546, 19 Jun 87.

Keywords: *Methane, Models, Production rates, Temperature, Velocity, *Diffusion flames, Production rates.

Chemical mechanisms of pyrolysis, growth, and oxidation processes in flames have traditionally been inferred from spatial profile measurements of species concentrations. Experimental investigations now include the detection of numerous minor species such as reactive radicals and intermediate hydrocarbons. In assessing a proposed mechanism important new constraints can be established when the detailed species profile data are combined with velocity and temperature measurements and analyzed to determine production and destruction rates for specific molecules. Recent results on hydrocarbon diffusion flames provide new information on the interplay between chemical and transport processes. These measurements

have led to direct tests of proposed routes for the formation of aromatic hydrocarbons and the first, small soot particles.

700,250
PB87-224234 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Unconventional Ionic Hydrogen Bonds. 1. $\text{CH}_2\text{delta}^+ \cdots \text{X}$. Complexes of Quarternary Ions with n- and pi-Donors.

Final rept.,
M. Mautner, and C. A. Deakyne. 1985, 6p
See also PB87-224242.
Pub. in Jnl. of the American Chemical Society 107, n2 p469-474 1985.

Keywords: *Hydrogen bonds, Reprints, *Quaternary ions, Onium ions.

CH sigma- X interaction energies are obtained from the clustering of quaternary onium ions with n-donor solvent molecules. The dissociation energies (delta degrees of Me_4N^+ clustered with the n-donors H_2O , MeOH , MeNH_2 , and Me_3N and with the pi donors benzene and toluene range between 8 and 10 kcal/mol. With the weak, bulky n-donor MeCl the interaction is weaker (6.5 kcal/mol) while the more popular ligands Me and MeCONMe_2 attach strongly (14.6 and 18.0 kcal/mol, respectively) to Me_4N^+ . Strong interactions, 20-23 kcal/mol, are also smaller by 2 kcal/mol than those to Me_4N^+ . Ab initio calculations show that in the $\text{Me}_4\text{N}_2\text{O}$, MeOH , MeNH_2 , and MeCl complexes the ligands attach electrostatically to a cavity created by protons of three CH_3 groups rather than hydrogen bonding to one proton or to one CH_3 group. Both experiment and theory indicate that a second solvent molecule (H_2O or CH_3OH) attaches preferentially to the first solvent molecule rather than to Me_4N^+ .

700,251
PB87-224242 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Unconventional Ionic Hydrogen Bonds. 2. $\text{NH}^+ \cdots \text{pl}$. Complexes of Onium Ions with Olefins and Benzene Derivatives.

Final rept.,
C. A. Deakyne, and M. Mautner. 1985, 6p
See also PB87-224234.
Pub. in Jnl. of the American Chemical Society 107, n2 p474-479 1985.

Keywords: *Hydrogen bonds, Reprints, *Olefins, *Benzene, *Onium ions.

Unconventional strong ionic hydrogen bonds of the $\text{-XH}^+ \cdots \text{pi}$ type, where the electron donor is a pi bond or an aromatic pi-system, are formed in the clustering reactions of NH_4^+ and MeNH_3^+ with C_2H_4 and benzene derivatives. The interaction energies range from 10 to 22 kcal/mol. The experimental results and ab initio calculations on $\text{C}_2\text{H}_4\text{NH}_4^+$, $\text{C}_6\text{H}_6\text{NH}_4^+$, and $\text{C}_6\text{H}_5\text{FNH}_4^+$ indicate that the interaction is primarily electrostatic in nature with little pi-donation into the bond. The most stable structure of $\text{C}_2\text{H}_4\text{NH}_4^+$ is the conformer where one N-H^+ bond points at the center of the double bond. For $\text{C}_6\text{H}_6\text{NH}_4^+$ and $\text{C}_6\text{H}_5\text{FNH}_4^+$, the lowest energy pi-dimers have two NH_4^+ hydrogens directed toward the ring. The F-H-NH_3^+ sigma-complex was studied also for $\text{C}_6\text{H}_5\text{FNH}_4^+$. The latter complex is the more stable of the two at this level of calculation.

700,252
PB87-231536 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Break-Junction Tunneling Measurements of the High-Tc Superconductor $\text{YBa}_2\text{Cu}_3\text{O}_{9-\delta}$.

Final rept.,
J. Moreland, J. W. Ekin, L. F. Goodrich, T. E. Capobianco, A. F. Clark, J. Kwo, M. Hong, and S. H. Liou. 1987, 2p
Contracts DE-AI01-84ER52113, N00014-86-F-0109
Sponsored by Department of Energy, Washington, DC., and Office of Naval Research, Arlington, VA.
Pub. in Physical Review B 35, n16 p8856-8857, 1 Jun 87.

Keywords: *Superconductors, Reprints, *Break junctions, Energy gap, Tunneling spectroscopy, Vacuum tunneling.

Current-voltage tunneling characteristics in a high-critical-temperature superconducting material containing predominately $\text{Y1Ba2Cu3O}_{9-\delta}$ have been measured using the break-junction technique. Sharp gap structure was observed, with the largest superconductive energy gap measured to be $\delta = 19.5$ plus or minus 1 meV, assuming a superconductor-insulator-superconductor junction. The energy gap corresponds to $2\delta/k_B T_c = 4.8$ at $T = 4$ K, for a critical temperature of 93 K (midpoint of the resistive transition).

700,253

PB87-232005

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Precipitation Diagrams and Solubility of Uric Acid Dihydrate.

Final rept., V. Babic-Ivancic, H. Furedi-Milhofer, W. E. Brown, and T. M. Gregory. 1987, 7p

Sponsored by American Dental Association, Chicago, IL.

Pub. in Jnl. of Crystal Growth 83, p581-587 1987.

Keywords: *Uric acid, Reprints, *Phase diagram, *Precipitation diagram, Renal fluids, *Solubility.

The solubility of uric acid dihydrate ($\text{UA} \cdot 2\text{H}_2\text{O}$) and the precipitation of $\text{UA} \cdot 2\text{H}_2\text{O}$ and anhydrous uric acid (UA) from solutions containing sodium hydroxide and hydrochloric acid have been investigated. For the solubility studies, crystals of pure $\text{UA} \cdot 2\text{H}_2\text{O}$ were prepared and equilibrated with water and with solutions of HCl or NaOH for 60 min or 20 h, respectively. The equilibrium pH (pH = 2-6.25) and uric acid concentration were determined. For the precipitation experiments, commercial UA was dissolved in NaOH in a 1:1.1 molar ratio and $\text{UA} \cdot 2\text{H}_2\text{O}$ and/or UA were precipitated with hydrochloric acid. The precipitates and/or supernatants were examined 24 h after sample preparation. The results are represented in the form of tables, precipitation diagrams and 'chemical potential' diagrams. Solubility measurements with 60 min equilibration times yielded the solubility products of $\text{UA} \cdot 2\text{H}_2\text{O}$ $K(\text{sp})$ (298 K) = (0.926 plus or minus 0.025) times 10 to the minus 9th power sq. mol. minus 6 dm. and $K(\text{sp})$ (310 K) = (2.25 plus or minus 0.05) times 10 to the minus 9th power sq. mol. minus 6 dm. and the first dissociation constants of uric acid, K_1 (298 K) = (2.45 plus or minus 0.07) times 10 to the minus 6th power mol. minus 3 dm. and K_1 (310 K) = (3.63 plus or minus 0.08) times 10 to the minus 6th power mol. minus 3 dm. Precipitation diagrams show that under the given experimental conditions, at 298 K, $\text{UA} \cdot 2\text{H}_2\text{O}$ is stable for 24 h while at 310 K this was true only for precipitates formed from solutions of high supersaturations. At lower supersaturations, mixtures of $\text{UA} \cdot 2\text{H}_2\text{O}$ and UA formed. Consequently, while the $K(\text{sp})$ value determined from precipitation data obtained at 298 K ($K(\text{sp}) = 1.04$ times 10 to the minus 9th power sq. mol. minus 6 dm.) was consistent with the respective solubility product, the 310 K precipitation boundary yielded an ion activity product, AP, the value of which fulfills the conditions $K(\text{sp})(\text{UA}) < \text{AP} < K(\text{sp})(\text{UA} \cdot 2\text{H}_2\text{O})$. Similar ion activity products were obtained from solubility measurements in pure water at 20 h equilibration time.

700,254

PB87-233698

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Classical Permanganate Ion: Still a Novel Oxidant in Organic Chemistry.

Final rept., A. J. Fatiadi. 1987, 43p

Pub. in Synthesis, n2 p85-127 1987.

Keywords: *Oxidation, *Synthesis (Chemistry), Reagents, Reprints, *Permanganate ions.

Recent synthetic applications of permanganate to organic chemistry are reviewed. The usefulness of the reagent as a classical oxidant and as a new reagent, being transferred into an organic phase or incorporated on to solid supports, or being applied as an organic salt are surveyed. Recent views on the mechanism of the permanganate oxidation of organic compounds are also discussed.

700,255

PB87-233946

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Gas and Surface Processes Leading to Hydrogenated Amorphous Silicon Films.

Final rept.,

A. Gallagher, and J. Scott. 1987, 6p

Sponsored by Solar Energy Research Inst., Golden, CO.

Pub. in Solar Cells 21, p147-152 1987.

Keywords: *Semiconducting films, Surfaces, Silanes, Hydrogen, Reprints, *Amorphous silicon, Silicon solar cells, Hydrogenation.

A qualitative model is given for gas and surface reactions in silane discharges, leading to a a-Si:H films and gas constituents. Several experiments are described.

700,256

PB88-100672

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Analysis of Dielectric Strength Data for Binary Electronegative Gas Mixtures.

Final rept.,

T. Aschwanden, R. J. Van Brunt, and M. E. Bieber. 1987, 2p

Sponsored by Department of Energy, Washington, DC. Pub. in Proceedings of International Conference on Phenomena in Ionized Gases (18th), Swansea, United Kingdom, July 13-17, 1987, p102-103.

Keywords: *Argon, *Carbon dioxide, Critical field, Dielectric strength, Gas mixtures, Helium, Neon, Hexafluoride/sulfur.

The consistency among dielectric strength, electron swarm, and collision cross section data for ionization, attachment, and momentum transfer have been determined for the binary gas mixtures SF_6/He , SF_6/Ne , SF_6/Ar , and SF_6/CO_2 using a theoretical approach recently developed by Van Brunt. Dielectric strength data for SF_6/Ar and SF_6/CO_2 measured by Aschwanden can be accurately described by the model calculation and exhibit a high degree of consistency with swarm and cross section data. The model also appears to successfully describe preliminary electrical breakdown data for SF_6/Ne mixtures. The theoretical model fails for SF_6/He because it does not allow for the important effect of Penning ionization which is possible in this case.

700,257

PB88-100698

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Transfer of F(1-) in Collisions of $\text{SF}_6(1-)$ with Fluorinated Gases and SO_2 at Thermal Energies.

Final rept.,

L. W. Sieck, and R. J. Van Brunt. 1987, 1p

Sponsored by Department of Energy, Washington, DC. Pub. in Proceedings of the International Conference on the Physics of Electronic and Atomic Collisions (15), Brighton, United Kingdom, July 22-28, 1987, p710.

Keywords: *Collisions, *Corona discharge, Reaction rates, Temperature dependence.

Measured temperature dependencies of F transfer rates for collisions of SF_6 with SOF_2 , SO_2F_2 , SOF_4 , SO_2 , SF_4 , and SIF_4 are reported. The results are used to interpret the complex anionic chemistry that occurs during electrical discharges to SF_6 .

700,258

PB88-109079

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Structural Model for Octacalcium Phosphate-Succinate Double Salt.

Final rept.,

M. Mathew, and W. E. Brown. 1987, 3p

Grant PHS-DE-05030

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

Pub. in Bulletin of the Chemical Society of Japan 60, p1141-1143 1987.

Keywords: *Crystal structure, *Calcium phosphates, Succinates, Reprints, *Octacalcium phosphate, *Octacalcium phosphate-succinate salt, *Phosphate-succinate salt.

A new structural model for octacalcium hydrogenpentakis(phosphate) succinate pentahydrate, $\text{Ca}_8\text{H}(\text{PO}_4)_5(\text{C}_2\text{H}_4(\text{COO})_2)_2 \cdot 5\text{H}_2\text{O}$, a reaction product of octacalcium dihydrogenhexakis(phosphate)

pentahydrate, $\text{Ca}_8\text{H}_2(\text{PO}_4)_5\text{H}_2\text{O}$, OCP, and succinate ions, is proposed on the basis of similarities in the unit cell dimensions and structures of OCP and calcium succinate trihydrate. The model can be used to develop information on the mode of incorporation of dicarboxylate ions into OCP and hydroxyapatite and its possible effects on biological mineralization processes.

700,259

PB88-112529

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Thermochemical Data on Gas Phase Compounds of Sulfur, Fluorine, Oxygen, and Hydrogen Related to Pyrolysis and Oxidation of Sulfur Hexafluoride,

J. T. Herron. c1987, 6p

Included in Jnl. of Physical and Chemical Reference Data, v16 n1 p1-6 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Fluorine, *Hydrogen, *Thermochemistry, Oxygen, Sulfur, Sulfur hexafluoride, Data, Evaluation.

Thermochemical data on selected gas phase compounds containing sulfur, fluorine, oxygen, and hydrogen are evaluated. These are of particular relevance to plasma chemistry and SE6 dielectric breakdown. Values of the enthalpies of formation and the entropy are provided at 298 K. Where no experimental data are available, methods for estimation have been developed for deriving the enthalpy of formation. Data are tabulated for 36 substances.

700,260

PB88-112537

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Chemical Physics.

Thermochemical Measurements on Rubidium Compounds: A Comparison of Measured Values with Those Predicted from the NBS (National Bureau of Standards) Tables of Chemical and Thermodynamic Properties.

V. B. Parker, W. H. Evans, and R. L. Nuttall. c1987, 53p

Included in Jnl. of Physical and Chemical Reference Data, v16 n1 p7-59 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Data evaluation, *Documentation, Thermochemical measurements, Rubidium compounds, Reaction catalog, *Enthalpy, Entropy, *Gibbs energy.

The report presents the assessed thermochemical measurements on rubidium compounds upon which the property values, $\Delta_f H$, $\Delta_f G$, S , C_p , and $H(T) - H(0)$ at 298.15 K and $\Delta_f H(0)$ K recommended in the 'NBS Tables of Chemical Thermodynamic Properties' are based. Included in this set of thermochemical measurements, or thermochemical reaction catalog, is a comparison of the observed values for the processes in question with those predicted (calculated) from the recommended property values in the mentioned tables. The evaluator's initially assigned uncertainties on the experimental measurements and final estimated reliabilities on the recommended process values are given. The paper illustrates the evaluation procedure used in preparing the full set of recommended data in the 'NBS Tables of Chemical Thermodynamic Properties'.

700,261

PB88-112545

Not available NTIS

Hebrew Univ. of Jerusalem (Israel). Dept. of Inorganic and Analytical Chemistry.

Standard Thermodynamic Functions of Gaseous Polyatomic Ions at 100-1000 K.

A. Loewenschuss, and Y. Marcus. c1987, 29p

Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n1 p61-89 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: Heat capacity, Polyatomic ions, Thermodynamic functions, *Enthalpy, *Entropy, *Gibbs energy.

The standard thermodynamic functions—heat capacity at constant pressure C_p , its ratio to that at constant volume, the entropy S , the enthalpy minus that at absolute zero $(H - H(0))/T$ were calculated for 131 gaseous ions in the temperature interval 100-1000 K, and

Basic & Synthetic Chemistry

are presented in tables. The input data included structural information (bond lengths and angles), vibrational spectroscopic information (vibrational frequencies and degeneracies), and electronic level occupation and degeneracies for ions having unpaired electrons. These were taken mainly from a recent review by the authors, and supplemented by further data from the literature, updated to the end of 1985.

700,262

PB88-112552

Not available NTIS

Center for Information and Numerical Data Analysis and Synthesis, Lafayette, IN.

Thermodynamic Properties of Manganese and Molybdenum,

P. D. Desai. c1987, 18p

Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n1 p91-108 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Thermodynamic properties, *Manganese, *Molybdenum, Fusion, Vaporization, Heat capacity, *Critical evaluation, *Data analysis, Enthalpy, Gibbs energy function.

The work reviews and discusses the data on the various thermodynamic properties of manganese and molybdenum available through March 1985. These include heat capacity, enthalpy, enthalpy of transitions and melting, vapor pressure, and enthalpy of vaporization. The existing data have been critically evaluated and analyzed. The recommended values for the heat capacity, enthalpy, entropy, and Gibbs energy function from 0.5 to 2400 K for manganese and from 0.4 to 5000 K for molybdenum have been generated, as have heat capacity values for supercooled beta-Mn and for gamma-Mn below 298.15 K. The recommended values for vapor pressure cover the temperature range from 298.15 to 2400 K for manganese and from 298.15 to 5000 K for molybdenum. These values are referred to temperatures based on IPTS-1968. The uncertainties in the recommended values of the heat capacity range from + or - 3% to + or - 5% for manganese and from + or - 1.5% to + or - 3% for molybdenum.

700,263

PB88-112560

Not available NTIS

Center for Information and Numerical Data Analysis and Synthesis, Lafayette, IN.

Thermodynamic Properties of Selected Binary Aluminum Alloy Systems,

P. D. Desai. c1987, 16p

Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n1 p109-124 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Thermodynamic properties, *Aluminum alloys, Activity coefficient, Enthalpy, Entropy, Gibbs energy, Heat capacity, Phase diagram.

This work reviews the data and information available through March 1985 on the various thermodynamic properties of five binary aluminum alloy systems: Al-Fe, Al-Mn, Al-Ni, Al-Si, and Al-Ti. The thermodynamic properties covered in this work are heat capacity, Gibbs energy, enthalpy, and entropy of formation. Existing data have been evaluated and analyzed. The values for heat capacity and room-temperature enthalpy of formation for a large number of alloys have been generated. For each of the binary alloy systems, the recommended values for integral Gibbs energy, enthalpy, and entropy of formation as well as the partial quantities, activity coefficients for each component covering the entire composition range have been reported. These values are reported for both solid and liquid alloys.

700,264

PB88-112578

Not available NTIS

A. T. and T. Bell Labs., Murray Hill, NJ.

13C Chemical Shieldings in Solids,

T. M. Duncan. c1987, 27p

Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n1 p125-151 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Chemical shielding, *Chemical shift anisotropy, Critical review, Nuclear magnetic resonance, Solid state.

Analogous to the importance of ¹³C isotropic shieldings for chemical analysis of liquids with nuclear magnetic resonance spectroscopy, ¹³C chemical shielding anisotropies are proving to be valuable in the characterization of solids. Specifically, molecular geometry is revealed by the full shielding anisotropy and molecular motion may be characterized by changes in the powder pattern. In particular, the principal components of the shielding reveal differences in bonding geometry which may not be correlated to monotonic changes in the isotropic shift. The report is a comprehensive, critical compilation of ¹³C chemical shieldings in solids, organized by carbon functionality. From these data, representative shieldings of common carbon functionalities are calculated.

700,265

PB88-112586

Not available NTIS

American Chemical Society, Washington, DC.

Journal of Physical and Chemical Reference Data,

Volume 16, Number 2, 1987.

Quarterly rept.

c1987, 392p

See also PB88-112594 through PB88-112677, and PB88-112511. Prepared in cooperation with American Inst. of Physics, New York. Sponsored by National Bureau of Standards, Gaithersburg, MD.

Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Research projects, *Chemical industry, Viscosity, Thermodynamic properties, *Foreign technology, Binary excess, Enthalpy, Absorption spectra, Chemical kinetics.

Contents: The Mark-Houwink-Sakurada relation for poly(methyl methacrylate); The viscosity of carbon dioxide, methane, and sulfur hexafluoride in the limit of zero density; The viscosity of normal deuterium in the limit of zero density; Standard chemical thermodynamic properties of alkanethiol isomer groups; Evaluation of binary excess volume data for the methanol+hydrocarbon systems; Evaluation of binary excess enthalpy data for the methanol+hydrocarbon system; Extinction coefficients of triplet-triplet absorption spectra of organic molecules in condensed phases: A least-squares analysis; Evaluated chemical kinetic data for the reactions of atomic oxygen O(3P) with unsaturated hydrocarbons; Spectral data for molybdenum ions, Mo VI-Mo XLII.

700,266

PB88-112594

Not available NTIS

National Bureau of Standards, Gaithersburg, MD.

Mark-Houwink-Sakurada Relation for Poly(Methyl Methacrylate),

H. L. Wagner. c1987, 9p

Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p165-173 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Benzene, Molecular weight, Toluene, Viscosity, *Butanone, *Chloroform, Mark-Houwink, Methyl ethyl ketone, Furan/tetrahydro.

In this third review of a series, the literature values for the viscosity-molecular weight relationship (Mark-Houwink-Sakurada) for poly(methyl methacrylate) have been critically evaluated. Although most of the studies have been concerned with conventionally produced poly(methyl methacrylate), some work has also been done with the isotactic polymer. The Mark-Houwink relations for the following solvents are discussed: benzene, toluene, acetone, chloroform, 2-butanone, and tetrahydrofuran, as well as for several other infrequently used solvents. The values of the coefficient K in the relation $(\eta) = K(M^{0.5})$ for several theta solvents are also reported.

700,267

PB88-112602

Not available NTIS

Imperial Coll. of Science and Technology, London (England). Dept. of Chemical Engineering and Chemical Technology.

Viscosity of Carbon Dioxide, Methane, and Sulfur Hexafluoride in the Limit of Zero Density,

R. D. Trengove, and W. A. Wakeham. c1987, 13p

Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p175-187 1987. Available from American

Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Carbon dioxide, *Methane, *Sulfur hexafluoride, Transport properties, Viscosity, Gases, *Corresponding states.

The paper contains accurate representations for the viscosity of the three polyatomic gases, carbon dioxide, methane, and sulfur hexafluoride, in the limit of zero density. These gases were studied because they possess permanent multipole moments of increasing order 4, 6, and 8, respectively. The correlations have associated uncertainties of + or - 0.3% around room temperature rising to + or - 1.5% at the low-temperature extreme and to a maximum of + or - 2.0% at the high-temperature extreme. The correlating equation for carbon dioxide is valid for the temperature range 200-1500 K, that for methane from 110-1050 K and that for sulfur hexafluoride from 220-900 K. It is shown that a two-parameter law of corresponding states is inadequate for the representation of the data over these wide ranges of temperature.

700,268

PB88-112610

Not available NTIS

Thessaloniki Univ., Salonika (Greece). Dept. of Chemical Engineering.

Viscosity of Normal Deuterium in the Limit of Zero Density,

M. J. Assael, S. Mixafendi, and W. A. Wakeham.

c1987, 4p

Prepared in cooperation with Imperial Coll. of Science and Technology, London (England). Dept. of Chemical Engineering and Chemical Technology. Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p189-192 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Correlation, *Deuterium, *Viscosity.

The paper contains a new representation of the viscosity of normal deuterium in the limit of zero density as a function of temperature. The correlation is based upon the semiclassical kinetic theory of polyatomic gases and a body of critically evaluated experimental data. The similarity of the intermolecular pair potentials of normal hydrogen and normal deuterium is employed to extrapolate the correlation for deuterium beyond the range of the experimental data. In the temperature range 250-350 K the accuracy of the representation of the viscosity is estimated to be + or - 1%, which deteriorates to + or - 2% at the lowest temperatures and to + or - 4% at the highest temperatures.

700,269

PB88-112628

Not available NTIS

Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

Standard Chemical Thermodynamic Properties of Alkanethiol Isomer Groups,

R. A. Alberty, E. Burmenko, T. H. Kang, and M. B.

Chung. c1987, 16p

Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p193-208 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Thermodynamic properties, Heat capacity, *Alkanethiols, Benson method, Enthalpy, Entropy, Gibbs energy.

The chemical thermodynamic properties of alkanethiol (RSH where R is an alkyl group) isomer groups from CH₄S to C₄H₁₀S in the ideal gas phase have been calculated from 298.15 to 1000 K from tables of Stull, Westrum, and Sinke. In the absence of literature data on all isomers of higher isomer groups, the properties of isomers of C₅H₁₂S to C₈H₁₈S have been estimated using Benson group values. Equilibrium mole fractions within isomer groups have been calculated for the ideal gas state from 298.15 to 1000 K. For isomer group properties, increments per carbon atom have been calculated to show the extent to which thermodynamic properties of higher isomer groups may be obtained by linear extrapolation. Values of C(P), S, delta(H), and delta(F)G are given for all species of alkanethiols from CH₄S to C₈H₁₈S in SI units for a standard state pressure of 1 bar.

700,270
PB88-112636 Not available NTIS
 Washington Univ., St. Louis, MO. Thermodynamics
 Research Lab.

Evaluation of Binary Excess Volume Data for the Methanol + Hydrocarbon Systems,
 R. Srivastava, and B. D. Smith. c1987, 10p
 Sponsored by National Bureau of Standards, Gaithersburg, MD.
 Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p209-218 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Hydrocarbons, *Methanol, Mixing, *Excess volume.

The volume change of mixing data for the methanol + hydrocarbon binary mixtures have been compiled and the best sets of data identified. The needs for a new experimental data have been defined.

700,271
PB88-112644 Not available NTIS
 Washington Univ., St. Louis, MO. Thermodynamics
 Research Lab.

Evaluation of Binary Excess Enthalpy Data for the Methanol + Hydrocarbon Systems,
 R. Srivastava, and B. D. Smith. c1987, 19p
 Sponsored by National Bureau of Standards, Gaithersburg, MD.
 Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p219-237 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Hydrocarbons, *Methanol, *Enthalpy, *Mixing heat.

The heat of mixing data for the methanol + hydrocarbon binary mixtures have been compiled and the best sets of data identified. The needs for new experimental data have been identified.

700,272
PB88-112651 Not available NTIS
 Notre Dame Univ., IN. Radiation Chemistry Data Center.

Extinction Coefficients of Triplet-Triplet Absorption Spectra of Organic Molecules in Condensed Phases: A Least-Squares Analysis,
 I. Carmichael, W. P. Helman, and G. L. Hug. c1987, 22p
 Sponsored by National Bureau of Standards, Gaithersburg, MD.
 Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p239-260 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Condensed phase, *Data compilation, *Extinction coefficients, Least squares method, Solution.

A global least-squares technique is developed to assist in the critical evaluation of data consisting of large sets of measurements. The technique is particularly designed to handle sets of data where many of the measurements are relative measurements. A linearization procedure is used to reduce the inherently nonlinear problem to a traditional multivariate linear regression. The technique developed here is used to evaluate extinction coefficients, ϵ 's, of triplet-triplet absorption (TTA) spectra of organic molecules in condensed phases. A previous assumption, that there are no solvent effects on the TTA spectra, is investigated and modified so that a group of compounds measured in benzene is treated separately. The set of 445 ϵ 's obtained from the global least-squares fit, including these solvent effects, is presented in the accompanying tables. How these least-squares results can be used in a hierarchy of TTA ϵ standards is discussed. Further solvent effects such as the separation of polar and nonpolar media and the influence of temperature are probed.

700,273
PB88-112669 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Evaluated Chemical Kinetic Data for the Reactions of Atomic Oxygen O(3P) with Unsaturated Hydrocarbons,
 R. J. Cvetanovic. c1987, 76p
 Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p261-326 1987. Available from American

Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Chemical kinetics, Alkenes, Alkynes, Aromatic hydrocarbons, Arrhenius parameters, *Atomic oxygen.

Chemical kinetic data for reactions of O(3P) atoms with unsaturated hydrocarbons are compiled and critically evaluated. Specifically, the reactions considered include the interactions of the ground electronic state of oxygen atoms, O(3P), with alkenes, cycloalkenes, halogen substituted alkenes and ketenes, alkynes, halogen substituted alkynes, aromatic hydrocarbons, halogen substituted aromatic hydrocarbons and pyridine. All kinetic data considered were restricted to gas phase reactions. 'Recommended' values of the rate parameters have been assessed and conservative uncertainty limits assigned to them.

700,274
PB88-112701 Not available NTIS
 SRI International, Menlo Park, CA.

High-Temperature Vaporization Behavior of Oxides II. Oxides of Be, Mg, Ca, Sr, Ba, B, Al, Ga, In, Ti, Si, Ge, Sn, Pb, Zn, Cd, and Hg,
 R. H. Lamoreaux, D. L. Hildenbrand, and L. Brewer. c1987, 25p
 Prepared in cooperation with California Univ., Berkeley, Dept. of Chemistry. Sponsored by National Bureau of Standards, Gaithersburg, MD.
 Included in Jnl. of Physical and Chemical Reference Data, v16 n3 p419-443 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Vaporization, High temperature, Oxide, *Enthalpy increment, Entropy, Gibbs energy function.

In order to assess the high-temperature vaporization behavior and equilibrium gas phase compositions over the condensed oxides of Be, Mg, Ca, Sr, Ba, B, Al, Ga, In, Ti, Si, Ge, Sn, Pb, Zn, Cd, and Hg, the relevant thermodynamic and molecular constant data have been compiled and critically evaluated. Selected values of the Gibbs energy 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 equilibrium partial pressures of vapor species as functions of temperature for representative environmental conditions ranging from reducing to oxidizing. The calculated partial pressures and compositions agree, for the most part, with experimental results obtained under comparable conditions. Maximum vaporization rates have been calculated using the Hertz-Knudsen equation. Literature references are given.

700,275
PB88-112719 Not available NTIS
 Brown Univ., Providence, RI. Div. of Engineering.

Equilibrium and Transport Properties of Eleven Polyatomic Gases at Low Density,
 A. Boushehri, J. Bzowski, J. Kestin, and E. A. Mason. c1987, 22p
 Sponsored by National Bureau of Standards, Gaithersburg, MD.
 Included in Jnl. of Physical and Chemical Reference Data, v16 n3 p445-466 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: Equilibrium properties, Transport properties, *Corresponding states, *Isotopic thermal diffusion, *Polyatomic gases.

The study presents a computer programmable, thermodynamically consistent representation of the second virial coefficient B, viscosity η , self-diffusion coefficient D, and isotopic thermal diffusion factor α of the eleven gases: N₂, O₂, NO, CO, N₂O, CO₂, CH₄, CF₄, SF₆, C₂H₄, and C₂H₆, all at low density. Limited thermodynamic consistency is achieved by the use of four scaling parameters (σ , ϵ , V_0 , p) in addition to the molecular weight. In terms of these parameters, the collision integrals for the transport properties obey a single law of corresponding states. Furthermore, $\omega(2,2)$ (T) is the same as that for the universal correlation of the monatomic gases (J. Phys. Chem. Ref. Data 13, 229 (1984)), whereas $\omega(1,1)$ (T) is only slightly modified. The same parameters nearly correlate the spherical part $B_0(T) = B(T) - B_{ns}(T)$ of the second virial coefficient corrected for the most important nonspherical influences; its dimensionless form $B_0(T)$ differs from that for the monatomic gases

and also, somewhat, for each of the eleven gases, except that one form suffices for N₂, O₂, NO, CO. The correlations embrace the reduced temperature range $1 < T < 10$ with the parameters σ and ϵ , and the range $T > 10$ with the parameters V_0 and p derived from high-energy beam experiments. The accuracy achieved is carefully specified, and the correlation can be used in a predictive mode.

700,276
PB88-112727 Not available NTIS
 University of Southern California, Los Angeles. Loker Hydrocarbon Research Inst.

Thermochemistry of Inorganic Solids. 4. Enthalpies of Formation of Compounds of the Formula MX(a)Y(b),
 M. W. M. Hisham, and S. W. Benson. c1987, 4p
 Sponsored by National Bureau of Standards, Gaithersburg, MD.
 Included in Jnl. of Physical and Chemical Reference Data, v16 n3 p467-470 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: Metals, Maximum deviation, Relation, *Additivity, *Average deviation, *Binary salts, Double salts.

It is found that the standard enthalpies of formation $\Delta_f H^\circ_{298}$ of double salts of the type MX_aY_b are related by a simple additivity relation to $\Delta_f H^\circ_{298}$ of their binary salts MX_c and MY_d . For divalent metals M this relation takes the form, $\Delta_f H^\circ_{298}(MX_aY_b) = 1/2 \Delta_f H^\circ_{298}(MX_2) + 1/2 \Delta_f H^\circ_{298}(MY_2) + C$, with $C = -13.4$ or -17.6 kJ/mol giving equally good fits to the data. From a lesser number of data for trivalent and tetravalent metals M, one finds again a simple additivity relation of the form $\Delta_f H^\circ_{298}(MX_aY_b) = (ax/z)\Delta_f H^\circ_{298}(MX_z/x) + (by/z)\Delta_f H^\circ_{298}(MY_z/y) + C$, where x, y , and z are the formal valences of X, Y, and M, respectively, so that $z = ax + by$, and $C = 0$. For 16 divalent metal compounds average deviations are 5.5 kJ/mol with a maximum deviation of 10.7 kJ/mol. For five tetravalent compounds, the average deviations are 3.5 kJ/mol with a maximum of 6.3 kJ/mol.

700,277
PB88-112735 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Chemical Kinetic Data Base for Combustion Chemistry. Part 2. Methanol,
 W. Tsang. c1987, 38p
 Included in Jnl. of Physical and Chemical Reference Data, v16 n3 p471-508 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Combustion, *Data base, Evaluation, Gas kinetics, Hydroxymethyl, *Methanol, Rate expressions.

The publication contains evaluated and estimated data on the kinetics of reactions involving methanol and hydroxymethyl radicals and various small inorganic and organic species which are of importance for the proper understanding of methanol combustion and pyrolysis. It is meant to be used in conjunction with the kinetic data given in an earlier publication pertaining to methane pyrolysis and combustion, but which also contains a large volume of data that are applicable to the methanol system. The temperature range covered is 300-2500 K and the density range 1 times 10 to the 16th power to 1 times 10 to the 21st power molecules per cu. cm.

700,278
PB88-112743 Not available NTIS
 Montreal Univ. (Quebec).

Phase Diagrams and Thermodynamic Properties of the 70 Binary Alkali Halide Systems Having Common Ions,
 J. Sangster, and A. D. Pelton. c1987, 53p
 Sponsored by National Bureau of Standards, Gaithersburg, MD.

Included in Jnl. of Physical and Chemical Reference Data, v16 n3 p509-561 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: Thermodynamic properties, *Alkali halides, *Molten salts, *Phase diagrams.

A very extensive literature survey of all available phase diagram and thermodynamic data has been carried out

for all 40 possible common-anion binary systems (AX-BX) and all 30 possible common-cation binary systems (AX-AY) involving the alkali halides (A, B = Li, Na, K, Rb, Cs; X, Y = F, Cl, Br, I). A critical analysis and evaluation of these data have been performed with a view to obtaining a 'best' evaluated phase diagram and a set of 'best' evaluated thermodynamic parameters for each system. To this end, a computer-assisted coupled analysis of the phase diagram data and the thermodynamic properties of all known phases have been obtained which are consistent with the measured thermodynamic properties and phase diagrams as well as with established thermodynamic principles and theories of solution behavior. The parameters of these expressions are reported here and have been used to generate the computer-calculated diagrams in the compilation.

700,279

PB88-117536 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Holistic Molecular Conformation and Total Surface Area Calculations as Predictors for Solution Properties and Chromatographic Parameters.

Final rept.,
E. Eng, R. B. Johannesen, E. J. Tierney, J. M. Bellama, and F. E. Brinckman. 1987, 9p
Pub. in *Jnl. of Chromatography* 403, p1-9 1987.

Keywords: *Organic compounds, Separation, Solutions, Surface properties, Salvation, Chromatographic analysis, Computation, Carbinols, Water, Antimony, Arsenic, Bismuth, Reprints, Triphenyl derivatives, Methanol.

Group VA triphenyl derivatives, (C₆H₅)₃M, were separated using a reversed-phase bonded C sub 18 column with a methanol-water (70:30, v/v) mobile phase. The SAREA program was used to calculate holistic total surface area (TSA) values for the compounds in various conformations. A significant linear correlation was obtained between the natural logarithms of the capacity factor and the TSA values for only one particular set of conformers implying preferred solute-column chemistry based on preferred C-M bond rotations. The advantages of using a holistic approach for the calculation of TSA values are that it distinguishes the local carbon and metal geometries and weights their contribution to the overall TSA predictor which is not possible using a fragment approach. This is particularly significant for organometallic systems due to the ability of the central metal or metalloid atom to expand its coordination number. This effectively would increase the range of geometries which is not the case for organic molecules.

700,280

PB88-121074 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Infrared Spectrum of the Delta v = 2 Transitions of Lead Sulfide (PbS).

Final rept.,
A. G. Maki, and F. J. Lovas. 1987, 8p
Pub. in *Jnl. of Molecular Spectroscopy* 125, p188-195 1987.

Keywords: Molecular spectroscopy, Reprints, *Absorption spectrum, *High temperature, Infrared, Lead sulfide.

High-resolution absorption measurements of the Delta v = 2 transitions of lead sulfide (PbS) are given between 830 and 863 cm⁻¹. The measurements were made with PbS in the gas phase at temperatures between 1100 and 1325 K and involved vibrational transitions ranging from v = 2-0 to v = 8-6. Transitions for the three most abundant isotopic species (208Pb32S, 207Pb32S, and 206Pb32S) have been measured. The fitted parameters related to the breakdown of the Born-Oppenheimer approximation (or a so-called nuclear field shift) are quite large for vibration as well as for rotation. The band centers for the 1-0 transitions are computed from these measurements as follows: v₀(208Pb32S) = 426.63239(12)cm⁻¹, v₀(207Pb32S) = 426.76880(12)cm⁻¹, and v₀(206Pb32S) = 426.90658(12).

700,281

PB88-129713 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.

Hydration of Tricalcium Aluminate and Tetra-calcium Aluminoferrite In the Presence of Calcium Sulfate.

Final rept.,
P. W. Brown. 1986, 11p
Pub. in *Mater. Struct.*, n110 p137-147 Mar/Apr 86.

Keywords: Aluminum inorganic compounds, Hydration, Chemical reactions, Reaction kinetics, Calcium sulfates, Aluminates, Reprints, Calcium aluminates, Calcium aluminoferrites.

The hydration of C3A, C4AF in the presence of calcium sulfate is reviewed. Mechanisms and kinetics of hydration are discussed.

700,282

PB88-134671 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Coronene as a Model of Charcoal: Calibration of the Carbon-13 NMR Shift Tensor to Count Carbon Atoms at the Plane Edge.

Final rept.,
H. A. Resing, and D. L. VanderHart. 1987, 19p
Pub. in *Zeitschrift für Physikalische Chemie Neue Folge*, Bd. 151, S., p137-155 1987.

Keywords: Charcoal, Carbon, Molecular structure, Calibration, Nuclear magnetic resonance, Reprints, *Foreign technology, Coronene.

The principal values of the carbon-13 NMR chemical shift tensors have been measured for each of the three sorts of carbon atoms of coronene. The innermost six carbon atoms show (within ca. 3 ppm) axially symmetric chemical shift tensors, which imply threefold electronic symmetry at each of their sites, as in graphite. The outer 18 carbon atoms do not show axial symmetry, but are like the carbon atoms of solid ben/ene in chemical shift anisotropy, these represent the edge carbon atoms in the charcoal aromatic fused ring system, and the conclusion is that the edge has a thickness of two carbon atoms.

700,283

PB88-140884 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Slit Jet IR Absorption Spectroscopy of Molecular Complexes.

Final rept.,
D. J. Nesbitt. 1987, 24p
Grants NSF-PHY82-00805, NSF-CHE86-05970
Sponsored by National Science Foundation, Washington, DC.
Pub. in *Structure and Dynamics of Weakly Bound Molecular Complexes*, p107-130 1987.

Keywords: Reprints, *IR laser spectroscopy, Slit supersonic expansion, van der Waals molecules.

The combination of high resolution (< 10⁻³ per. cm) cw tunable difference frequency generation, high sensitivity (< 10⁻⁶/sq. root of Hz) direct absorption methods, and long path length (2.54 cm) pulsed slit expansions provide a powerfully general technique for studying weakly bound complexes in a cold molecular beam environment. Transient absorption of the narrow band laser provides a nonintrusive probe of the quantum state, velocity, temporal and spatial dependence of cluster formation in the pulsed molecular beam. High resolution fundamental, combination and hot band spectra of ArHF, HFN2 and HFCO2 complexes are presented. Detailed information on the molecular structure is determined for vibrationally excited states which sample the potential energy surface far from the ground state, near equilibrium geometry.

700,284

PB88-140991 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Vibrational Anomalies and Dynamic Coupling In Hydrogen-Bonded Van Der Waals Molecules.

Final rept.,
A. S. Pine. 1987, 13p
Pub. in *Structure and Dynamics of Weakly Bound Molecular Complexes*, p93-105 1987.

Keywords: Reprints, *High resolution spectroscopy, *Hydrogen bonding, *Intermolecular potentials, Tunable infrared lasers, Tunneling, van der Waals.

High-resolution infrared spectra of the hydrogen halide dimers and the rare gas-hydrogen halide complexes

have been recorded under thermal equilibrium conditions in a long path coolable White cell using a tunable difference-frequency laser. Detailed and comprehensive structural and dynamical information has been obtained from the fully resolved rotational transitions between the ground and vibrationally excited levels. Empirical potential energy surfaces have been determined to explain dynamical phenomena such as rotational and vibrational predissociation, vibrational shifts and large-amplitude librational and tunneling motions. A number of these features, strongly influenced by the large excursions of the light hydrogen atoms involved in the van der Waals bond, are quite anomalous and require close attention to dynamic coupling.

700,285

PB88-141007 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Structure and Dynamics of Weakly Bound Molecular Complexes.

Final rept.,
A. Weber. 1987, 651p
Pub. in *Structure and Dynamics of Weakly Bound Molecular Complexes*, 651p 1987.

Keywords: *Meetings, *Molecules, van der Waals molecules, *Hydrogen bonded molecules, High resolution spectroscopy, Molecular beam scattering.

The book represents the proceedings of a NATO Advanced Research Workshop on Structure and Dynamics of Weakly Bound Molecular Complexes, held in Acquafredda di Maratea, Italy, September 21-26, 1987. The book is composed of 44 contributions representing up to date research results at the time of the Workshop. The papers deal with the properties of van der Waals and hydrogen bonded molecules obtained from experimental spectroscopic and molecular beam scattering investigations as well as theory. High resolution microwave pure rotation, infrared rotation-vibration as well as visible and near ultraviolet spectra are analyzed and interpreted as are the results of molecular beam scattering and photodissociation experiments. Various effects especially prominent in van der Waals and hydrogen bonded molecules, such as large amplitude motions, tunneling, predissociation, dynamics and lifetimes of excited states, are treated. Papers also deal with theoretical calculations of these effects as well as the derivations of intermolecular potential energy function. One paper is an extensive bibliography, through Dec. 1987, of rotation spectra of van der Waals and hydrogen bonded molecules. Additional entries extend the compilation by including relevant work on rotation-vibration spectra.

700,286

PB88-147293 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Chemical Physics.

Mechanism of the Reactions of Alkyl Ions with Alkylamines: Competing Proton Transfer and Condensation Reactions.

Final rept.,
P. Ausloos, and S. G. Lias. 1986, 5p
Pub. in *Jnl. of the American Chemical Society* 108, n8 p1792-1796 1986.

Keywords: *Condensation, Reprints, *Alkyl ion, *Amine, Ion cyclotron resonance spectrometer, Proton transfer, Ion molecule reaction mechanism.

The reactions of ethyl, isopropyl, and t-butyl ions with alkylamines have been examined in an ion cyclotron resonance spectrometer (ICR). Use of deuterium-labelled reactant ions permitted a detailed examination of the relative probabilities of the two competing reaction channels demonstrated previously by Meot-Ner. Even though for all reaction pairs both b1 and b2 are energetically allowed, the weaker C-N bond in the condensation ion predominantly undergoes scission to give a complex of an alkyl ion and the corresponding amine, followed by proton transfer in the complex.

700,287

PB88-147350 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Equation of State for Isobutane-Isopentane Mixtures with Corrections for Impurities.

Final rept.,
J. S. Gallagher. 1986, 11p
Pub. in *International Jnl. of Thermophysics* 7, n4 p923-933 1986.

Keywords: Mixtures, Reprints, *Dew bubble curves, *Geothermal energy, *Impurity effects, Isobutane, Isopentane, Thermodynamic surface.

A global Helmholtz function accurately representing the thermodynamic properties of isobutane-isopentane mixture over a wide range of temperatures and pressures has been developed. The Helmholtz function has been used for the generation by computer of tables and charts of properties of interest to designers of power cycles. The Helmholtz function has also been extended to allow for additional components in the mixture, thus enabling the accurate calculation of corrections to the thermodynamic properties when impurities are present in significant amounts.

700,288

PB88-147517

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Cation Binding Effect on Hydrogen Bonding.

Final rept.,
H. Basch, M. Krauss, and W. J. Stevens. 1985, 5p
Pub. in Jnl. of the American Chemical Society 107, n25
p7267-7271 1985.

Keywords: Reprints, *Cation binding, *Hydrogen bonds, *Imidazole, *Dimer.

Cation binding effects on nearby H-bonds is studied for the imidazole dimer. The binding of the cations, H^+ , Na^+ , $Zn(OH)^+$, and $Zn(2^+)$, is found to have a significant effect on both the H-bond energy and the equilibrium internuclear separation of the H-bond. The net stabilization energy ranges from 8.0 kcal for Na^+ to 28.0 kcal for $Zn(2^+)$. The polarization of the dimer is also appropriate to increase the binding of another imidazole. Proton transfer is also studied for the dimer itself and the cation perturbed dimer. Double wells are found in all cases in the energy curve for proton transfer with a fixed N-N' distance between the imidazole monomers. With the exception of $Zn(2^+)$ a substantial barrier is calculated for the proton transfer reaction. Compact effective potentials (CEP) were used in the calculations. Comparisons of the orbital energies and gradient optimized geometry of the CEP calculation for imidazole with a GTO 4-31G all-electron calculation is quite satisfactory.

700,289

PB88-147525

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Vibrational Predissociation Dynamics of the Nitric Oxide Dimer.

Final rept.,
M. P. Casassa, J. C. Stephenson, and D. S. King.
1987, 12p
Pub. in Structure and Dynamics of Weakly Bound Molecular Complexes, p513-524 1987.

Keywords: Reprints, *Nitric oxide dimer, Picosecond, *Product state distribution, Unimolecular reaction, van der Waals, *Vibrational predissociation.

Details of experimental measurements of the total energy distribution and time dependence of the vibrational predissociation of the nitric oxide dimer are presented. Energy disposal measurements following epsilon 1 excitation at 1870 cm⁻¹ indicated the fragments to be described by an average rotational energy (ER) = 75 cm⁻¹, full equilibration of the lambda doublet species, approximately equal populations in both spin-orbit states, no significant degree of alignment, an isotropic flux distribution, and an average kinetic energy of (EK) = 400 cm⁻¹ per fragment. Although approximately 75% of the available energy goes into fragment translation, picosecond laser pump - probe experiments showed that epsilon 1 decayed exponentially with a 880 ps lifetime. Excitation of epsilon 1 at 1789 cm⁻¹ gave a 39 ps predissociative lifetime.

700,290

PB88-152103

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Analysis of the 3-Micrometer Bands of Benzene.

Final rept.,
J. Pliva, and A. S. Pine. 1987, 17p
Pub. in Jnl. of Molecular Spectroscopy 126, p82-98 1987.

Keywords: *Absorption spectra, *Benzene, *Molecular spectroscopy, Reprints, *Laser spectroscopy, High resolution.

A comprehensive rovibrational analysis is reported for the 3-Micrometer absorption bands of the benzene molecule measured on a difference-frequency laser spectrometer and deconvolved to an effective linewidth of 0.0010-0.0015 1/cm.

700,291

PB88-152558

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Absolute OCS Wavenumbers and Analysis of Bands in the Region of the Lowest Fundamental (nu sub 2).

Final rept.,
K. Jolma, V. M. Horneman, J. Kauppinen, and A. G. Maki. 1985, 8p
Pub. in Jnl. of Molecular Spectroscopy 113, n1 p167-174 Sep 85.

Keywords: *Absorption spectra, *Carbonyl compounds, *Molecular spectroscopy, Reprints, *Carbonyl sulfide.

The high resolution infrared spectrum of carbonyl sulfide (OCS) in the region 490-560 1/cm has been recorded with a Fourier transform spectrometer at a resolution of about 0.005 1/cm.

700,292

PB88-152806

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.

Halomethylenes: Effects of Halogen Substitution on Absolute Heats of Formation.

Final rept.,
S. G. Lias, Z. Karpas, and J. F. Liebman. 1985, 8p
Pub. in Jnl. of the American Chemical Society 107, n21
p6089-6096 1985.

Keywords: Halogens, Heat of formation, Thermochemistry, Reprints, *Halomethylenes, *Carbenes, *Proton transport, Ion cyclotron resonance spectrometer, Substitutions.

New values for the heats of formation of CF₂, CCl₂, CClF, and CClH have been derived from estimations of the thermochemistry of the reaction(s): (CXYH + B -> CXY + BH(1+)) where X and Y are F and/or Cl and B is a molecule for which an absolute value of the gas phase basicity (or proton affinity) is available. The experiments were carried out in an ion cyclotron resonance spectrometer. Results are presented.

Industrial Chemistry & Chemical Process Engineering

700,293

PB87-165155

PC A06/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Center for Chemical Engineering Technical Activities: Fiscal Year 1986.

Research summary rept. Oct 85-Sep 86,
J. Hord. Feb 87, 115p NBSIR-86/3059
See also PB86-166295. Sponsored by National Research Council, Washington, DC.

Keywords: *Chemical engineering, *Research projects, Fluid mechanics, Thermophysical properties, Calibrating, Measurement.

Technical research activities performed by the Center for Chemical Engineering during the Fiscal Year 1986 are summarized herein. These activities fall within the general categories of process measurement, thermophysical properties data, and chemical engineering science. They embody: development and improvement of measurement principles, measurement standards, and calibration services such as volumetric and mass flow rates, liquid volume, liquid density, and humidity; generation (via accurate measurement and advanced predictive models) of reliable reference data for thermophysical properties of pure fluids, fluid mixtures, and solids of vital interest to industry; and development of improved correlations, models, and measurement techniques for complex flows, heat and mass transport, mixing, and chemically reacting flows of interest in modern unit operations.

700,294

PB87-216222

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.

Laser Tomography for Simultaneous Concentration and Temperature Measurement in Reacting Flows.

Final rept.,
S. R. Ray, and H. G. Semerjian. 1984, 25p
Pub. in Progress in Astronautics and Aeronautics, v92
p300-324 1984.

Keywords: *Absorption, *Lasers, Combustion, Diagnosis, Spectroscopy, Multiangular, Reprints, *Tomography.

Laser tomography, a new optical diagnostic technique based upon multiangular absorption spectroscopy has been developed. This technique allows the rapid measurement of both species concentration and temperature throughout a two- or three-dimensional non-uniform flow field. Laser tomography involves making absorption measurements along M parallel rays at N equally spaced angles. These M x N measurements are used to reconstruct the spatially resolved two-dimensional property field. Experimental results using two optical geometries are reported for measurements of sodium concentration in a seeded premixed flat flame. Computer simulations of a complete tomography system are presented, including the effects of noise based upon the experimental measurements. Results indicate that within the flame zone both the concentration of absorbing species and temperature can be recovered to within plus or minus 3% without noise filtering and to plus or minus 1.7% with filtering.

700,295

PB87-231494

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Before the Smoke Clears--Heat and Mass Transfer in Fires and Controlled Combustion.

Final rept.,
L. A. Kennedy, and L. Y. Cooper. 1987, 6p
Pub. in Mechanical Engineering 109, n4 p62-67 Apr 87.

Keywords: *Combustion, *Chemical reactions, Flows, Reprints, Compartment fires, Heat transfer, Mass transfer.

Combustion phenomena are often arbitrarily divided into two broad topics depending upon whether it is controlled or uncontrolled. Controlled combustion will normally imply the consumption of a fuel to liberate heat which subsequently will result in useful work. Uncontrolled combustion which is referred to as fire, implies the unintended destruction of a fuel source. In a discussion more or less divided along these lines, the paper outlines current technical issues in the context of some key areas of research and development related to heat and mass transfer-related phenomena.

700,296

PB87-231502

Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

Low Temperature Magnetic Properties of F.C.C. (Face Centered Cubic) Fe-Cr-Ni Alloys: Effects of Manganese and Interstitial Carbon and Nitrogen.

Final rept.,
E. R. Jones, T. Datta, C. Almasan, D. Edwards, and H. M. Ledbetter. 1987, 8p
Grant NSF-ISP80-11451
Sponsored by Department of Energy, Washington, DC.
Office of Fusion Energy, and National Science Foundation, Washington, DC.
Pub. in Materials Science and Engineering 91, p181-188 1987.

Keywords: Low temperatures, Magnetic susceptibility, Reprints, *Alloying effects, *Austenitic steels, Iron alloys, Neel transition.

The authors have measured the low temperature magnetic susceptibility of two series of f.c.c. Fe-Cr-Ni alloys: one series contained varied amounts of interstitial carbon and nitrogen; the other contained varied amounts of manganese. Characteristic of antiferromagnets, all specimens displayed a distinct peak in magnetic susceptibility as a function of temperature. Above the transition temperature the behavior of all specimens could be well described by a modified Curie-Weiss law. In the first series the position of the susceptibility maximum decreased from 47.9 plus or minus 0.5 to 35.0 plus or minus 0.5 K as the carbon-plus-nitrogen content increased from 0.080 to 0.359

CHEMISTRY

Industrial Chemistry & Chemical Process Engineering

wt.%. In the second series the position of the susceptibility maximum increased from 46 plus or minus 0.5 to 86.5 plus or minus 0.5 K as the manganese content was increased from 1.02 to 5.80 wt.5. A linear relationship was found to predict the Neel temperature from the alloy composition with an r.m.s. deviation of 1 K.

700,297
PB87-231635 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Chemical Engineering Science Div.
Transport of Aniline, Chloroaniline, Nitroaniline, and Urea through Perfluorosulfonated Ionomer Membranes.
Final rept.,
P. G. Glugla, and H. Dindi. 1986, 7p
Pub. in Jnl. of Membrane Science 28, p311-317 1986.

Keywords: *Amines, *Membranes, Reprints, Ionomer membranes, Membrane separations, Urea.

The permeabilities of aniline, p-chloroaniline, p-nitroaniline, and urea were measured in a perfluorosulfonated ionomer membrane. Permeabilities for these compounds were of the order of 2 times 10 to the minus 10 power sq. m./sec when the external solutions were pH 7. Permeabilities for these compounds were of the order of 6 times 10 to the minus 9th power sq. m./sec when the sink solution was pH 1 and the source solution was pH 7. These results indicate that the rate at which these amines exit the ionomer is the rate-limiting step in the transport process.

700,298
PB87-233839 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Preparation of Ultrapure Acids from Small to Large Scale.
Final rept.,
J. R. Moody, E. S. Beary, and P. J. Paulsen. 1987, 14p
Pub. in Proceedings of the International Congress of Pure and Applied Chemistry (31st), Sofia, Bulgaria, July 13-18, 1987, p118-131.

Keywords: *Acids, Analysis, *Trace metals, Inductively coupled plasma, Mass spectrometers, Ultrapure, Sub-boiling.

Methods in use at NBS and elsewhere for the preparation of ultrapure acids are described in a historical context as well as the present recommended procedures. A new apparatus capable of distilling more than 20x the rates of other commercial/times sub-boiling stills has been designed and evaluated at NBS. A new analytical procedure utilizing the ICP/Mass Spectrometer has been developed to assist in evaluating reagent quality.

Photo & Radiation Chemistry

700,299
PB87-162178 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.
Positive Charge Transfer in the UV Photolysis and beta Radiolysis of trans-Decalin Solutions.
Final rept.,
F. P. Schwarz. 1985, 13p
Pub. in Radiation Physics and Chemistry 26, n4 p401-413 1985.

Keywords: *Photolysis, *Radiolysis, Energy transfer, Toluene, Benzene, Reprints, *Decalin, Benzene/fluoro, Benzene/difluoro.

Dilute solutions of benzene, fluorobenzene, o-difluorobenzene, m-difluorobenzene, p-difluorobenzene, and toluene in trans-decalin have been irradiated with UV light and with beta radiation. Fluorescence measurements on the additive aromatic species permit a determination of the efficiency of energy transfer from the lowest excited singlet state of trans-decalin, and, above the ionization onset, of charge transfer from the trans-decalin radical cation. The aromatic ions generated in the charge transfer process undergo recombination with electrons, resulting in excited species with fluorescence; this recombination fluorescence is shown to give an indication of the relative importance of the charge transfer reaction. Although the factors

which influence the efficiencies of the observed charge transfer processes are not completely understood, a general trend is observed of increasing efficiency of charge transfer as the reaction is increasingly energetic.

700,300
PB87-163788 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Observation of Radiative Transfer of Polarized Light.
Final rept.,
M. Belsley, A. Streater, K. Burnett, P. Ewart, and J. Cooper. 1986, 11p
Grant NSF-PHY82-00805
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 36, n2 p163-173 1986.

Keywords: Polarization, Reprints, *Polarized light, Radiative transfer.

The results of an experiment sensitive to polarization and angle-dependent effects of resonance line radiation transport in a collisional environment are presented. Having measured both the excited atomic state population and alignment as a function of distance from the initial excitation, considerable anisotropy in the alignment is found. Included in the discussion are the results of an angle-average model calculation, which allows us to point out, in a qualitatively way, some of the important physics of the problem.

700,301
PB87-197778 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Comparison of the Electronic Energy Levels of Diatomic Molecules in the Gas Phase and in Inert Solid Matrices.
Final rept.,
M. E. Jacox. 1987, 17p
Pub. in Jnl. of Molecular Structure 157, p43-59 1987.

Keywords: *Diatomic molecules, Matrix isolation, Vibrational structure, Reprints, *Charge transfer, Electronic band origins, Rydberg states.

Electronic band origins and vibrational band spacings in excited electronic states have been compared for the approximately 230 electronic transitions of diatomic molecules which have been observed both in the gas phase and in rare-gas or nitrogen matrices. With few exceptions, valence transitions and the associated vibrational band spacings are shifted by less than about 1% in neon matrices. Somewhat larger shifts, often to longer wavelengths, result from isolation of the molecule in a heavier rare-gas or a nitrogen matrix. The perturbation of Rydberg transitions by the matrix, the effects of charge-transfer interaction with the heavier rare-gas matrices, and the behavior of the potential curve of the matrix-isolated molecule in the vicinity of the dissociation continuum are discussed.

700,302
PB87-197919 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Quantification of Pulsed Ion Currents Produced in Resonance Ionization Mass Spectrometry.
Final rept.,
J. D. Fasset, R. J. Walker, J. C. Travis, and F. C. Ruegg. 1987, 16p
Pub. in International Jnl. of Mass Spectrometry and Ion Processes 75, p111-126 1987.

Keywords: *Ion detection, Mass spectrometry, Osmium, Resonance ionization, Rhenium, Reprints, *Isotope ratio, *Laser ionization.

An evaluation is made of a measurement system that quantifies the pulsed ion currents produced in resonance ionization mass spectrometry. An electron multiplier detector operated at intermediate gain has been combined with a preamplifier and a transient digitizer. The output of the transient digitizer is processed in real time so that no ionization information is lost. The linearity, pulse height distributions, and gain of the detector system have been examined. Operation of the detector in pulse counting and analog modes is demonstrated. Ratio measurements representative of these detection modes are presented for 185Re/187Re and 184Os/192Os.

700,303
PB87-201596 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Optical Studies of Product State Distributions in Thermal Energy Ion-Molecule Reactions.
Final rept.,
V. M. Bierbaum, and S. R. Leone. 1987, 33p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and National Sanitation Foundation, Ann Arbor, MI.
Pub. in Structure/Reactivity and Thermochemistry of Ions, p23-55 1987.

Keywords: *Auroras, Chemiluminescence, Optical properties, Fluorescence, *Ion-molecule interactions.

Product state distributions of thermal energy ion-molecule reactions are determined by the sensitive optical methods of infrared chemiluminescence and laser-induced fluorescence detection. Experiments to obtain detailed vibrational state populations are carried out in a flowing afterglow reaction vessel, and measurements to extract rotational state distributions are performed in a single-collisions crossed-beam apparatus that uses a flowing afterglow ion source. Product state information is obtained for a series of proton transfer reactions and charge transfer reactions, which reveals many aspects of the dynamical behaviors of these processes. Measurements are also presented for polyatomic ion-molecule reactions, for optically-determined rates of ion collisional excitation, and deactivation, and on visible chemiluminescence yields and branching fractions for reactions important in the aurora.

700,304
PB87-223764 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Effect of Closed Classical Orbits on Quantum Spectra: Ionization of Atoms in a Magnetic Field.
Final rept.,
M. L. Du, and J. B. Delos. 27 Apr 87, 3p
Sponsored by National Science Foundation, Washington, DC.
Pub. in Physical Review Letters 58, n17 p1731-1733, 27 Apr 87.

Keywords: *Absorption spectra, Magnetic fields, Reprints, *Photoionization, Rydberg states, Chaos.

Measurements of the absorption spectrum near the ionization threshold for an atom in a strong magnetic field showed that the spectrum is a superposition of many oscillatory terms ('quasi-Landau oscillations'). The authors have developed a quantitative theory which shows that each classical closed electron orbit which begins and ends near the nucleus contributes an oscillatory term to the average oscillator strength. The theory gives new understanding of the behavior under combined Coulomb and Lorentz forces, and it elucidates the role of isolated closed orbits in chaotic systems. The first results of the theory are shown to be in good agreement with experimental results.

700,305
PB87-233490 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Importance of Multiple Scattering in X-ray Photoelectron and Auger Electron Diffraction in Crystals (Summary Abstract).
Final rept.,
W. F. Egelhoff. Aug 87, 1p
Pub. in Jnl. of Vacuum Science and Technology A 5, n4 p1684 Jul/Aug 87.

Keywords: *Auger spectroscopy, *Epitaxy, Copper, Forward scattering, Multiple scattering, Nickel, Reprints, Photoelectron spectroscopy.

Angle resolved x-ray photoelectron and Auger electron spectra of sandwich structures of epitaxial Ni on Cu on Ni have been used to assess the importance of multiple scattering of the electron wave in XPS and Auger diffraction. It is found that multiple scattering is very important for the part of the wave that travels down a row of atoms for more than about three atomic spacings.

700,306
PB87-233938 Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Collision-Induced Dissociation of Laser-Excited Br₂ (B Triplet P(1/2)) + Br₂ (B Triplet P(3/2)) at Energies 1-5 kT Below Dissociation.

Final rept., J. E. Smedley, H. K. Haugen, and S. R. Leone. 1987, 12p

Grants NSF-PHY86-04504, NSF-CHE84-08403 Sponsored by National Science Foundation, Washington, DC., and Army Research Office, Research Triangle Park, NC.

Pub. in Jnl. of Chemical Physics 86, n12 p6801-6812, 15 Jun 87.

Keywords: *Bromine, *Dissociation, Excitation, Reprints, *Photodissociation, Atom-molecule collisions, Molecule-molecule collisions, Laser radiation.

Absolute rate constants are measured for the title problem by thermal energy collisions with Br₂(X singlet (Sigma sub g)(1+)), Xe, and Ar at 297 K. A 0.04/cm etalon-narrowed pulsed dye laser populates specific rovibrational levels of isotopic Br₂ which are 1-5 kT below the B-state dissociation limit; in addition the laser directly photodissociates molecules which are in thermally excited vibrational levels. The method used to determine the absolute rate constants combines four sets of experimental determinations, which include infrared detection of Br*, visible Br₂(B) fluorescence lifetimes, absorption spectroscopy of Br₂ (B < Y), and transient gain-vs-absorption spectroscopy on Br/Br*.

**700,307
PB88-110705** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Yields of Excited States of Aromatic Derivatives in the Radiolysis of Hydrocarbon Solutions.
Final rept., F. P. Schwarz, and D. Smith. 1985, 10p
Pub. in Radiation Physics and Chemistry 26, n3 p257-266 1985.

Keywords: *Hydrocarbons, *Aromatic compounds, *Radiolysis, Fluorescence, Solutions, Radiation chemistry, Cations, Emission, Scavenging, Reprints.

The yields of aromatic excited singlet states produced in the steady state beta radiolysis of solutions of the aromatics in cis-decalin, decane, cyclohexane, cyclopentane, isopentane, and 2,2,4-trimethylpentane are determined from fluorescence measurements. The aromatic solutes are toluene, 1-methylnaphthalene (1-methylnaphthalene is also an electron scavenger), and aniline, which can scavenge positive charge from the solvent cations produced in the radiolysis.

**700,308
PB88-112677** Not available NTIS
National Bureau of Standards, Gaithersburg, MD.

Spectral Data for Molybdenum Ions, Mo VI-Mo XLII.
T. Shirai, Y. Nakai, K. Ozawa, K. Ishii, and J. Sugar. c1987, 51p
Prepared in cooperation with Japan Atomic Energy Research Inst., Tokai, Kyoto Univ. (Japan), and Japan Information Center of Science and Technology, Tokyo. Included in Jnl. of Physical and Chemical Reference Data, v16 n2 p327-377 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Atomic data, *Energy levels, Molybdenum, Spectra.

Wavelengths, intensities, and classifications for the molybdenum ions Mo VI to Mo XLII are compiled. A short review of the work on each stage of ionization is included. The data are critically evaluated and the best results are quoted.

**700,309
PB88-120977** Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.

Measurement and Analysis of the Far Infrared Absorption Spectrum of the Gaseous Mixture H₂-CH₄.
Final rept., G. Birnbaum, A. Borysow, and H. G. Sutter. 1987, 11p

Contract NSF-AST83-10786
Sponsored by National Science Foundation, Washington, DC.

Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 38, n3 p189-199 1987.

Keywords: Reprints, *Bandshape, *Absorption, *Far infrared, Planetary atmosphere, Spectral moments.

The collision-induced absorption of H₂-CH₄ mixtures was measured from approx. 20 to 900 per cm. at 195 and 297 K. By subtracting the absorption due to H₂-H₂ and CH₄-CH₄ collisions from that of the mixture, the absorption due to H₂-CH₄ collisions was obtained. This spectrum was analyzed using the BC model line shape to provide a way of estimating the far-i.r. spectrum of H₂-CH₄ for various concentrations of H₂ and CH₄. Theoretical spectral moments were computed with different potential functions and compared with experimental values.

**700,310
PB88-152186** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Photodissociation Dynamics of Small Molecules.
Final rept., W. M. Jackson, and H. Okabe. 1986, 94p
Pub. in Advances in Photochemistry 13, p1-94 1986.

Keywords: *Photodissociation, Photochemical reactions, Molecules, Fluorescence, Reprints, Time of flight spectrometers, Radicals.

The manuscript is a recent review on photochemistry primary processes of about 60 small molecules. The review emphasizes the detection of photofragments (free radicals and small molecules) by laser induced fluorescence (LIF), time of flight, coherent anti-Stokes Raman spectroscopy (CARS), and other recent techniques, by which the internal and translational energies of the photofragments can be accessed.

**700,311
PB88-152988** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Use of an Optical Multi-Channel Analyzer for Recording Absorption Spectra of Short-Lived Transients.
Final rept., E. P. L. Hunter, M. G. Simic, and B. D. Michael. 1985, 6p
Pub. in Review of Scientific Instruments 56, n12 p2199-2204 Dec 85.

Keywords: *Pulse height analyzers, *Absorption spectra, *Photolysis, *Radiolysis, Signal to noise ratio, Resolution, Reprints, Transients.

Characteristics of an adapted commercial optical multichannel analyzer system for recording of transient absorption spectra in single shot pulse radiolysis and flash photolysis are described. The features discussed include temporal (2 microsec) and spectral (1nm) resolution, signal-to-noise ratio and its improvement, linearity of response, and wavelength coverage (300-650 nm). The system is intermediate in both cost and capabilities compared to two other methods: (1) recording transient spectra by repetitive pulsing and (2) using an image converter streak camera. The system is convenient for discrimination of small differences in fine structured absorption spectra of short lived species.

Physical & Theoretical Chemistry

**700,312
AD-A167 157/7** PC A02/MF A01
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.

Simple Sum Rule for Total Radiative Decay Rates--Comparison of Quantal and Classical Methods for Diatomic Molecules.
J. Tellinghuisen, and P. S. Julienne. 15 Dec 84, 8p
AFOSR-TR-86-0213
Grant AFOSR-83-0110
Pub. in Jnl. of Chemical Physics, v81 n12 pt 1 p5779-5785, 15 Dec 84.

Keywords: *Diatomic molecules, *Electron transitions, Quantum theory, Coefficients, Mass, Moments, Reduction, Reprints, Molecular vibration, Sum rules.

Total radiative decay coefficients for electronic transitions in diatomic molecules are evaluated by means of an initial state expectation value < V-cubed(R)(mu

sub e)squared(R)>(V = difference potential, micron = transition moment function) in place of the usual sum over final states. This exception value is calculated by quantal and classical methods and compared with the exact expression as a function of reduced mass and initial vibrational state for several combinations of initial and final potentials and transition moment functions. The errors in both the sum rule and its classical implementation seldom exceed 1%, and then only for hydrogenic reduced mass. Keywords: Radiative decay coefficients electronic transitions; Diatomic molecules; and Reprints.

**700,313
AD-A182 285/7** PC A09/MF A01
National Bureau of Standards (NML), Washington, DC.

International Conference on Chemical Kinetics: Program and Abstracts Held in Gaithersburg, Maryland on 17-19 June 1985.
Final rept. 15 Mar-30 Sep 85,
J. T. Herron, W. Tsang, S. E. Stein, and D. M. Golden. Jun 85, 189p AFOSR-TR-87-0707
Grant AFOSR-ISSA-85-0062

Keywords: *Abstracts, *Reaction kinetics, *Chemical reactions, International, Symposia, Laboratories, Research facilities, Molecules, Biomolecules, Ions, Universities.

This meeting held at the National Bureau of Standards, Gaithersburg, MD, brought together leading investigators from universities, research laboratories, and industrial organizations to review the progress and problems in theoretical and experimental chemical kinetics. The scope of the meeting was broadened to include ion-molecule reactions and processes occurring in the condensed phase. Other topics covered unimolecular and biomolecular reactions, energy transfer, and a symposium in honor of Professor Sidney W. Benson. Keywords: kinetics, reactions, energy transfer.

**700,314
PATENT-4 654 279** Not available NTIS
Department of the Navy, Washington, DC.

Interpenetrating-Network Polymeric Electrolytes.
Patent,
B. J. Bauer, C. K. Chiang, and G. T. Davis. Filed 10 Jul 86, patented 31 Mar 87, 6p PB87-182580, PAT-APPL-6-884 143
Supersedes AD-A012 485.
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: *Patent applications, *Polymers, *Solid electrolytes, Conductivity, Crosslinking(Chemistry), Electrolytes, Poly(oxide/ethylene), Poly(oxide/propylene), Poly(imine/ethylene).

A solid polymeric electrolyte which is a two phase interpenetrating network of a mechanically supporting phase of a continuous network of a crosslinked polymer and an ionic conducting phase comprising a metal salt complexing liquid polymer which is a liquid poly(ethylene oxide), poly(propylene oxide), or poly(ethylene imine) complexed with a suitable metal salt. The mechanically supporting phase forms a matrix which supports the interpenetrating ionic conducting liquid polymer phase which provides continuous paths of high conductivity in all directions throughout the matrix.

**700,315
PB87-149381** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Picosecond Measurements of the Dissociation Rates of the Nitric Oxide Dimer nu(sub 1)=1 and nu(sub 4)=1 Levels.
Final rept., M. P. Casassa, A. M. Woodward, J. C. Stephenson, and D. S. King. 1986, 3p
Pub. in Jnl. of Chemical Physics 85, n10 p6235-6237, 15 Nov 86,

Keywords: *Nitrogen oxide(NO), *Dissociation, Vibrational spectra, Reprints, *Rate constants, Dimers, Picosecond pulses.

Direct picosecond measurements of the vibrational predissociation rates of the nitric oxide dimer excited to v=1 levels of the nearly equal energy symmetric nu(sub 1) = 1870/cm and asymmetric nu(sub 4) = 1789/cm N-O stretching fundamentals are reported.

CHEMISTRY

Physical & Theoretical Chemistry

Lifetimes obtained are 880 + or - 260 ps for nu(sub 1) and 39 + or - 8 ps for nu(sub 4) excitations.

700,316
PB87-149415 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Molecular Spectroscopy Div.
Adiabatic Analysis of Distant Perturbations: Application to Herzberg-Teller Vibronic Coupling Theory.
Final rept.,
F. H. Mies. 1985, 14p
Pub. in Molecular Physics 54, n6 p1423-1436 1985.

Keywords: *Adiabatic conditions, Molecular spectra, Formaldehyde, Intensity, Reprints, *Vibronic coupling, Propynal.

The simplest form of Herzberg-Teller theory involves the vibronic coupling of a single mode between two energetically separated molecular states. An adiabatic analysis of the system is presented which incorporates the effect of the distant state without recourse to direct summation over distant energy levels. The theory is compared to exact numerical results for vibronic-coupling in Propynal and Formaldehyde. The adiabatic eigenvalues are exceptionally accurate, especially if proper radial Born-Oppenheimer terms are added to the adiabatic potential for the ground state. The quality of the resultant amplitudes associated with the distant state are adequate to represent any intensity borrowing effects in the molecular spectra to well within 5%. The adiabatic theory is quite general and can be used with equal force to represent distant perturbations due to repulsive as well as attractive states, and without any commitment to linear vibronic coupling models.

700,317
PB87-149423 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Molecular Spectroscopy Div.
Microwave Spectrum of the K=0 States of Ar-NH3.
Final rept.,
D. D. Nelson, G. T. Fraser, K. I. Peterson, K. Zhao, W. Klemperer, F. J. Lovas, and R. D. Suenram.
1986, 7p
Pub. in Jnl. of Chemical Physics 85, n10 p5512-5518, 15 Nov 86.

Keywords: *Ammonia, *Argon, *Microwave spectra, Reprints, Dimers.

The microwave spectrum of Ar-NH3 has been obtained using molecular beam electric resonance spectroscopy and pulsed nozzle Fourier transform microwave spectroscopy. The spectrum is complicated by nonrigidity and most of the transitions are not yet assigned. The NH3 orientation in the complex is discussed primarily on the basis of the measured dipole moment projection and the quadrupole coupling constant. It is concluded that the Ar-NH3 intermolecular potential is nearly isotropic and that the NH3 subunit undergoes practically free internal rotation in each of its angular degrees of freedom. Spectroscopic evidence is presented which indicates that the NH3 subunit also inverts within the complex. These conclusions concerning the internal dynamics in the Ar-NH3 complex support the model initially proposed in the authors previous study of the microwave and infrared spectra of this species.

700,318
PB87-149449 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.
Free Radical Chemistry of Sulfite.
Final rept.,
P. Neta, and R. E. Huie. 1985, 9p
Pub. in Environmental Health Perspectives 64, p209-217 Dec 85.

Keywords: *Free radicals, *Sulfites, Chemical radicals, Oxidation, Reprints, *Chemical reaction kinetics, Sulfite radicals, Peroxysulfate radicals.

The free radical chemistry of sulfite oxidation is reviewed. Chemical transformations of organic and biological molecules induced by sulfite oxidation are summarized. The kinetics of the free radical oxidations of sulfite are discussed as are the kinetics of the reactions of the sulfite derived radicals SO3(1-) and its peroxy derivative (SO5(1-)) with organic compounds.

700,319
PB87-149472 Not available NTIS

National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.
Zinc Porphyrin pi-Radical Cations in Aqueous Solution. Formation, Spectra and Decay Kinetics.
Final rept.,
P. Neta, and A. Harriman. 1985, 16p
Pub. in Jnl. of the Chemical Society-Faraday Transactions II, v81 p123-138 Jan 85.

Keywords: *Zinc, *Porphyrins, Chemical radicals, Reaction kinetics, Reprints, Pulse radiolysis.

Zinc porphyrins are oxidized readily to the pi-radical cation by certain inorganic and organic radicals in aqueous solution under pulse radiolytic conditions. Dimolecular rate constants for the oxidation process depend upon thermodynamic driving forces and Coulombic interactions between the reactants and lie within the range 10 to the 7th power - 10 to the 10th power/M s. The resultant pi-radical cations exist in aqueous solution in equilibrium with any anions or complexing agents (e.g. pyridine) present in solution. This complexation affects both the absorption spectrum of the pi-radical cation and its rate of decay. With zinc tetrakis (4-sulphonatophenyl) porphyrin, the pi-radical cation is quite persistent (t (sub 1/2) approx 6s) but its rate of decay increases when SCN-ions are present. Positively-charged zinc porphyrins form shorter-lived pi-radical cations that decay on the ms timescale. Under some conditions, this decay leads to formation of a relatively long-lived intermediate which is either a pi-radical dimer of an isoporphyrin derivative.

700,320
PB87-149506 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Ceramics Div.
Viscosity and Structure of Iron- and Aluminum-Bearing Calcium Silicate Melts at 1 atm.
Final rept.,
B. O. Mysen, D. Virgo, C. M. Scarfe, and D. J. Cronin. 1985, 12p
Pub. in American Mineralogist 70, n5-6 p487-498 1985.

Keywords: *Viscosity, *Calcium silicates, Molecular structure, Silicate minerals, Raman spectra, Reprints, *Silicate melts.

The temperature-viscosity relationships of four melt compositions in the system CaO-SiO2-Fe-O have been determined. The Fe(3+)/sigma Fe and structural positions of Fe(3+) and Fe(2+) in the melts were obtained with (57)Fe Mossbauer spectroscopy. Raman spectra were obtained on quenched melts (from 1550 deg C) of these samples as well as aluminum analogues of the iron-bearing melts. Aluminum and ferric iron are tetrahedrally coordinated, and ferrous iron is in octahedral coordination in all melts. The viscosities (eta) range between 8 and 50 kcal/mole as a function of Ca/Si, iron content and temperature (in the temperature range 1400 deg - 1600 deg C). The viscosity shows a distinct increase as 5 wt % Fe2O3 is added to iron-free melts. Additional Fe2O3 results in decreasing viscosity. Published data show that analogous addition of Al2O3 results in a continuous viscosity increase.

700,321
PB87-149589 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.
Rare-Earth Crystal Growth from the Vapor: Eu/Re and Eu/W.
Final rept.,
A. J. Melmed, V. Maurice, O. Frank, and J. H. Block. 1984, 6p
Pub. in Jnl. de Physique 45, nC9 p47-52 1984.

Keywords: *Crystal growth, *Rare earth minerals, Europium, Rhenium, Tungsten, Epitaxy, Reprints.

Epitaxial crystal growth of Eu/Re and Eu/W has been done using Field Emission Microscopy. Nucleation, crystal growth and epitaxial relationships are comparatively described and discussed, and a value of the electron work function for poly-faced Eu has been determined.

700,322
PB87-149597 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.

Influence of Surface Additives, Sodium and Oxygen, on the Structure and Bonding of H2O and NH3 on Ru(001).
Final rept.,
T. E. Madey, C. Benndorf, D. L. Doering, and S. Semancik. 1985, 12p
Pub. in Proceedings of Int. Congr. Catal. (8th), pIV51-IV62 1985.

Keywords: *Surface chemistry, *Sodium, *Oxygen, Surfaces, Chemisorption, Bonding, Water, Ammonia, Ruthenium, Molecular structure, Electron stimulated desorption.

The bonding geometry and thermal desorption kinetics of adsorbed molecular NH3 and H2O on Ru(001) are altered by interaction with adsorbed oxygen or sodium atoms. In all instances, local molecular reorientations are induced in NH3 and H2O by the additive atoms. The molecular axes of adsorbed H2O and NH3 are strongly 'tilted' by interaction with Na, whereas adsorbed oxygen causes a striking azimuthal-ordering in NH3.

700,323
PB87-149605 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.
Influence of Surface Additives (Na and O) on the Absorption and Structure of NH3 on Ni(110).
Final rept.,
T. E. Madey, and C. Benndorf. 1985, 9p
Pub. in Surface Science 152, p587-595 Apr 85.

Keywords: *Chemisorption, *Surface chemistry, *Sodium, *Oxygen, *Ammonia, *Nickel, Adsorption, Molecular structure, Reprints, Electron stimulated desorption.

The structure and kinetics of NH3 interacting with clean and sodium or oxygen-dosed Ni(110) have been studied using ESDIAD (electron stimulated desorption ion angular distribution), LEED and thermal desorption spectroscopy. NH3 adsorbs in molecular form at 80 K. No azimuthal ordering is found for molecular NH3 on either clean or O-dosed Ni(110), but NH3 reacts with O above 200 K to form a surface species 'inclined' along (001) azimuths, identified as OH(ad). Coadsorption of NH3 with Na causes a reorientation of the molecular axes of the NH3 bonded near Na.

700,324
PB87-149613 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.
Weich Memorial Lecture: Electron Stimulated Desorption and Its Relation to Molecular Structure at Surfaces.
Final rept.,
T. E. Madey. 1986, 5p
Sponsored by Department of Energy, Washington, DC. Office of Basic Energy Sciences, and Office of Naval Research, Arlington, VA.
Pub. in Jnl. of Vacuum Science and Technology A. 4, n3 p257-261 May/Jun 86.

Keywords: *Molecular structure, *Surfaces, *Desorption, Chemisorption, Ammonia, Water, Silver, Iron, Surface chemistry, Reprints, Electron stimulated desorption.

Recent examples of the use of electron stimulated desorption ion angular distribution (ESDIAD) in determining the structures of molecules on surfaces are discussed. These include the adsorption and decomposition of NH3 on Fe(100), and the stabilization of H2O on Ag(110) by impurity O and Br atoms, ESDIAD evidence for 'lying down' CO on several surfaces is presented, and the influence of beam damage in producing new surface structures for H2O on Ni(110) is discussed. Calculations of the influence of the surface image potential and reneutralization effects on ion trajectories are described briefly.

700,325
PB87-149621 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.
Uses and Limitations of ESDIAD for Determining the Structure of Surface Molecules.
Final rept.,
T. E. Madey. 1985, 5p
Pub. in Springer Ser. Surf. Sci., Struct. Surf. 2, p264-268 1985.

Physical & Theoretical Chemistry

Keywords: *Molecular structure, *Surface chemistry, Chemisorption, Reprints, Electron stimulated desorption.

The principles and mechanisms of electron stimulated desorption (ESD) and photon stimulated desorption (PSD), as well as the utility of the electron stimulated desorption ion angular distributions (ESDIAD) method as a tool for determining the structure of surface molecules, have been described in a recent book and several review articles. The present short paper is intended to provide a guide to the relevant literature, and to describe briefly some recent work relating to the uses and limitations of ESDIAD for determining the structure of surface molecules.

700,326

PB87-149779

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

X-ray Absorption Study of Tantalum Oxide Films on Silicon.

Final rept.,

G. G. Long, A. G. Revesz, and M. Kuriyama. 1985,

8p.

Pub. in Jnl. of Non-Crystalline Solids 70, n2 p271-279 1985.

Keywords: *Silicon, *Tantalum oxides, Films, X ray absorption, Reprints.

The results of x-ray absorption measurements are used to demonstrate that noncrystalline Ta 0.29 0.71 films, prepared by thermal oxidation of deposited Ta on Si single crystals, are glassy in the sense that the short range order and bond (chemical) ordering closely resemble those in B-Ta2O5.

700,327

PB87-150660

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.

Re-examination of the Characteristic Fluorescence Correction.

Final rept.,

R. L. Myklebust, and R. B. Marinenko. 1984, 3p

Pub. in Proceedings of the Annual Conference - Microbeam Analysis Society (19th), Bethlehem, PA., July 16-20, 1984, p205-207.

Keywords: Fluorescence, *Electron microprobes.

Methods of computing the characteristic fluorescence correction factors in quantitative electron microprobe analysis procedures is discussed. Various formulas for calculating fluorescence yields are compared.

700,328

PB87-150686

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.

Use of a Monte Carlo Electron Trajectory Simulation for Quantitative Analysis of Thick Films in the Electron Probe Microanalyzer.

Final rept.,

D. Newbury, R. Myklebust, and E. Steel. 1984, 3p

Pub. in Proceedings of the Annual Conference - Microbeam Analysis Society (19th), Bethlehem, PA., July 16-20, 1984, p198-200.

Keywords: *Microanalysis, Monte Carlo method, *Electron probes.

The analysis of thick films, that is, those whose thickness dimension is greater than 0.1 of the range of a 20 keV electron, is complicated by electron scattering and x-ray absorption and fluorescence effects which differ from bulk targets. Conventional ZAF analysis with normalization produces relative errors of + or - 20% or more. Monte Carlo electron trajectory simulation can be used to calculate x-ray emission from thick film targets in order to provide correction factors to apply to ZAF analysis.

700,329

PB87-150694

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Experimental Study of Thermal Fluctuation in Spinodal Decomposition of a Binary Polymer Mixture.

Final rept.,

M. Okada, and C. C. Han. 1 Nov 86, 11p

Pub. in Jnl. of Chemical Physics 85, n9 p5317-5327, 1 Nov 86.

Keywords: *Polymers, Neutron scattering, Polystyrene, Reprints, *Binary mixtures, *Spinodal decomposition, Poly(ether/methyl-vinyl).

The kinetics of spinodal decomposition of a binary polymer system of polystyrene/poly(vinylmethylether) near its critical composition has been studied by the temperature jump light scattering technique. The results indicate that the linearized theory of the Cahn-Hilliard Cook type which includes the thermal fluctuation term can describe the polymer system very well in the early-time and shallow-quench region. The virtual structure factor $S_x(q)$, which is a consequence of including the thermal fluctuation, has been obtained for the first time. For experiments of deeper quench, the virtual structure factor becomes small in our experimental q range, and the time dependent static structure factor, $S(q,t)$, reduces back to the original Cahn-Hilliard type.

700,330

PB87-150702

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Refractive Index and Evaporation Rate of Individual Smoke Droplets.

Final rept.,

G. W. Mulholland, R. L. McKenzie, E. Marx, and R.

H. Fletcher. 1985, 6p

Pub. in Langmuir 1, n3 p367-372 1985.

Keywords: *Drops(Liquids), *Smoke, *Refractivity, Particle size, Evaporation, Reprints.

The size and refractive index of individual smoke droplets have been measured using a single particle light scattering instrument. Droplets of a given size were selected by use of a mobility classifier and then electrostatically charged. The measured scattered intensities were fitted to curves determined from Mie theory to find the best values of the refractive indices. The refractive index of smoke from a moderately large, steady state smolder reactor is found to be much less variable than that of cigarette smoke. Relative humidity is found to have a significant effect on the evaporation rate of the smoke droplets.

700,331

PB87-150736

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

H2O Adsorption on Ni(110): Evidence for Oriented Water Dimers.

Final rept.,

C. Nöbl, C. Benndorf, and T. E. Madey. 1985, 14p

Pub. in Surface Science 157, n1 p29-42 1985.

Keywords: *Chemisorption, *Nickel, Adsorption, Surface chemistry, Reprints, Electron stimulated desorption.

H2O adsorption on clean Ni(110) surfaces at less than or = 150 K leads at coverages below theta approx. = 0.5 to the formation of chemisorbed water dimers, bound to the Ni substrate via both oxygen atoms. The linear hydrogen bond axis is oriented parallel to the (001) surface directions. With increasing H2O coverage (theta greater than or equal to 0.5), the accumulation of further hydrogen bonded water molecules induces some modifications into the dimer configuration resulting at theta approx. = 1 in a two dimensional hydrogen bonded network with a slightly distorted ice lattice structure and long range order.

700,332

PB87-150751

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

One-Electron and Inner-Shell Energy Levels in High Z Atoms.

Final rept.,

E. G. Kessler, and R. D. Deslattes. 1986, 5p

Pub. in Physica Scripta 34, p408-412 1986.

Keywords: *Atomic energy levels, X ray spectroscopy, Electrons, Reprints.

Precision X-ray spectroscopy of one electron and one vacancy ions in the mid-to-high-Z region is discussed and results are compared to recent theoretical calculations. The comparisons are made as a function of Z and reveal deficiencies in the theoretical calculations and experimental measurements. Pertinent experimental topics are briefly covered including wavelength normalization, production of clean X-ray spectra (free of satellites), and high resolution instrumentation. Dis-

cussion of the theoretical calculations includes the variation of various terms as a function of Z and the importance of correlation effects in one vacancy ions. Future experimental measurements are briefly mentioned.

700,333

PB87-150876

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Two-Photon Optical Spectroscopy of Trapped HgII.

Final rept.,

J. C. Bergquist, D. J. Wineland, W. M. Itano, M.

Hemmati, H. U. Daniel, and G. Leiberman.

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and Office of Naval Research, Arlington, VA.

Pub. in Laser Spectroscopy VII 49, p6-9 1985.

Keywords: *Frequency standards, Reprints, *Mercury ions, Multi-photon processes, Laser spectroscopy, Mercury 198.

The Doppler-free, two-photon 5d(10) 6s doublet S(1/2)-5d(9) 6s(2) doublet D(5/2) transition in singly ionized Hg, attractive as an optical frequency standard, has been observed for the first time. A few 198Hg ions were confined in a radio-frequency (rf) trap and the two-photon transition was detected by monitoring the change in the fluorescence light scattered by the ions from a laser beam tuned to the first resonance transition at 194 nm. Optical amplitude modulation (AM) sidebands, induced by the secular (thermal) motion of the harmonically bound ions, were observed also for the first time.

700,334

PB87-150884

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Rotational Structure of (16)O2, (16)O(17)O, and (16)O(18)O (X (sup 3)Sigma g bar) from Laser Magnetic Resonance Spectra.

Final rept.,

M. Mizushima, L. R. Zink, and K. M. Evenson. 1984,

10p

Pub. in Jnl. of Molecular Spectroscopy 107, n2 p395-404 1984.

Keywords: *Rotational spectra, *Oxygen, Molecular spectroscopy, Isotopes, Reprints, Laser magnetic resonance.

Improved values of the rotational constants, B and D of (16)O (17)O(v=0) and D of (16)O2(v=1) were obtained from an analysis of the laser magnetic resonance spectra at 765 and 4252 GHz.

700,335

PB87-151270

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Microelectronics Dimensional Metrology in the Scanning Electron Microscope, Part 2.

Final rept.,

M. T. Postek, and D. C. Joy. Dec 86, 9p

Pub. in Solid State Technology 29, n12 p77-85 Dec 86.

Keywords: Metrology, Reprints, *Scanning electron microscopy.

The initial installment of the paper appeared in our November 1986 issue. In this concluding installment, the effects of the electron beam/sample interaction and its modelling with the Monte Carlo technique are discussed. The various sources of error in SEM metrology are also examined. Finally, the prospect of automated wafer inspection and progress in establishing SEM measurement standards are outlined.

700,336

PB87-151288

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Redistribution of Radiation in the Absence of Collisions.

Final rept.,

G. G. Lombardi, D. E. Kelleher, and J. Cooper. 1985,

4p

Pub. in Astrophysical Jnl. 288, n2 p820-823 1985.

Keywords: *Helium, *Hydrogen, *Spectral lines, Excitation, Radiation, Reprints.

CHEMISTRY

Physical & Theoretical Chemistry

Redistribution and depolarization of near-resonant radiation was studied for the He 2 singlet P - 3 singlet D line (668 nm) (and some data are also presented for H(α) (656 nm)). These transitions have lower levels with natural line widths large compared with their upper level natural widths and, under experimental conditions, their collisional widths were also small. The authors measurement of the ratio of Rayleigh to fluorescent intensities confirm the prediction that redistribution of radiation occurs in the absence of collisions for transitions having significant lower level radiative widths. Depolarization rates by collisions with helium were also inferred from the measurements.

700,337
PB87-151478 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Magnetic Excitations in Transition Metals.

Final rept.,

J. W. Lynn. 1984, 9p

See also report dated Dec 84, DE85-007396.

Pub. in Proceedings of 1984 Workshop on High-Energy Excitations in Condensed Matter, Los Alamos, New Mexico, February 13, 1984, v1 p255-263.

Keywords: *Transition metals, *Excitation, Atomic energy levels, Iron, Cobalt, Nickel, Chromium, Neutron scattering.

A brief review is given of the spin dynamics of the 3d elements Fe, Co, Ni and Cr. These materials have proved difficult to investigate thoroughly because the excitations extend to very high energies, but should be well suited to study with spallation neutron sources as demonstrated by recent measurements on pure iron at IPNS.

700,338
PB87-151502 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

What Controls the Thicknesses of Wetting Layers.

Final rept.,

R. F. Kayser, M. R. Moldover, and J. W. Schmidt.

1986, 19p

Pub. in Jnl. of Chem. Soc., Faraday Trans. 82, p1701-1719 1986.

Keywords: *Wetting, *Substrates, Thickness, Adsorption, Fluid dynamics, Diffusion, Reprints.

Wetting layers can form on solid and fluid substrates when the long-ranged part of the effective intermolecular potential (which tends to thicken the layers) competes with gravity (which tends to thin the layers). Authors have reported layers whose thicknesses range from 7 to 600 nm on a variety of substrates. The authors use the theory of dispersion forces to make simple estimates of a layer's thickness in equilibrium. The estimates imply that, in certain cases, the measured, thickness differs by a factor 10 from the thickness expected in equilibrium. To resolve these differences, they have estimated the rates of several hydrodynamic processes are estimated.

700,339
PB87-151510 Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Theoretical Calculation of the Transport Properties of Monatomic Lithium Vapor.

Final rept.,

P. M. Holland, L. Biolsi, and J. C. Rainwater. 1986,

8p

Pub. in Jnl. of Chemical Physics 85, n7 p4011-4018, 1 Oct 86.

Keywords: *Transport properties, *Lithium, *Vapors, Thermophysical properties, Diffusion, Reprints, Monatomic gases, Atom-atom collisions.

Transport properties of dilute monatomic gases depend on two body atom-atom interaction potentials. When two ground state (doublet S) lithium atoms interact, they can follow either of two potential energy curves corresponding to the Li₂ molecule in the X singlet Sigma(1+)(sub g) or triplet Sigma(1+)(sub u) state. Transport collision integrals for these states have been calculated by accurately representing quantum mechanical potential energy curves with the Hulburt-Hirschfelder potential. The excellent agreement of calculated viscosities with experimental results provides further evidence that the potential can be used to estimate accurately transport properties under conditions where experimental data are sparse or unavailable.

700,340
PB87-151635 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Modifying Structure and Properties of Optical Films by Coevaporation.

Final rept.,

A. Feldman, E. N. Farabaugh, W. K. Haller, D. M.

Sanders, and R. A. Stempniak. 1986, 6p

Contracts AFOSR-ISSA-84-00060, AFOSR-ISSA-84-0006

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Jnl. of Vacuum Science and Technology A4, n6 p2969-2974 Nov/Dec 86.

Keywords: *Optical materials, *Thin films, Molecular structure, Refractivity, Optical properties, Reprints, *Coevaporation.

Coevaporated e-beam films show modification of structure and properties that depend on composition. In pure zirconia films, x-ray diffraction indicates two crystal phases present and scanning electron microscopy (SEM) shows a columnar structure. The pore fractions in these films can exceed 25%. The admixture of small amounts of silica (<20% by volume) results in films having a single crystalline phase. At volume fractions of silica >20%, the films show an amorphous structure lacking columnar growth. Measurements of refractive index and thickness as a function of composition indicate an initial decrease in porosity with increasing silica content. A simple model gives the porosity of the films as a function of composition. In addition, the mixed films show greater index stability, decreased surface roughness, and decreased optical scatter.

700,341
PB87-151999 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.

Effect of Electron Correlation in the Target Wavefunction on Electron-molecule Scattering.

Final rept.,

J. R. Rumble, W. J. Stevens, and D. G. Truhlar.

1984, 7p

Pub. in Jnl. of Physics B-Atomic and Molecular Physics 17, n15 p3151-3157 1984.

Keywords: *Nitrogen, Elastic scattering, Reprints, *Electron-molecule collisions.

Elastic scattering cross sections for electron scattering by N₂ have been calculated in the static-plus-local-exchange model using two different target wavefunctions: Hartree Fock (HF) and Multi-configuration Self-Consistent-Field First-Order-Configuration-Interaction (MCSF-FOCI). The range of impact energy considered is 1.5 to 30 eV. Inclusion of electron correlation in the target wavefunction changes the position of the Pi(sub g) low-energy resonance by about 0.5 eV. Non-resonant partial cross sections typically change by 2% at the equilibrium internuclear separation but sometimes more (up to 26% at the equilibrium internuclear distance and even more at stretched geometries).

700,342
PB87-152013 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.

Measurement of Resonant and Non-Resonant Third Order Nonlinear Susceptibilities by Coherent Raman Spectroscopy.

Final rept.,

G. J. Rosasco, and W. S. Hurst. 1985, 19p

Pub. in Physical Review A-General Physics 32, n1 p281-299 1985.

Keywords: *Nitrogen, Gases, Reprints, *Raman spectroscopy.

A phase modulation technique for coherent Raman spectroscopy is used to measure both the real and imaginary parts of the third-order nonlinear susceptibility of gases. The Raman Q-branch resonance of D₂ is calibrated by comparison to the Q-branch resonance of N₂. By using D₂ as an internal standard, the non-resonant electronic susceptibility of Ar and the sum of the electronic and molecular reorientation contributions to the non-resonant susceptibility of N₂ are determined. The results of these measurements are compared to published data on the Q-branch Raman cross-section of H₂, to predictions from the theory of the optical (AC) Kerr effect, and to measurements of

electronic hyperpolarizabilities. Formula inter-relating a number of different definitions of third-order susceptibilities found in the literature are presented.

700,343
PB87-152864 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Molecular Half Collision Analysis of Atomic Line-shapes.

Final rept.,

F. H. Mies, and P. S. Julienne. 1985, 28p

Pub. in Spectral Line Shapes 3, p393-420 1985.

Keywords: *Dissociation, *Photochemical reactions, Reprints, *Atomic line shapes.

Given current access to powerful quantum chemistry codes which provide interaction potentials, electronic wavefunctions and coupling matrix elements for diatomic molecules, and given the very stable numerical close-coupling codes that are available, the authors can generate multichannel continuum wavefunctions Psi(1+, sub i) for the diatom AB of almost arbitrary accuracy. If these numerical capabilities are coupled with the rigorous analytic description of the diatomic wavefunctions provided by multichannel quantum defect analysis (MCQDA), especially in the vicinity of dissociation thresholds, the authors are in a position to describe a wide variety of diatom phenomena with a great deal of confidence, and with renewed insights.

700,344
PB87-153672 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Stimulated Desorption Studies of Defect Structures on TiO₂.

Final rept.,

R. L. Kurtz. 1986, 27p

Sponsored by Office of Naval Research, Arlington, VA. Pub. in Surface Science 177, p526-552 1986.

Keywords: *Titanium dioxide, *Rutile, *Desorption, Surfaces, Reprints, Electron stimulated desorption, Photon stimulated desorption.

The influence of the surface geometric structure on the electron and photon-stimulated desorption (ESD, PSD) ion yield from TiO₂(001) and TiO₂(110) has been studied. For both surfaces, angle-integrated ESD yields have been measured as a function of annealing temperature ranging from room temperature sputtered surfaces to 1200 K annealed surfaces. These measurements imply that the local geometry of the desorption site must be considered in order to adequately explain the observed ion yield variations.

700,345
PB87-153698 Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Alkali-Metal Negative Ions. 4. Multichannel Calculations of K(1-) Photodetachment.

Final rept.,

K. T. Taylor, and D. W. Norcross. 1986, 14p

Grant NSF-PHY82-00805

Sponsored by National Science Foundation, Washington, DC.

Pub. in Physical Review A 34, n5 p3878-3891 Nov 86.

Keywords: Reprints, *Photodetachment, *Negative ions, *Alkali metals.

The results of ab initio calculations of photodetachment of K(1-) are presented and compared with experimental measurements. The energy region studied is from threshold to the vicinity of the first excited state of neutral potassium. The calculations are essentially nonrelativistic in nature, but the fine structure in the first excited state (a doublet) is resolved in the calculations by a three-step process: a transformation of dynamical variables to a form that is relatively independent of energy over an energy range comparable to the splitting, an algebraic transformation from LS to jj coupling, and finally by kinematic corrections for the splitting. The initial transformation, a simple phase rotation, was determined empirically, but is shown to be consistent with a formal correction for the effects of long-range polarization forces in electron scattering by potassium near the np(2)p(0) threshold.

700,346
PB87-153706 Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Observation of Quantum Jumps.

Final rept.,

T. Sauter, W. Neuhauser, R. Blatt, and P. E.

Toschek. 1986, 3p

Pub. in Physical Review Letters 57, n14 p1696-1698, 6 Oct 86.

Keywords: *Reprints, *Barium ions, *Laser spectroscopy, *Resonance fluorescence, Ion trapping.

The authors have recorded the laser-excited resonance fluorescence of one to three Ba(+) ions and observed Bohr's 'quantum jumps' when an ion decayed to the metastable doublet D(5/2) state, suddenly quenching its fluorescence. Most of the jumps mark Raman-Stokes scattering from the doublet S(1/2) and doublet D(3/2) levels.

700,347

PB87-153805

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Stark Broadening of H(sub alpha) and H(sub beta) Lines of C(5+).

Final rept.,

D. H. Oza, R. L. Greene, and D. E. Kelleher. 1986,

4p

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Review A 34, n5 p4519-4522 Nov 86.

Keywords: *Carbon, Spectral lines, Electrons, Density, Reprints, *Stark broadening.

The authors have computed the Stark-broadened profiles of the first two Balmer lines ($n=3,4 \rightarrow 2$) of C(5+). Plasma conditions span the electron density range $n(\text{sub } e)=10(\text{sup } 17)\text{--}10(\text{sup } 20)/\text{cc}$, and $T=20\text{--}300\text{ eV}$. The calculations include ion-dynamic effects, which are very important at the lower densities for H(sub alpha) ($n=3 \rightarrow 2$). At the higher densities, the dynamic profiles approach the static ones.

700,348

PB87-153847

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.

Characterization of Single Levitated Droplets by Raman Spectroscopy.

Final rept.,

R. E. Preston, T. R. Lettieri, and H. G. Semerjian.

1985, 3p

Pub. in Langmuir 1, n3 p365-367 1985.

Keywords: *Drops(Liquids), Aerosols, Molecular spectra, Reprints, *Raman spectroscopy.

The results of a preliminary investigation into the use of Raman spectroscopy for the chemical characterization of single aerosol droplets are reported. The dioctyl phthalate droplets, 10 to 35 micrometers in diameter, were suspended by the radiation pressure of an argon ion laser beam. Initial experiments used a photomultiplier-based system which collected a 400 cm wide spectrum in about one half hour. This system was adequate for monitoring quasi-static droplet processes, but for faster processes an optical multichannel analyzer-based system was used to collect spectra in about one second. Droplet spectra from both instruments showed sharp, unexplained features not present in bulk liquid spectra.

700,349

PB87-157111

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Electronic Transition Dipole Moment Functions for NaK.

Final rept.,

L. B. Ratcliff, D. D. Konowalow, and W. J. Stevens.

1985, 14p

Pub. in Jnl. of Molecular Spectroscopy 110, n2 p242-255 Apr 85.

Keywords: *Dipole moments, Molecular spectroscopy, Reprints, Diatomic molecules.

Phase consistent electronic transition dipole moment functions are calculated (as a function of internuclear separation) for the 80 dipole selection rule allowed transitions in the manifold of states of NaK treated by the authors earlier. Agreement is found with experimental determinations of the Z (sup 1)Pi - 1 (sup 1) sigma(1+) transition. Agreement of the asymptotic

values with experimental and previous theoretical determinations of corresponding atomic transition moments suggests that the present computations may be relatively reliable. The positions of a number of satellite bands are predicted from their potential energy difference curves.

700,350

PB87-157152

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Neutron and X-ray Diffraction Study on Polymorphism in Lithium Orthotantalate, Li3TaO4: Correction and Discussion.

Final rept.,

R. S. Roth. 1984, 2p

See also report dated 1983, PB84-137876.

Pub. in Jnl. of Solid State Chemistry 51, n3 p403-404 1984.

Keywords: *Neutron diffraction, *X ray diffraction, *Polymorphism, Synthesis(Chemistry), Stability, Low temperature tests, Reprints, *Lithium tantalates.

Synthesis and stability of various polymorphs of Li3TaO4 are discussed and a wrong impression, given in the previous paper of the same title, is corrected.

700,351

PB87-161568

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Theory of Ostwald Ripening.

Final rept.,

P. W. Voorhees. Jan 85, 21p

See also report dated January 1, 1984, AD-A139661.

Pub. in Jnl. of Statistical Physics 38, n1-2 p232-252 Jan 85.

Keywords: *Phase transformation, *Ostwald ripening.

Developments in the theory of Ostwald ripening since the classic work of I. M. Lifshitz and V. V. Sloyzov (LS) is reviewed and directions for future work are suggested. Recent theoretical work on the role of a finite volume fraction of coarsening phase on the ripening behavior of two-phase systems is reformulated in terms of a consistent set of notation through which each of the theories can be compared and contrasted. New work on transient Ostwald ripening is presented which illustrates the broad range of behavior which is possible in the regime. The conditions responsible for the presence of the asymptotic state first discovered by LS, as well as the manner in which this state is approached is also discussed. The role of elastic fields during Ostwald ripening in solid-solid mixtures is reviewed, and it is shown that these fields can play a dominant role in determining a solid-solid systems coarsening behavior.

700,352

PB87-161576

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Trends in the Electric Quadrupole Fields at Dilute Impurity Sites in Transition Metal-Transition Metal Alloys.

Final rept.,

R. E. Watson, R. M. Sternheimer, and L. H. Bennett.

1 Nov 84, 11p

Pub. in Physical Review B 30, n9 p5209-5219, 1 Nov 84.

Keywords: *Transition metals, Alloys, Reprints, Electric quadrupole fields.

The available electric field gradient data at transition metal impurity and at host sites in transition metal hosts has been inspected for indications of trends in alloying behavior. The raw data indicates that the gradients fall in two groups, depending on whether the host metal has over or under half-filled d bands, and the gradients for any given probe atom are largely independent of which host, in a given group, is involved. Inspection of the normalized results suggests that the observed gradients, by their very magnitude, must be largely intra-atomic in origin. It is found that, while there is scatter in the data, the gradients at host and impurity sites, in the under half-filled d shell hosts, show little chemical variation with either differing impurity or differing host. The normalized data for the over half-filled d shell hosts, on the other hand, appear to show a chemical trend which is also to be seen in the enthalpies of formation of the more concentrated alloys.

700,353

PB87-161634

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Convection-Induced Distortion of a Solid-Liquid Interface.

Final rept.,

R. J. Schaefer, and S. R. Coriell. 1984, 7p

Pub. in Metallurgical Transactions A 15A, n12 p2109-2115 1984.

Keywords: *Convection, Crystal growth, Stability, Solidification, Reprints.

Measurements of convective flow fields and solid-liquid interface shapes during the solidification of a pure and a slightly alloyed transparent material reveal that the convective transport of solute can cause a macroscopic depression to develop in the solid-liquid interface. This effect occurs under conditions close to those which are predicted to produce morphological instability of a planar interface. A cellular or dendritic microstructure later develops within the interface depression. The convection is attributed to the effect of radial temperature gradients in the crystal growth apparatus.

700,354

PB87-161741

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Observation of Quantum Jumps In a Single Atom.

Final rept.,

J. C. Bergquist, R. G. Hulet, W. M. Itano, and D. J.

Wineland. 6 Oct 86, 4p

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and Office of Naval Research, Arlington, VA.

Pub. in Physical Review Letters 57, n14 p1699-1702, 6 Oct 86.

Keywords: *Atoms, *Atomic energy levels, Fluorescence, Reprints, *Mercury ions, Ion trapping, Laser cooling.

The authors detect the radiatively driven electric quadrupole transition to the metastable doublet D(5/2) state in a single, laser-cooled Hg II ion by monitoring the abrupt cessation of the fluorescence signal from the laser-excited doublet S(1/2) -> doublet P(1/2) first resonance line. When the ion 'jumps' back from the metastable D state to the ground S state, the S -> P resonance fluorescence signal immediately returns. The statistical properties of the quantum jumps are investigated; for example, photon antibunching in the emission from the D state is observed with 100% efficiency.

700,355

PB87-161758

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Far-Infrared Laser Magnetic Resonance Spectrum of the CF Radical and Determination of Ground State Parameters.

Final rept.,

J. M. Brown, J. E. Schubert, R. J. Saykally, and K. M.

Evenson. 1986, 14p

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

Pub. in Jnl. of Molecular Spectroscopy 120, p421-434 1986.

Keywords: *Chemical radicals, Ground state, Far infrared radiation, Molecular spectroscopy, Reprints, *Electronic structure.

Observations in the far-infrared laser magnetic resonance spectrum of the CF radical in its ground (sup 2)Pi state have been extended to include fine structure transitions between the two spin components. The data are fitted together with all previous measurements relating to the nu=0 level to obtain a complete set of molecular parameters, including the spin-orbit splitting which has been determined at 77.196916(14)/cm. The implications for the electronic structure of various parameters are also discussed.

700,356

PB87-161790

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.

CHEMISTRY

Physical & Theoretical Chemistry

Interaction of Water with Li-Predosed Ru (001).

Final rept.,
S. Semancik, D. L. Doering, and T. E. Madey. 1985, 2p
Pub. in Jnl. of Vacuum Science and Technology A - Vacuum Surfaces and Films 3, n3 p1571-1572 1985.

Keywords: *Sorption, *Ruthenium, *Water, Surface chemistry, Lithium, Reprints, Electron stimulated desorption.

Surface sensitive techniques have been used to investigate the reaction of H₂O with Li on a Ru(001) crystal. Water dissociation was found to occur for Li coverages significantly lower than those at which Na induced H₂O decomposition on the same substrate.

700,357

PB87-161840

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Thermophysics Div.

Ellipsometry of Thin Films on Vapor-Liquid Interfaces.

Final rept.,
J. W. Schmidt, and M. R. Moldover. Dec 83, 3p
Pub. in Jnl. Phys. Colloq. 44, nC-10 p243-245 Dec 83.

Keywords: *Thin films, *Polarimetry, Reprints, Binary mixture, Cyclohexane/methyl-perfluoro, Isopropanol.

In certain binary solutions the lower of the two liquid phases can form a layer which intrudes between the upper liquid phase and the vapor. As the temperature is increased, the intruding layer abruptly appears at a characteristic wetting temperature $T(\text{sub } w) = 311\text{K}$. This temperature is well below the consolute temperature ($T(\text{sub } c) = 363\text{K}$). Below $T(\text{sub } w)$, the layer's thickness (measured by ellipsometry) may be zero and is no greater than 2 nm. Above $T(\text{sub } w)$ the intruding layer's thickness is several hundred Angstroms and its variation with temperature is extremely weak. As the temperature of a particular sample was raised still further towards $T(\text{sub } c)$ the lower phase dissolved into the upper liquid phase. At 328K the lower phase disappeared. Within \pm or - 0.05 K of this temperature the film thickness abruptly returned to zero. These data provide strong experimental evidence that both transitions are first order.

700,358

PB87-161857

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Thermophysics Div.

Transport Properties of Isobutane.

Final rept.,
J. C. Nieuwoudt, B. Le Neindre, R. Tufeu, and J. V. Sengers. 1987, 8p
Pub. in Jnl. of Chemical and Engineering Data 32, n1 p1-8 1987.

Keywords: *Transport properties, Butanes, Viscosity, Thermal conductivity, Reprints, *Isobutane.

Representative equations are presented for the viscosity and thermal conductivity of isobutane as a function of temperature and density. The equations are based on existing experimental data for the viscosity and new experimental data for the thermal conductivity of isobutane.

700,359

PB87-162053

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Scientific Computing Div.

Molecular Dynamics on Vector Computers.

Final rept.,
F. Sullivan, R. D. Mountain, and J. O'Connell. 1985, 16p
Pub. in Jnl. of Computational Physics 61, n1 p138-153 1985.

Keywords: Algorithms, Reprints, *Molecular dynamics, Computer applications, Cyber-205 computers.

An algorithm has been developed for computer simulation of molecular dynamics. The algorithm, called the 'Method of Lights', is based on sorting and on reformulating the way in which neighbor lists are constructed. It uses data structures compatible with either traditional scalar computer architecture or specialized vector statements which perform computations in parallel. The algorithm has been implemented on the CYBER 205 computer. Tests indicate that the method reduces running time over standard methods in scalar form, and that 'vectorization' produces an order-of-magnitude decrease in execution time.

700,360

PB87-162087

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Length and Mass Div.

Remeasurement of the Rydberg Constant.

Final rept.,
P. Zhao, W. Lichten, H. P. Layer, and J. C. Bergquist. 1986, 4p

Grant NSF-PHY84-19105

Sponsored by National Science Foundation, Washington, DC.

Pub. in Physical Review A 34, n6 p5138-5141 Dec 86.

Keywords: Metrology, Reprints, *Rydberg constant.

The authors report a remeasurement of the Rydberg constant via a single-photon determination of the Balmer- α wavelength. The new value reflects the redefinition of the meter, a reexamination of corrections, and improvements of the experimental apparatus. The result is $R = 109737.31569 \text{ cm}^{-1}$, where $c = 299792458 \text{ m/s}$ by definition. The result does not significantly disagree with the preceding measurement by Amin et al., significantly disagrees with the measurement by Hildum et al., and agrees very well with a recent measurement by Biraben and Julien.

700,361

PB87-162244

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Doppler-Free Resonantly-Enhanced Two-Photon Spectroscopy of np and nf Rydberg States in Atomic Cesium.

Final rept.,
C. J. Sansonetti, and C. J. Lorenzen. Oct 84, 7p
Pub. in Physical Review A 30, n4 p1805-1811 Oct 84.

Keywords: *Cesium, Excitation, Reprints, *Rydberg states, Laser spectroscopy.

The fine-structure intervals of selected np ($n = 18-83$) and nf ($n = 14-28$) Rydberg states in neutral Cs have been measured by Doppler-free resonantly-enhanced two-photon laser spectroscopy with a thermionic diode detector. One cw dye laser was tuned near resonance with a 6s - 5d electric quadrupole transition while a second was scanned through the relevant 5d - np, nf transitions. This is the first Doppler-free study of these series by strictly optical methods. The experimental fine-structure intervals are in good agreement with splitting formulas derived by other authors from fine-structure measurements of lower-lying np and nf levels. Our results and the best previous data have been fitted with several expressions that have been used or suggested for the representation of fine structure data. A recently proposed expansion formula including inverse even powers of the effective quantum number is found to be inconsistent with the best available $n(2)P$ intervals.

700,362

PB87-162285

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Application of a New High Temperature Reactor to Unimolecular Decompositions.

Final rept.,
M. D. Scheer, W. Braun, and J. R. McNesby. 25 Jan 85, 6p
Pub. in Chemical Physics Letters 113, n4 p407-412, 25 Jan 85.

Keywords: *Decomposition, Chemical reactions, Activation energy, Reprints, *Cyclobutanone, *Chemical reactors, Laser applications.

The heating of fused silica by the absorption of laser infra-red radiation is the basis for the design of a short residence time-high temperature reactor. When the laser is focused on the exit orifice of a silica flow tube a dilute mixture of a reactant gas in helium is exposed to the high orifice temperature for only about 2×10^{-5} s. During such short time intervals, secondary decompositions tend to be reduced. The heating method was applied to the multichannel decomposition of cyclobutanone. The formation of propylene by the secondary isomerization of cyclopropane was suppressed sufficiently and shown to be formed directly from the cyclobutanone in a high activation energy channel.

700,363

PB87-162293

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Thermal Decomposition of Ions. 1. Pyrolysis of Protonated Ethers. Activation Energies and A Factors.

Final rept.,
L. W. Sieck, and M. Mautner. 1984, 4p
See also PB87-162301.
Pub. in Jnl. of Physical Chemistry 88, n22 p5324-5327 1984.

Keywords: *Pyrolysis, *Ethers, Mass spectroscopy, Chemical reactions, Gases, Decomposition, Activation energy, Reprints, Rate constants.

Unimolecular rate constants $k(\text{sub } d)$ have been measured at the high pressure limit for the thermal decomposition of protonated dimethoxyethane (glyme) and (2-methoxyethyl) ether (diglyme). In both cases the decomposition involves loss of CH₃OH and formation of an oxy-carbonium ion. The variation of $k(\text{sub } d)$ with temperature gives $\log A = 11.1$ and $E(\text{sub } a) = 21.1 \text{ kcal/mol}$ for the pyrolysis of (glyme)H⁺(+1) and $\log A = 13.7$ and $E(\text{sub } a) = 30.7$ for (diglyme)H⁺. To the best of the authors knowledge these are the first Arrhenius parameters ever determined for the decomposition of cations in the vapor phase under equilibrium conditions at the high pressure limit. The data and thermochemistry are consistent with a transition state in which electron shifts result in the disruption of an internal hydrogen bond.

700,364

PB87-162301

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Thermal Decomposition of Ions. 2. Pyrolysis of Protonated t-Butylmethylether at the Low Pressure Limit. Activation Efficiencies for Various Bath Cases.

Final rept.,
L. W. Sieck, and M. Mautner. 1984, 4p
See also PB87-162293.
Pub. in Jnl. of Physical Chemistry 88, n22 p5328-5331 1984.

Keywords: *Pyrolysis, Chemical reactions, Gases, Reprints, *Ether/butyl-methyl, Rate constants.

The efficiencies of various bath gases in promoting the thermal unimolecular decomposition of (t-C₄H₉O(H₃))H⁺(+1) which dissociates to yield CH₃OH and t-C₄H₉(+1), has been investigated by pulsed high pressure mass spectrometry. These measurements were taken at the low pressure limit at 518 K. Taking the activation efficiency of CO₂ as 1.00, relative values range from 0.42 for N₂ to 3.8 for cyclohexane. The temperature dependence of the efficiencies of N₂ and cyclohexane have also been measured from 500 to 560 K. Comparison of the activation data with efficiencies reported for collisional stabilization (deactivation) of excited ionic substrates shows some striking similarities.

700,365

PB87-163697

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD.

Catalog of Saddle Shaped Surfaces in Crystals.

Final rept.,
J. E. Taylor, and J. W. Cahn. Jan 86, 12p
Pub. in Acta Metallurgica 34, n1 p1-12 Jan 86.

Keywords: *Crystal structures, *Surfaces, Anisotropy, Metallography, Reprints.

The authors present a catalog of features of surfaces of minimum energy in or on solids. This catalog corrects an earlier expectation about local structures by one of us (Cahn) that was too restrictive. The authors list all possible local structures of interfaces under quite general conditions, and provide in the appendix a proof of completeness.

700,366

PB87-163705

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD.

Metallic Phase with Long-Range Orientational Order and No Translational Symmetry.

Final rept.,
D. Shechtman, I. Blech, D. Gratias, and J. W. Cahn. 12 Nov 84, 3p
Pub. in Physical Review Letters 53, n20 p1951-1953, 12 Nov 84.

Keywords: *Aluminum alloys, Symmetry, Reprints, Amorphous materials.

The authors give evidence of a new kind of metallic solid made by rapid solidification that has long-ranged orientational order, but is not a crystal. Its point group symmetry, icosahedral, is inconsistent with lattice translations. The solid is unlike a liquid crystal because it is solid and its orientational order is long-ranged. For the same reasons, it is also unlike several theoretical speculations about locally orientationally ordered phases, such as the hexatic two-dimensional phase. The morphology indicates that the solid forms from the liquid by a first order transition.

700,367

PB87-163770 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Measurement of Ion/Molecule Reactions between 10 and 20 K.

Final rept.,
S. E. Barlow, J. A. Luine, and G. H. Dunn. 1986, 32p
Grant NSF-PHY82-00805

Sponsored by National Science Foundation, Washington, DC.

Pub. in International Jnl. of Mass Spectrometry and Ion Processes 74, p97-128 1986.

Keywords: *Mass spectroscopy, Chemical reactions, Spectroscopic analysis, Reprints, *Penning ion trap, *Ion-molecule collision.

In the paper, the authors describe an instrument and measurement technique which makes possible the determination of gas-phase ion/molecule reactions down to 10 K or lower and up to 20-100 K, depending on the species. The technique is particularly useful for the measurement of reaction rates between 10 to the minus 11th power and 10 to the minus 15th power cc/s to the minus 1 power. The instrument makes use of a cooled hyperbolic Penning trap and a bolometric detector. The authors also describe the behavior of the stored ions and their interactions with the cryogenic neutral gases.

700,368

PB87-163812 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Electron-Impact Excitation of Ions in the Magnesium Sequence. II. S V, Ar VII, Ca IX, Cr XIII, and Ni XVII.

Final rept.
R. B. Christensen, D. W. Norcross, and A. K. Pradhan. Dec 86, 12p

Contract DOE-EA-77-66-6010

Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 34, n6 p4704-4715 Dec 86.

Keywords: *Excitation, Electron scattering, Sulfur, Vanadium, Argon, Calcium, Chromium, Nickel, Reprints, *Electron-ion collisions, *Mg like ions.

Collision strengths are presented for all transitions between the states (including fine structure) 3s(2) singlet S(sub 0), 3s 3p(triplet P(sub 0,1,2), singlet P(sub 1)), 3p(2) (triplet P(sub 0,1,2), singlet D(sub 2), singlet S(sub 0), 3s 3d (triplet D(sub 1,2,3), singlet D(sub 2), and 3s 4s (triplet S(sub 1), singlet S(sub 0)) in Mg-like ions Sv, Ar VII, Ca IX, Cr XIII, and Ni XVII. The calculations are carried out in LS coupling using the distorted-wave approximation with a ten-state eigenfunction expansion. Relativistic effects in the target states are taken into account using the Breit-Pauli Hamiltonian, and the term-coupling coefficients thereby obtained are employed to accomplish the transformation of the scattering matrices to intermediate coupling. Atomic effects involving autoionizing resonances in some transitions are considered, as well as the contribution of high partial waves to the transition 3s(2) singlet S(sub 0) - 3s 3d singlet D(sub 2). The problem of bound-channel correlation-type functions in the eigenfunction expansion is discussed in some detail.

700,369

PB87-163820 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Time-Resolved FTIR Photofragment Emission Spectroscopy: HCl Vibrational Distributions from the 193 nm Photolysis Chloroethylenes.

Final rept.,
D. J. Donaldson, and S. R. Leone. 12 Dec 86, 7p
Contract DE-AC02-79-ER10396, Grant NSF-CHE84-08403

Sponsored by Department of Energy, Washington, DC., and National Science Foundation, Washington, DC.

Pub. in Chemical Physics Letters 132, n3 p240-246, 12 Dec 86.

Keywords: *Infrared spectroscopy, Vinyl chloride, Hydrogen chloride, Reprints, *Fourier transform spectroscopy, Ethylene/dichloro.

With minor modifications to commercial instrumentation, time-resolved FTIR emission spectroscopy is demonstrated for the determination of photofragment internal state distributions. Vinyl chloride and dichloroethylene photolysis at 193 nm serve as test cases and exhibit high signal-to-noise. The vibrational distributions in the first four levels of the HCl photoproduct of vinyl chloride and 1,2-trans-dichloroethylene are in good agreement with previous determinations.

700,370

PB87-163861 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Chemical Engineering Science Div.

Thermodynamics of Ammonium Scheelites. 3. An Analysis of the Heat Capacity and Related Data of Deuterated Ammonium Perrhenate ND4ReO4.

Final rept.,
R. J. C. Brown, J. E. Callanan, R. D. Weir, and E. F. Westrum. 15 Nov 86, 8p

See also PB87-118105. Sponsored by Natural Sciences and Engineering Research Council of Canada, Ottawa (Ontario), and Department of National Defence, Ottawa (Ontario).

Pub. in Jnl. of Chemical Physics 85, n10 p5963-5970, 15 Nov 86.

Keywords: *Thermodynamics, Specific heat, Deuterium compounds, *Ammonium scheelites, Heat capacity.

An analysis of the heat capacity of deuterated and undeuterated NH4ReO4 has been carried out in which the effects of the anisotropy of the thermal expansion have been considered, an approach hitherto not used for ammonium compounds. In the ammonium scheelites, the axial thermal expansion coefficients are very large, but of opposite sign, and as a result the volume of the scheelite lattice is nearly independent of temperature. It is shown that the correction from constant stress to constant strain results in a major contribution to the heat capacity of this highly anisotropic lattice. The difference between the experimental and calculated values of heat capacity, referred to as $\Delta C(p)$, is expressed as the sum of the contributions from the anisotropy and the rotational heat capacity. The results of the analysis show that the rotational contribution is much smaller than previously thought. However, the exact contribution of the anisotropy cannot be calculated at this time because the elastic constants are not known.

700,371

PB87-164000 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Thermophysics Div.

Stabilized Vapor Liquid Interface in Deuterated Cyclohexane-Methanol Mixtures.

Final rept.,
J. W. Schmidt. 15 Sep 86, 5p

Contract NASA-H-27954-B

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

Pub. in Jnl. of Chemical Physics 85, n6 p3631-3635, 15 Sep 86.

Keywords: *Cyclohexane, Ellipsometry, Carbinols, Interfaces, Deuterium compounds, Reprints, *Binary mixtures, *Methanol.

The ellipticity of the vapor-liquid interface above mixtures of methanol (CH3OH) and deuterated cyclohexane (C6D12) has been measured in the vicinity of the consolute point. The data above and below T(sub c) are consistent with models for the structure of the interface adapted from the theory of Widom and Ramos-Gomez and Widom. As three-phase coexistence is approached, the quantity of methanol adsorbed at the interface increases whether ordinary or

deuterated cyclohexane is used in the mixture. If ordinary cyclohexane were used for studies within the three-phase region below T(sub c), thick, unstable, lenticular films of the methanol-rich liquid phase would form at the interface and lead to nonreproducible data. In the present measurements lenticular films do not form when deuterated cyclohexane is used in the mixture. (The entire methanol-rich phase then forms on top.) The gravitationally stable interface above the deuterated mixture can be studied reliably in the three-phase region below T(sub c) even though the liquid phases are nearly density matched.

700,372

PB87-164018 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Thermophysics Div.

Surface Properties of the Mixture Water + Phenol.

Final rept.,
F. Guzman, and J. W. Schmidt. 15 Jan 87, 2p
Pub. in Jnl. of Physical Chemistry 91, n2 p263-264, 15 Jan 87.

Keywords: *Phenol, *Water, *Surface properties, Wetting, Polarimetry, Reprints, Binary mixtures.

A surprising observation concerning the vapor-liquid interface in the mixture phenol + water has been confirmed. An ellipsometric study of this mixture shows no indication of a thick wetting layer at the vapor-liquid interface when the mixture undergoes a transition from one into two liquid phases. The behavior in this system is markedly different from that of alcohol + fluorocarbon systems studied with the same technique in which layers form that can be hundreds of angstroms thick. By contrast in this system hundreds of tiny droplets form at the vapor-liquid interface and persist for many hours both in thermally equilibrated and in steadily cooled samples. Ellipticity values from equilibrated samples when interpreted via a slab model yield film thicknesses of only two or three monolayers.

700,373

PB87-165684 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Electron-Impact Excitation of the Resonance Transition in Be (+1): An 'ab Initio' Treatment of Core-Correlation and -Polarization Effects.

Final rept.,
F. A. Parpia, D. W. Norcross, and F. J. da Paixao. Dec 86, 8p
Contract DOE-77-A-01-6010

Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 34, n6 p4777-4784 Dec 86.

Keywords: *Excitation, *Beryllium, Electron scattering, Reprints.

The authors present theoretical electron-impact-excitation cross sections for several transitions in Be(+1), and fluorescence radiation polarizations for the Be(+1) resonance doublet. The projectile-electron energy varies from 0.3-2.0 Ry. A five-state close-coupling approximation is used. The target model is the most sophisticated employed in any scattering calculation to date, and yields oscillator strengths for several transitions in Be(+1) that are the most accurate available. The results do not, however, improve upon previous work as regards the notable discrepancies between calculations and experimental measurements for excitation of the resonance transition. This indicates that high rigor in the treatment of short-range core-correlation effects is not required for an accurate description of these processes, and therefore either that other, heretofore ignored, effects must be taken into account in the theory or that other measurements are necessary. An accurate measurement of the hyperfine structure of the $j=3/2$ fine-structure level of the doublet would be of particular and decisive importance.

700,374

PB87-165692 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Bound Electronic States of HCl(-1).

Final rept.,
S. V. O'Neil, P. Rosmus, D. W. Norcross, and H. J. Werner. 15 Dec 86, 9p
Contract DOE-EA-77-A-01-6010, Grant NSF-PHY82-00805

Sponsored by National Science Foundation, Washington, DC., and Department of Energy, Washington, DC.

Pub. in Jnl. of Chemical Physics 85, n12 p7232-7240, 15 Dec 86.

Keywords: *Hydrogen chloride, Reprints, *Electronic structure.

The paper reports ab initio Born-Oppenheimer calculations on the X singlet Sigma state of HCl and on the 1 double Sigma, 2 doublet Sigma and (sup 2)Pi states of HCl(-1) for internuclear distances at which these states are electronically bound. The calculations employed square-integrable configuration interaction wave functions which included all single and double replacements from multiconfiguration reference functions. The MC-SCF reference configurations and the Gaussian atomic basis encompass the dominant effects which govern the electronic states studied. In the process of these calculations, the authors have calculated the static polarizability of Cl(-1) and reproduced the known polarizabilities of H, Cl, and H(-1). The calculations on the X singlet Sigma state of HCl yield a D(sub e) within 0.10 eV of the measured value, and omega (sub e) within 3/cm of the measured value. For the molecular ion, they find the potential of the doublet Sigma state of HCl(-1) to be attractive and to undergo substantial charge transfer, and the potential of the (sup 2)Pi and 2 doublet Sigma states to be repulsive even at large internuclear separations.

700,375
PB87-165726 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Optimized Predictions for Heats of Formation of Transition-Metal Alloys 2.
Final rept.,
R. E. Watson, and L. H. Bennett. 1984, 15p
Pub. in CALPHAD: Computer Coupling Phase Diagrams Thermochem 8, n4 p307-321 1984.

Keywords: *Heat of formation, *Transition metals, Thermodynamic properties, Enthalpy, Reprints.

A simple Friedel type d-band model of alloy enthalpies of formation has been used in an interpolation scheme, fitted to experimental data, to obtain heats for the 50/50 transition-metal alloys. This present fit employs a data base which is substantially improved over the one used previously in the journal. The fit has also been extended to include La and Th alloys. The rms error in the fit, for the set of alloys for which there is experimental enthalpy, is the same as the rms uncertainty in that data. Granted this, these enthalpy values should be of use in the thermodynamic predictions of phase diagrams for which there is no experimental data.

700,376
PB87-165742 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Quasi-Static Ion Broadening of Isolated Spectral Lines.
Final rept.,
L. A. Woltz. 1986, 9p
Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 36, n6 p547-555 1986.

Keywords: *Spectral lines, Reprints, *Static ion broadening.

A tabulation of theoretical profiles of isolated spectral lines broadened by quasi-static ions is presented. This calculation is based on the quasi-static ion theory of Griem. A greater frequency range and a larger number of ion-broadening parameters than published by Griem are employed to facilitate comparisons with experiments. Observations on the validity of asymptotic wing formulas are included.

700,377
PB87-165890 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Autoionization States (3i3i') of the Helium-Like Nitrogen Ion.
Final rept.,
D. H. Oza. 1987, 5p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Jnl. of Physics B: Atomic and Molecular Physics 20, pL13-L17 1987.

Keywords: Electron scattering, Resonance, Reprints, *Nitrogen ions, *Autoionization.

The scattering of electrons by the N(6+) ion has been studied in the vicinity of the intrashell autoionization

levels (3i3i') of the N(5+) ion using a 14-state pseudostate close-coupling approximation. The resonance parameters (energy and width) are determined for the autoionization states. The present results are in good agreement with those obtained by the complex coordinate rotation method. The energy values of these states are supported by recent experimental measurements of the ejected-electron energies following the autoionization.

700,378
PB87-166443
(Order as PB87-166401, PC A05/MF A01)
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Chemical Engineering.
Ideal Gas Thermodynamic Functions for Water,
H. W. Woolley. 27 Oct 86, 17p
Included in Jnl. of Research of the National Bureau of Standards, v92 n1 p35-53 Jan-Feb 87.

Keywords: *Water vapor, *Steam, *Thermodynamic properties, Ideal gas law, Computer programs, Basic programming language.

The calculation of ideal gas thermodynamic properties for steam to 10,000 K is examined. Centrifugal effects are included using spectroscopic data for the lowest vibrational levels, with extension to higher bending levels based on estimates from a bending model. Modifications are examined for rotational and vibrational cut-off effects. Uncertainties in obtaining a suitably regularized representation of energy versus bond stretching vibration in approaching the dissociation energy region appear relevant to the reliability of the extrapolation.

700,379
PB87-171690 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.
Equilibrium Study of the Conversion of L-Phenylalanine to Trans-Cinnamic Acid and Ammonia.
Final rept.,
Y. B. Tewari, E. Gajewski, and R. N. Goldberg. 12 Feb 87, 6p
Pub. in Jnl. of Physical Chemistry 91, n4 p904-909, 12 Feb 87.

Keywords: *Thermodynamics, *Phenylalanine, *Cinnamic acids, Chemical equilibrium, Amino acids, Carboxylic acids, Chromatographic analysis, Enthalpy, Gibbs free energy, Specific heat, Reprints.

The thermodynamics of the enzymatic conversion (L-phenylalanine ammonia-lyase) of aqueous L-phenylalanine to trans-cinnamic acid and ammonia has been investigated by using high-performance liquid chromatography (HPLC). The reaction was carried out in 0.1 M Tris/HCl buffer containing ammonium chloride over the pH range 7.0-7.7, at ionic strengths from 1.0 to 2.1 mol/kg, and over the temperature range 285-316 K. Analysis of the HPLC data using an estimated heat capacity change of 50 J/mol K and an 'ion-size' parameter of 1.6/mol(sup 1/2) kg(sup 1/2) leads to an equilibrium constant of 1.16 +/- 0.3 mol/kg and an enthalpy change of 24.8 +/- 2.0 kJ/mol at 298.15 K for the process L-phenylalanine (aq) = trans-cinnamic acid (aq) + NH4+(aq). The use of these thermodynamic parameters in an equilibrium model for this system allows for the prediction of values of the apparent equilibrium constant as a function of pH, temperature, and composition and also of the effects of these parameters on the optimal product yield of L-phenylalanine during its manufacture from trans-cinnamic acid and ammonia. The available thermochemical data for this generic type of reaction can be rationalized in terms of a scheme which views the entropy changes for related processes to be comparable and then attributes differences in Gibbs energy changes to differences in enthalpy changes which can be influenced by effects such as resonance stabilization of the double bonds which are formed.

700,380
PB87-171757 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Wavelengths and Energy Levels of Zn XII to Zn XX.
Final rept.,
J. Sugar, and V. Kaufman. 1986, 8p
Sponsored by Department of Energy, Washington, DC.
Pub. in Physica Scripta 34, p797-804 1986.

Keywords: *Zinc, *Atomic energy levels, Wavelengths, Atomic spectra, Reprints.

Spectra of zinc in the ionization stages XII to XX were obtained with a laser-generated plasma and recorded photographically with a 10.7m grazing incidence vacuum spectrograph in the range of 40 to 460 A. Transition arrays of the type 3s(2) 3p(sup n) - 3s 3p((n+1) sup 1) and 3s(2) 3p(sup n) - 3s 3p((n-1) sup 1) 3d in the Al to Cl isoelectronic sequences were analyzed. In addition four excited configurations of Mg-like Zn were established. The authors present measurements of 145 spectral lines, of which 120 are newly classified. Energy levels, fitted radial integrals, and percentage compositions in LS-coupling are given. Previously classified magnetic dipole (M1) lines are compared with these levels for confirmation of their identification, and are sometimes used to improve the level values. For P-like zinc, predicted values for the M1 transitions within the ground configuration are obtained from the new levels.

700,381
PB87-172680 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Interfacial Resistance for Carboxylic Acid Transfer from Decane to Water.
Final rept.,
G. J. Hanna, R. D. Noble, and F. C. Michel. 15 Jan 87, 4p
Pub. in Jnl. of Physical Chemistry 91, n2 p362-365, 15 Jan 87.

Keywords: *Carboxylic acids, *Decane, Acetic acid, Butyric acid, Propionic acid, Water, Reprints, *Interfacial resistance.

The transfer of three carboxylic acids (acetic, propionic, and butyric) from decane to water was studied by using the rotating diffusion cell with organic and aqueous membranes. The interfacial resistance was very sensitive to the value of the diffusion coefficient used. A trend of increasing interfacial resistance with increasing carbon chain length was observed.

700,382
PB87-172755 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Role of Site Conversion in Vibrational Spectroscopy of Adsorbed Molecules.
Final rept.,
J. W. Gadzuk. Feb 87, 10p
Pub. in Jnl. of the Optical Society of America B 4, n2 p201-210 Feb 87.

Keywords: *Carbon monoxide, *Platinum, *Adsorption, Surface chemistry, Vibrational spectra, Reprints.

Extremely useful connections exist between the dynamics of adsorbed molecules and their vibrational spectra, as revealed in optical absorption spectroscopy. These connections have been nicely established by Noid et al. (J. Chem. Phys. 67,404 (1977)). The present study has been motivated by recent experiments suggesting that CO adsorbed on Pt(111) shows evidence for conversion between twofold and threefold symmetric adsorption sites. The role of multiple wells along a reaction coordinate (hindered translations) in determining the vibrational spectrum of an internal mode (intramolecular stretch) anharmonically coupled to the hindered translation is investigated.

700,383
PB87-173696 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Electron Impact Ionization of B(2+) and O(5+): Excitation-Autoionization in Li-Like Ions.
Final rept.,
D. H. Crandall, R. A. Phaneuf, D. C. Gregory, A. M. Howard, D. W. Mueller, T. J. Morgan, G. H. Dunn, D. C. Griffin, and R. J. W. Henry. Sep 86, 11p
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 34, n3 p1757-1767 Sep 86.

Keywords: *Excitation, *Oxygen ions, Reprints, *Oxygen ions, *Boron ions, *Autoionization.

New measurements for the total, single ionization of B(2+) and O(5+) by electron impact are reported with particular attention directed to the indirect contribution of excitation-autoionization. For B(2+) these are the first measurements to our knowledge while for O(5+) the present data improve on previous measurements. In both cases the direct total ionization cross sections are in good agreement with recent distorted-wave pre-

dictions of Younger, and the excitation-autoionization contribution is consistent with measurements for other Li-like ions.

700,384
PB87-173795 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Neutron Powder Diffraction Study and Physical Characterization of Zeolite D-ZK-5 Deep-Bed Calcined at 500 deg C and 650 deg C.

Final rept., R. X. Fischer, W. H. Baur, R. D. Shannon, R. H. Staley, A. J. Vega, L. Abrams, and E. Prince. Sep 86, 10p

Pub. in Zeolites 6, p378-387 Sep 86.

Keywords: *Neutron diffraction, *Ion exchange resins, Reprints, *Powder diffraction, *Zeolites.

Zeolite ZK-5 samples, deep-bed calcined at 500 deg C and at 650 deg C, respectively, were studied by neutron powder diffraction, i.r. and n.m.r. In addition their methanol sorption was measured. The neutron diffraction study shows Cs atoms located in eight rings and shows a peak in the difference Fourier map at 0, approx 0.45, and approx 0.07 in the y cage which has been attributed to non-framework Al/O atoms. The discrepancy between the number of Al/O in the y cage and that found by Al and Si n.m.r. is attributed to the presence of non-framework Al/O in other sites or randomly distributed condensed Al-O-OH clusters.

700,385
PB87-173803 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Structure of the Lithium Insertion Compound Li₂Fe₂(MoO₄)₃ from Neutron Powder Diffraction Data.

Final rept., C. C. Torardi, and E. Prince. 1986, 8p

Pub. in Materials Research Bulletin 21, n6 p719-726 1986.

Keywords: *Neutron diffraction, Molecular structure, Reprints, *Powder diffraction, *Ferric molybdate.

The structure of Li₂Fe₂(MoO₄)₃ has been determined by a profile refinement of neutron powder diffraction data. Li₂Fe₂(MoO₄)₃ was prepared at ambient temperature by the reaction of solid ferric molybdate, Fe₂(MoO₄)₃, with a Li/acetone nitrile solution. The title compound is orthorhombic with a = 12.8947(5), b = 9.4957(4), and c = 9.3477(3) Angstrom, in the space group Pbcn. Its structure is related to that of garnet and langbeinite with corner-sharing Fe(2+)O₆ octahedra and Mo(6+)O₄ tetrahedra. The lithium ions reside in general positions and these sites are ordered and fully occupied. Lithium is tetrahedrally coordinated to oxygen by bridging the edges of two FeO₆ octahedra. Bond valence calculations are entirely consistent with the structure.

700,386
PB87-173878 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Synthesis, Structure and Low Temperature Magnetism of the New Lithium and Sodium Insertion Compounds: LiFe(II)ClMoO₄ and NaFe(II)ClMoO₄.

Final rept., C. C. Torardi, W. M. Reiff, K. Lazar, and E. Prince. 1986, 10p

Pub. in Jnl. of Physical Chemistry Solids 47, n8 741-750 1986.

Keywords: *Magnetism, Molecular structure, Synthesis(Chemistry), Reprints, *Lithium iron chlorine molybdate.

The recently described tetragonal layered compound Fe(III)ClMoO₄ is found to undergo reversible lithium and sodium ion insertion by stirring the solid in an acetone nitrile solution of lithium or sodium iodide under argon. The structure of LiFe(II)ClMoO₄, determined by a Rietveld refinement of neutron powder diffraction data, is essentially the same as that of the precursor and contains Li ions in distorted octahedral sites between the layers. Also, the Fe atoms are shifted to a position where they are 6-coordinated compared to the 5-coordination observed in the ferric precursor. Zero field Mossbauer spectra for the lithium compound undergo hyperfine splitting that corresponds to a three-dimensional magnetic ordering process with T(sub Neel) approx 68.5 K.

700,387
PB87-179354 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Classical Trajectory Surface Hopping Approach to Non-Adiabatic Molecule-Surface Processes.

Final rept., M. Karikorpi, S. Holloway, and J. W. Gadzuk. 1986, 12p

Pub. in Jnl. of Electron Spectroscopy and Related Phenomena 39, p223-234 1986.

Keywords: *Surface chemistry, Reprints, *Molecule collisions.

Scattering processes of diatomic molecules from solid surfaces in which the molecular affinity level crosses the surface Fermi level thus enabling charge transfer back and forth between the metal and molecule are considered here. The nuclei are assumed to move classically on a single model potential energy surface until a diabatic potential energy surface crossing is reached. At such points the trajectory is split into branches, each of which follows a different potential surface. The probability for hopping onto a new potential energy surface or remaining on the initial one is determined within the Landau-Zener-Tully-Preston picture. The phase averaged outgoing vibrational energy as well as the average residence time of the molecular ion resonances have been calculated as a function of the incident kinetic energy treating the off-diagonal matrix element within the Landau-Zener branching probabilities parametrically.

700,388
PB87-179362 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Vibrational Excitation in Gas-Surface Collisions.

Final rept., J. W. Gadzuk, and S. Holloway. Mar 86, 3p

Pub. in Physical Review B33, n6 p4298-4300, 15 Mar 86.

Keywords: *Surface chemistry, *Nitrogen oxide(NO), *Silver, Excitation, Molecular vibration, Reprints, *Molecule collisions.

Recent experimental observations and accompanying interpretation of Rettner, Fabre, Kimman, and Auerbach for vibrational excitation in NO molecules scattered from Ag(III) surfaces are discussed in terms of existing models for such events.

700,389
PB87-179370 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Anisotropic Charge Transfer Rates in the Scattering of Oriented Atoms or Molecules from Surfaces.

Final rept., J. W. Gadzuk. 1987, 12p

Pub. in Surface Science 180, p225-236 1987.

Keywords: *Surface chemistry, Scattering, Excitation, Reprints.

Atoms or molecules scattered from surfaces can undergo charge transfer to or from the surface during the scattering event. It is proposed that when the incident particle is 'prepared' in an excited or ionic state which is oriented with respect to the surface, observable anisotropies in charge transfer rates involving the oriented state should occur. The effect is illustrated with two examples.

700,390
PB87-179404 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Torsional-Wagging Tunneling Problem and the Torsional-Wagging-Rotational Problem in Methylamine.

Final rept., N. Ohashi, and J. T. Hougen. 1987, 28p

See also report dated 1985, PB86-124112. Pub. in Jnl. of Molecular Spectroscopy 121, p474-501 1987.

Keywords: *Methylamine, *Molecular rotation, Molecular vibration, Molecular energy levels, Reprints.

A theoretical formalism is presented for fitting rotational energy levels in isolated (unperturbed) vibrational states of methylamine. The formalism is obtained by

recasting and extending theoretical studies in the earlier literature, which were undertaken to help analyze the methylamine microwave spectrum. The present formalism is applicable when both the NH₂ umbrella (wagging) motion and the CH₃ internal rotation (torsion) motion take place near the high-barrier limit and leads to the usual Fourier sine and cosine series expansions for molecular energy levels. The derivation is separated into two parts, one treating the large-amplitude vibrational problem (the torsional-wagging problem) by itself, the other treating the torsional-wagging-rotational problem. In both treatments, permutation-inversion group and extended group ideas are used to determine the allowed terms in an effective rotational-tunneling Hamiltonian operator and to block diagonalize the matrix representation of this operator for a near-prolate symmetric top. The resulting energy levels and selection rules are discussed, but application of the method in detail to the methylamine spectrum is planned for a later paper.

700,391
PB87-179412 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Infrared Spectrum of the Overtone Band 2nu(sub5,sup0) of the Hydrogen Bonded Complex HCN--HF.

Final rept., M. W. Jackson, B. A. Wofford, J. W. Bevan, W. B. Olson, and W. J. Lafferty. 1 Sep 86, 5p

Pub. in Jnl. of Chemical Physics 85, n5 p2401-2405, 1 Sep 86. Sponsored by National Science Foundation, Washington, DC.

Keywords: *Infrared spectrum, *Hydrogen fluoride, *Hydrogen cyanide, Molecular spectroscopy, Reprints.

The infrared spectrum of the overtone of the 'intramolecular' bending vibration 2nu(sub5,sup0) of the hydrogen bonded complex HCN--HF centered at 1437.539 91 (24)/cm has been obtained with a resolution of 0.006/cm. Line assignments for the band as well as two hot bands 2nu(sub5,sup0) + nu(sub7,sup1) - nu(sub7,sup1) and 2nu(sub5,sup0) + 2nu(sub7,sup2) - 2nu(sub7,sup2) have been made, and rotational constants for all the levels involved have been determined. Despite the fact that the higher J energy levels of the observed lines of 2nu(sub5,sup0) are above the dissociation energy of the complex, no predissociative line broadening is apparent.

700,392
PB87-180840 Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

Programmed Symmetry Lowering in 2D Colloids.

Final rept., Y. Tang, R. M. Malzbender, R. C. Mockler, W. J. O'Sullivan, and J. A. Beall. 1987, 4p

Contract DE-FG02-86ER45236. Sponsored by Department of Energy, Washington, DC. Pub. in Jnl. of Physics A: Mathematical and General 20, pL189-L192 1987.

Keywords: *Colloids, *Dispersions, Electron beams, Electrostatics, Lithography, Reprints, Two dimensional.

A new experimental technique is presented for producing model two-dimensional systems subject to external fields of arbitrary symmetry and variable coupling strength. An aqueous suspension of colloidal microspheres is confined to a single layer between two quartz flats, on one of which a pattern of eroded features is etched using electron-beam lithography combined with plasma etching. By varying the depth of the etched features, the strength of the electrostatic wall-particle forces can be adjusted smoothly. The feasibility of the method is presented, and possible applications are discussed.

700,393
PB87-181285 (Order as PB87-181251, PC A05/MF A01)

National Bureau of Standards, Gaithersburg, MD.

Description of the Thermotropic Behavior of Membrane Bilayers in Terms of Raman Spectral Parameters: A Two-State Model.

W. H. Kirchhoff, and I. W. Levin. 3 Dec 86, 16p

Prepared in cooperation with National Institutes of Health, Bethesda, MD.

CHEMISTRY

Physical & Theoretical Chemistry

Included in Jnl. of Research of the National Bureau of Standards, v92 n2 p113-128 Mar-Apr 87.

Keywords: *Phase transformations, *Membranes, Mathematical models, Spectroscopic analysis, Raman spectroscopy.

An analytical expression is developed for describing the thermotropic behavior of membrane bilayers as studied by Raman spectroscopy. The expression is derived from a two-state model of the main gel to liquid crystalline phase transition in lipid bilayers. Experimental data for a variety of diacylphosphatidylcholines and their derivatives have been fit by least squares to the two-state expression to within currently achievable measurement error. Numerical techniques have been developed for placing bounds on the parameters of the two-state model in situations of sparse data in the phase transition region. By fitting the model to the measured spectroscopic data, estimates of the extent of cooperativity in the phase transition can be obtained in a systematic manner.

700,394
PB87-181830 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.
Molecular Dynamics Study of a Supercooled Soft-Sphere Fluid.
Final rept.,
J. G. Amar, and R. D. Mountain. Feb 87, 7p
Pub. in Jnl. of Chemical Physics 86, n4 p2236-2242, 15 Feb 87.

Keywords: Viscosity, Reprints, *Molecular dynamics, Soft sphere, Supercooled liquids.

Results obtained from equilibrium molecular dynamics simulations (performed on a 1000-particle system) for a soft-sphere fluid in the supercooled region are presented. The hydrodynamic length $l(\text{sub } 1)$ corresponding to the range of dynamical correlations in the transverse current is found to increase rapidly as the amount of supercooling increases. The shear viscosity and bulk viscosity are also found to increase rapidly in the supercooled region, due to the increasing contribution of the tails of the corresponding correlation functions. While the bond-orientational order parameters $Q(\text{sub } 6)$ and $Q(\text{sub } 8)$ do not increase significantly the lifetimes of the corresponding time correlation functions also increase rapidly in the supercooled region.

700,395
PB87-190252 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
One-Dimensional Coagulation: Scaling and Phase-Separation Dynamics.
J. A. Marqusee. 15 Feb 87, 7p
Pub. in Physical Review A 35, n4 p1856-1862, 15 Feb 87.

Keywords: *Coagulation, Scaling, Simulation, Reprints, *Droplets, *Phase studies, Density, Mass.

A simulation of a one-dimensional coagulating system of droplets with mass-dependent diffusion coefficient is presented. Simple kinetic arguments are derived. The scaling behavior and the similarity to phase-separation dynamics is investigated. The scattering function is calculated. It develops a well-defined peak which grows in intensity and shifts to lower wave vectors as a function of time. The scattering function and the droplet-size distribution are both shown to assume scaled forms in the late stages.

700,396
PB87-191011 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Effects of Cinnabar on Pyrite Oxidation by 'Thiobacillus ferrooxidans' and Cinnabar Mobilization by a Mercury-Resistant Strain.
Final rept.,
F. Baldi, and G. J. Olson. 1987, 5p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Applied and Environmental Microbiology 53, n4 p772-776 Apr 87.

Keywords: *Cinnabar, *Pyrite, *Oxidation, Mercury, Ores, Reprints, *Thiobacillus ferrooxidans, *Bioleaching, Biotechnology.

The effect of cinnabar on pyrite oxidation by mercury-sensitive and mercury-resistant strains of *Thiobacillus ferrooxidans* was investigated by using percolation col-

umns. Mercury-resistant strains oxidized pyrite in pyrite-cinnabar mixtures, whereas a mercury-sensitive strain did not. Elemental mercury was produced by the mercury-resistant strains growing in the pyrite-cinnabar mixtures in percolation columns and in flasks containing cinnabar only. Manometric experiments showed that cinnabar had little effect on oxygen uptake of mercury-sensitive or mercury-resistant cells growing on ferrous sulfate, pyrite, or pyrite-ferrous sulfate mixture. In addition, shake flask leaching experiments showed that cinnabar had little effect on pyrite oxidations at 1% but inhibited growth of mercury-sensitive and mercury-resistant strains at 10%. Mercury-resistant strains were unable to grow on cinnabar as an energy source.

700,397
PB87-191086 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Photoionization Cross-Section Studies of the Platinum-Donor Center in Silicon.
Final rept.,
S. Mayo, and J. R. Lowney. Apr 87, 7p
Pub. in Jnl. of Applied Physics 61, n7 p2626-2632, 1 Apr 87.

Keywords: *Silicon, *Platinum, Reprints, *Photoionization.

The relative photoionization cross section of the platinum donor center in silicon was measured over the wavelength range of 2.4 to 3.9 micrometers by electrical deep-level optical spectroscopy on an $n(\text{sup } +)$ p junction at 80 K. The data were analyzed in terms of the lattice-coupling model proposed by Ridley and Amato which was modified for valence-band nonparabolicity. Good agreement was obtained between the experimental results and the model calculations of the cross section with the energy level of the donor at $0.320 \pm$ or -0.005 eV above the valence-band edge and a Huang-Rhys factor S of approximately 1.4. The S value corresponds to a Franck-Condon energy shift of 70 meV with a phonon energy of 50 meV. Previously reported photoionization data of the gold donor were also fit by the same model, yielding S approx. 0.4, a surprisingly small value.

700,398
PB87-191094 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Effects of Ion-Implantation Damage on Two-Dimensional Boron Diffusion in Silicon.
Final rept.,
J. F. Marchiando, and J. Albers. Feb 87, 12p
Pub. in Jnl. of Applied Physics 61, n4 p1380-1391, 15 Feb 87.

Keywords: *Boron, *Silicon, *Diffusion, Implantation, Reprints.

Model two-dimensional distributions of implanted boron and implantation-induced displacement damage near a mask edge are used to calculate the two-dimensional redistribution of boron resulting from a typical short-time anneal. The damage is removed during annealing by releasing vacancies which enhance the diffusion of boron. The effect is that boron preferentially redistributes further into the bulk. Such considerations become increasingly important as metal-oxide-semiconductor field-effect transistors become smaller.

700,399
PB87-191102 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Novel Superconducting Thermometer for Bolometric Applications.
Final rept.,
D. G. McDonald. Mar 87, 3p
Pub. in Physical Review Letters 50, n12 p775-777, 23 Mar 87.

Keywords: *Bolometers, Temperature measurement, Reprints.

The temperature dependence of the magnetic penetration depth in a superconductor, in the kinetic inductance limit, is proposed as a basis for a sensitive thermometer. Considered as a bolometer, the noise equivalent power from the sum of the Johnson noise and the preamplifier noise can be reduced to about 10 to the -20th W/sq rt (Hz), which is approximately four orders of magnitude below currentized values.

700,400
PB87-191144 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
N₂ and Air Broadening in the Fundamental Bands of HF and HCl.
Final rept.,
A. S. Pine, and J. P. Looney. 1987, 15p
Pub. in Jnl. of Molecular Spectroscopy 122, p41-55 1987.

Keywords: *Molecular spectroscopy, *Hydrogen fluoride, *Hydrogen chloride, Band spectra, Lasers, Reprints, Collision line narrowing.

N₂- and air-broadened lineshapes of HF and HCl transitions in the upslon = 1 < 0 bands have been measured at T = 295 and 202 K with a high-resolution difference-frequency laser spectrometer. Pressure broadening, shift and collisional narrowing parameters have been extracted by least-squares fitting of several collisional profiles to the spectra. At low pressures, the collisional, or Dicke, narrowing effect caused deviations from the Voigt profile having a Doppler-fixed Gaussian component and yields a measure of the diffusion constants for the hydrogen halides in the buffer gases. At high J, where the pressure shifts are comparable to or larger than the broadenings, a slight asymmetry is observed in the lineshapes which is attributed to statistical correlation between velocity and state-changing collisions. The ratio of air-to-N₂ broadening is roughly given by the relative quadrupolar contributions of O₂ and N₂, though it varies systematically with rotational level. The temperature variations in the broadening coefficients are also J dependent, deviating significantly from T^{1/2} and exhibiting opposite behavior for HF and HCl. (Copyright (c) 1987 Academic Press, Inc.)

700,401
PB87-191219 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.
Diffusion Coefficients of Multicomponent Hard-Sphere Fluid Mixtures.
Final rept.,
M. L. de Haro, J. M. Kincaid, and E. G. D. Cohen. 1983, 5p
Pub. in Proceedings of Winter Annual Meeting of the American Society of Mechanical Engineers, Boston, MA., November 13-18, 1983, 5p.

Keywords: *Fluids, *Mixtures, *Diffusion coefficient, Kinetic theory, Binary systems(Materials), Ternary systems, Reprints.

As part of a general kinetic theory for multicomponent dense fluid mixtures, results for the mutual diffusion coefficients of binary and ternary hard-sphere mixtures are presented. The theoretical values are obtained on the basis of the Standard and Revised Enskog theories. A study is made of the dependence of the diffusion coefficients on a wide variety of settings of the parameters of the mixture. The Standard Enskog theory, used up until now for correlation purposes, appears to be only reliable at low densities. Some trends, noted in the Revised Enskog theory and possibly useful for real mixtures, are discussed.

700,402
PB87-191227 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
New Correlation Effects Observed for inner-Shell Excitations in Titanium and Vanadium.
Final rept.,
N. E. Erickson, C. J. Powell, and D. E. Ramaker. Feb 87, 4p
Pub. in Physical Review Letters 58, n5 p507-510, 2 Feb 87.

Keywords: *Titanium, *Vanadium, Spectroscopy, Metals, Reprints, *Appearance potential spectra, Auger electron spectroscopy, X-ray spectroscopy.

An interpretation of energy-calibrated appearance-potential spectra for Ti and V reveals new correlation effects. A proposed initial-state, final-state rule is utilized to understand these and other many-body effects which arise in the x-ray, Auger-electron, and appearance-potential spectra for these metals.

700,403
PB87-197729 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.
Enthalpies of Combustion of D-ribose and 2-deoxy-D-ribose.
 Final rept.,
 J. C. Colbert, E. S. Domalski, and B. Coxon. 1987, 9p
 Pub. in Jnl. of Chemical Thermodynamics 19, p433-441 1987.

Keywords: *Calorimetry, Combustion, Enthalpy, Formation, Monosaccharide, Reprints, *Anomer, Ribose/deoxy, Pentose.

The enthalpies of combustion of the crystalline monosaccharides D-ribose (C₅H₁₀O₄, cr) and 2-deoxy-D-ribose (2-deoxy-D-erythro-pentose) (C₅H₁₀O₄, cr) have been determined by combustion bomb calorimetry.

700,404
PB87-197760 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
(A Tilde) (sup 2)Pi - (X Tilde)(sup 2)Sigma(+) Transition of HC2 Isolated in Solid Argon.
 Final rept.,
 M. E. Jacox, and W. B. Olson. 1987, 9p
 Sponsored by Army Research Office, Research Triangle Park, NC.
 Pub. in Jnl. of Chemical Physics 86, n6 p3134-3142, 15 Mar 87.

Keywords: *Acetylene, *Absorption spectra, *Argon, Atoms, Excitation, Infrared spectra, Fourier transformation, Perturbation, Electron transitions, Ground state, Atomic energy levels, Reprints, *Fourier transform absorption spectra, *Acetylene radicals.

Fourier transform absorption spectra have been obtained between 700 and 7900 /cm at a resolution of 0.2 /cm for Ar:C₂H₂ samples codeposited at 12 K with a beam of argon atoms that had been excited in a microwave discharge. Detailed isotopic substitution studies have confirmed that the predominant product species is HC₂, which contributes not only the absorptions previously assigned to its two stretching fundamentals but also several weaker absorptions in the 2000-3600 /cm spectral region and a prominent, complicated pattern of absorptions between 3600 and 7800 /cm. The previous assignment of the 3611 /cm HC₂ absorption as the CH-stretching fundamental is reviewed, and the assignment of an absorption at 2104 /cm as $\nu_2 + \nu_2$ of ground-state HC₂ is discussed. The near infrared absorption band system has been assigned to the (A Tilde) (sup 2)Pi - (X Tilde) (sup 2)Sigma(+) transition of HC₂, extensively perturbed by interaction with high vibrational levels of the ground state. The position of the transition origin could not be definitively established. The previous assignment of gas-phase absorptions of HC₂ at 3786, 4012, and 4108 /cm to ground-state combination bands has been confirmed, and carbon-isotopic data have been obtained for these bands.

700,405
PB87-197893 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Thermophysics Div.
Thermal Conductivity Surface for Mixtures of Methane and Ethane.
 Final rept.,
 D. G. Friend, and H. M. Roder. 1987, 14p
 Sponsored by Gas Research Inst., Chicago, IL.
 Pub. in International Jnl. of Thermophysics 8, n1 p13-26 Jan 87.

Keywords: *Ethane, *Methane, *Thermal conductivity, Mixtures, Gases, Liquids, Reprints.

A correlation is presented for the extensive series of thermal conductivity measurements of binary methane-ethane mixtures. The composition dependences of the thermal conductivity in the dilute-gas region, dense-gas and liquid region, and critical region are discussed. The average absolute percentage deviation of the thermal conductivity surface as a function of temperature, density, and composition, from the experimental data, is 1.60%.

700,406
PB87-197927 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Nearly Free Internal Rotation in Ar-CH₃Cl.
 Final rept.,
 G. T. Fraser, R. D. Suenram, and F. J. Lovas. 1987, 8p
 Pub. in Jnl. of Chemical Physics 86, n6 p3107-3114, 15 Mar 87.

Keywords: *Argon, Internation, Methyl chloride, Reprints, *Intermolecular forces, Van der Waals molecule.

Rotational spectra of Ar-CH₃Cl, for both Cl isotopes, have been observed, at 4 kHz resolution, using a pulsed nozzle Fourier transform microwave spectrometer. The observed spectra are consistent with a T-shaped complex in which the methyl group is undergoing nearly free internal rotation. A combined analysis of the ground and excited (E) internal rotor states places an upper bound of 20 cm⁻¹ on the threefold barrier to internal rotation. The Coriolis interactions in the E state also allow the determination of eQq(ab) for Ar-CH₃ 35Clas 13.0(3) MHz. The symmetry axis of the CH₃Cl subunit is nearly perpendicular (approx. 82 deg) to the line joining the centers of mass of the two binding partners. The isotopic data indicate that the Cl end of the methyl chloride is tilted toward the argon. The distance between the centers of mass of the two subunits is 3.7826 Å for Ar-CH₃ 35Cl and 3.7839 Å for Ar-CH₃ 37Cl implying an Ar-Cl distance of 3.750 Å. Centrifugal distortion analysis yields a weak bond stretching force constant of 0.0157 mdyn/Å and stretching frequency of 34.6 cm⁻¹ for Ar-CH₃ 35 Cl. The results from this investigation are related to previous lower resolution microwave studies on Ar-CH₃Cl.

700,407
PB87-197968 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Synthesis of Ionic Conducting Interpenetrating Polymer Networks.
 Final rept.,
 C. K. Chiang, B. J. Bauer, R. M. Briber, and G. T. Davis. Feb 87, 2p
 See also AD-A 171547. Sponsored by Office of Naval Research, Arlington, VA.
 Pub. in Polymer Communications 28, n2 p34-35 Feb 87.

Keywords: *Solid electrolytes, *Polymers, Epoxy compounds, Polyethylene plastics, Salts, Electrical conductivity, Ionic current, Synthesis, Networks, Lithium, Chlorates, Reprints, Ionic conductivity.

Epoxy and ionic conducting poly(ethylene oxide)-salt complexes form interpenetrating polymer networks. The co-continuity of the two phases has been tested independently by using mechanical and electrical measurements. Examination of the network by using transmission electron microscopy suggests that the size scale of the phases ranges from 0.1 to 0.5 micro.

700,408
PB87-198008 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Near-Resonant Collisional Energy Transfer in Sr(5s6p singlet P(1))-Rare-Gas Systems.
 Final rept.,
 R. W. Schwenz, and S. R. Leone. 1987, 7p
 Grant AFOSR-84-0272
 Sponsored by Air Force Weapons Lab., Kirtland AFB, NM., and National Science Foundation, Washington, DC.
 Pub. in Chemical Physics Letters 133, n5 p433-439, 30 Jan 87.

Keywords: Lasers, Metal vapors, Strontium, Reprints, *Branching ratios, *Electronic energy transfer.

The total quenching cross sections for strontium (5s6p 1P1) collisions with the rare gases are determined by pulsed laser, time-resolved fluorescence measurements to be 80, 40, 73, 101, 140 Å² for He, Ne, Ar, Kr and Xe, respectively. For collisions with Kr, all of the near-resonant states, 4d5p3F, 5s6p3P and 4d5p1D₂, are observed to be excited. The cross sections are interpreted in terms of a curve crossing mechanism. The product branching can be explained in terms of strong coupling of the initial state with the near-resonant states, weighted by energy gap considerations.

700,409
PB87-198016 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Reply to the 'Comment on Silane Pyrolysis and the Insertion of Silylene into Molecular Hydrogen'.
 Final rept.,
 R. M. Robertson, and A. Gallagher. 1987, 2p
 Pub. in Jnl. of Chemical Physics 86, n5 p3059-3060, 1 Mar 87.

Keywords: *Silane, *Pyrolysis, Surfaces, Reprints, Amorphous silicon.

The authors respond to a comment on the recent paper on silane pyrolysis (R. M. Robertson and A. Gallagher, J. Chem. Phys. 85, 3623 (1986)).

700,410
PB87-198057 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Autodetachment Study of the Electronic Spectroscopy of FeO(-1).
 Final rept.,
 T. Andersen, K. R. Lykke, D. M. Neumark, and W. C. Lineberger. 1987, 10p
 Grants NSF-CHE83-16628, NSF-PHY86-04504
 Sponsored by National Science Foundation, Washington, DC.
 Pub. in Jnl. of Chemical Physics 86, n4 p1858-1867, 15 Feb 87.

Keywords: *Iron oxides, Ground state, Ions, Reprints, Autodetachment spectroscopy, Photodetachment spectroscopy, Excited states.

The anion FeO(1-) was studied by autodetachment spectroscopy in a coaxial laser-ion beam photodetachment spectrometer. Transitions were observed between the ground electronic state of the ion and several excited electronic states near the electron detachment threshold. Rotational assignments were carried out for several bands, and the measured linewidths yielded autodetachment lifetimes as a function of rotational energy for these bands. The results indicate a (sup 4)Delta ground state of FeO(1-). The autodetachment lifetimes show that some of the excited electronic states are dipole bound, and that one weakly bound state may be a valence excited state.

700,411
PB87-198115 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Hydrogen Pairing and Anisotropic Potential for Hydrogen Isotopes in Yttrium.
 Final rept.,
 I. S. Anderson, J. J. Rush, T. J. Udovic, and J. M. Rowe. 1986, 4p
 Pub. in Physical Review Letters 57, n22 p2822-2825, 1 Dec 86.

Keywords: *Yttrium, *Hydrogen, *Hydrogen isotopes, Neutron spectroscopy, Reprints.

The potential for H isotopes in alpha-phase (hexagonal) YH(D)O₁₈ has been probed by neutron spectroscopy. The results reveal a highly unusual potential, which is considerably softer and anharmonic along the c axis than in the basal plane, even though the near-neighbor arrangement of metal atoms is only slightly distorted from regular tetrahedral symmetry. Low-temperature results show a splitting of the c-axis vibrational modes, consistent with the pairing of hydrogen on either side of yttrium atoms.

700,412
PB87-198149 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Neutron Powder Diffraction Study and Physical Characterization of Zeolite D-RHO Deep-Bed Calcined at 773 and 923 K.
 Final rept.,
 R. X. Fischer, W. H. Baur, R. D. Shannon, R. H. Staley, A. J. Vega, L. Abrams, and E. Prince. 1986, 10p
 See also PB87-173795.
 Pub. in Jnl. of Physical Chemistry 90, n18 p4414-4423 1986.

Keywords: *Ion exchange resins, *Neutron diffraction, Reprints, *Zeolites, *Powder diffraction, Rietveld method.

Zeolite RHO samples, deep-bed calcined at 773 and at 923 K, respectively, were studied by neutron powder

diffraction, IR, and NMR. In addition their methanol sorption was measured.

700,413
PB87-199279 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Thermophysics Div.

Round-Table: Perspectives in Nonequilibrium Molecular Dynamics.

Final rept.,
H. J. M. Hanley. 1986, 10p
Pub. in Proceedings of Conference on Molecular-Dynamics Simulation of Statistical-Mechanical Systems, Varenna, Italy, July 23-August 2, 1986, p317-326.

Keywords: *Simulation, Computer simulation, *Molecular dynamics.

Panel remarks on nonequilibrium molecular dynamics held at the Enrico Fermi Summer School on Statistical Mechanics are recorded. The status of the technique is discussed, speculations on the future are given and some problems are mentioned.

700,414
PB87-199329 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Resonance Ionization Mass Spectrometry.

Final rept.,
J. C. Travis, J. D. Fassett, and T. B. Lucatorto. 1987, 4p
Pub. in Proceedings 1986 Resonance Ionization Mass Spectrometry Conference, Swansea, Wales, September 7-12, 1986, p91-96.

Keywords: *Atomic spectroscopy, Mass spectroscopy, Instrumentation, Atoms, Ionization potentials, Trends, Excitation, Dispersion, Reprints, *Resonance ionization mass spectrometry, Laser spectroscopy, Ionization spectrometers.

A review is given of the literature on resonance ionization mass spectrometry (RIMS) during the period 1984 through early 1986. Instrumentation trends are discussed in the areas of free-atom generation methods, excitation/ionization lasers, and mass-dispersion. The analytical performance of the method is surveyed, as well as the apparent directions.

700,415
PB87-203022 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Length and Mass Div.

New Value for the Rydberg Constant from the Hydrogen Balmer-beta Transition.

Final rept.,
P. Zhao, W. Lichten, H. P. Layer, and J. C. Bergquist. 1987, 3p
Pub. in Physical Review Letters 58, n13 p1293-1295, 30 Mar 87.

Keywords: *Fundamental constants, Hydrogen, Metrology, Standards, Reprints, *Rydberg constant, Laser spectroscopy.

The Rydberg constant R was determined to 3 parts in 10 to the 10th power by direct comparison of the four H,D Balmer-beta transitions with a National Bureau of Standards standard laser. This is the most precise value: $R = 109737.31573(3)/\text{cm}$; it approaches the limits of accuracy for optical measurements. The fine structure splittings and isotope shift are in excellent agreement with theory. The result agrees with less precise experiments by Zhao et al. and Biraben and Julien, but disagrees with the result of Hildum et al.

700,416
PB87-203691 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Dielectronic-Recombination Rate Coefficients for Ions of the Fluorine Isoelectronic Sequence.

Final rept.,
L. J. Roszman. 1987, 8p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy, and Lawrence Livermore National Lab., CA.
Pub. in Physical Review A 35, n5 p2138-2145, 1 Mar 87.

Keywords: Reprints, *Atomic rates, *Dielectronic recombination, *Ion impurities.

The rate coefficients for the dielectronic recombination of $\text{Ar}(9+)$, $\text{Fe}(17+)$, $\text{Kr}(27+)$, and $\text{Mo}(33+)$, all mem-

bers of the fluorine isoelectronic sequence, are computed in the single-configuration, LS-coupled, frozen-core, corona model approximation. Comparison is made with other calculations. Analytic formulas which can be used for interpolating the rate coefficients for other members of the fluorine isoelectronic sequence are given.

700,417
PB87-203709 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

F- and G-Wave Phase Shifts and Resonances for Electron Scattering by $\text{He}(1+)$.

Final rept.,
D. H. Oza. 1987, 4p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Physical Review A 35, n10 p4430-4433, 15 May 87.

Keywords: *Electron scattering, Phase shift, Resonance, Reprints, *Electron-ion collisions, *Helium ions.

The study of the scattering of electrons by $\text{He}(1+)$ ions has been extended to the $L=3$ and the $L=4$ partial waves below the $N=2$ threshold of the ion. The ab initio calculations are performed in a pseudostate close-coupling approximation. An 11-state pseudostate basis set is used in the non-resonant energy range and a relatively long-range 14-state pseudostate basis set is used to examine the resonances. Resonance parameters for 19 F-wave and 10 G-wave resonances are obtained with the outer electron extending up to $n \approx 7$. Comparisons with other available results are made.

700,418
PB87-203717 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Rydberg States with Anisotropic Ion Cores: Stark Effect.

Final rept.,
D. E. Kelleher, and E. B. Saloman. 1987, 12p
Pub. in Physical Review A 35, n8 p3327-3338, 15 Apr 87.

Keywords: *Stark effect, *Anisotropy, Quadrupole moment, Ionization, Spectrum analysis, Barium, Reprints, *Rydberg states, Autoionization, Spectral shift.

The authors have measured the Stark spectra of $5d3/281$ autoionizing states in barium. Because of the anisotropic $5d$ ion core, the Stark manifolds at higher fields are considerably more complex than those for the analogous $6s$ bound states. The electrostatic coupling of the Rydberg electron with the anisotropic core gives rise to relatively large fine-structure splittings. For nonpenetrating orbitals (l greater than l_{core}), jK coupling is a useful representation and the number of fine-structure components due to this interaction with the core increases the number of eigenstates ($2j_{\text{core}} + 1$)-fold. The authors present a theoretical model for the calculation of Stark spectra in jK coupling. Results for barium are in quantitative agreement with the experimental observations for both sigma and pi polarizations up to fields where there is extensive overlap between adjacent n manifolds. These fine-structure effects occur for any states with nonisotropic cores (j_{core} greater than $1/2$), i.e., the states of most atoms except for bound singly excited states of alkali-metal and alkaline-earth-metal atoms.

700,419
PB87-203725 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Thermal Conductivity of Liquid Argon.

Final rept.,
J. C. G. Calado, U. V. Mardolcar, C. A. Nieto de Castro, H. M. Roder, and W. A. Wakeham. 1987, 12p
Sponsored by North Atlantic Treaty Organization, Brussels (Belgium).
Pub. in Physica 143A, p314-325 1987.

Keywords: *Argon, *Thermal conductivity, Liquefied gases, Reprints, *Liquid argon, *Hard-sphere model.

The thermal conductivity of liquid argon has been measured along isotherms at 107, 113, 118, 124 and 130 K and pressures up to 10 MPa using the transient hot-wire technique. The instrument is capable of measuring the thermal conductivity of fluids with an accuracy of ± 0.5 percent in thermodynamic states far

from the critical region. The experimental data have been employed in conjunction with ideas based upon the hard-sphere theory of dense fluids to develop a reliable procedure for interpolation and extrapolation of the thermal conductivity of liquid argon.

700,420
PB87-203790 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Hydrogen Component Fugacities in Binary Mixtures with Carbon Dioxide: Pressure Dependence.

Final rept.,
T. J. Bruno. 1987, 12p
Sponsored by Gas Research Inst., Chicago, IL.
Pub. in International Jnl. of Thermophysics 8, n2 p205-216 1987.

Keywords: *Hydrogen, *Carbon dioxide, *Fugacity, Measurement, Reprints, *Binary mixtures, High pressure, Equilibrium, Membrane transport.

The fugacity coefficients of hydrogen in binary mixtures with carbon dioxide were measured isothermally using a physical equilibrium technique. This technique involves the use of an experimental chamber which is divided into two regions by a semipermeable membrane. Hydrogen can penetrate and pass through the membrane, while carbon dioxide cannot. During the approach to equilibrium, the pressure of pure hydrogen on one side of the membrane approaches the partial pressure of hydrogen in the mixture on the other side of the membrane. This allows a direct measurement of the hydrogen component fugacity at a given mixture mole fraction. In the study, results are reported for measurements made on the hydrogen plus carbon dioxide binary at 130 C (403 K), with total mixture pressure of 3.45, 5.17, 8.62, 10.34, and 13.79 MPa. General trends in the experimental results are discussed and comparisons are made with predictions from the Redlich Kwong, Peng-Robinson, and extended corresponding-states models.

700,421
PB87-203816 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Conformality in the Kirkwood-Buff Solution Theory of Statistical Mechanics.

Final rept.,
E. Z. Hamad, G. A. Mansoori, and J. F. Ely. 1987, 7p
Sponsored by Gas Research Inst., Chicago, IL.
Pub. in Jnl. of Chemical Physics 86, n3 p1478-1484, 1 Feb 87.

Keywords: Reprints, *Chemical potentials, *Corresponding states, *Kirkwood-Buff theory, *Mixing rules.

The Kirkwood-Buff solution theory of statistical mechanics is examined in the light of the conformal solution approximation of the mixture radial distribution functions. By joining the mixture compressibility equation of the Kirkwood-Buff solution theory with the mixture energy and virial equations of statistical mechanics, a set of density and temperature dependent mixing rules has been developed which are used here to calculate properties of molecular fluids with varying size and interaction energy differences. It is demonstrated that the conformality approximation in the compressibility equation produces mixture results with a deviation, from the exact mixture data, on the opposite side of the predictions of the van der Waals theory of mixtures. The Kirkwood-Buff relation for the composition derivative of the chemical potential is also integrated by combining it with the conformal solution approximation and compared with the simulation data.

700,422
PB87-203840 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Dielectronic-Recombination Rate Coefficients for Ions of the Oxygen Isoelectronic Sequence.

Final rept.,
L. J. Roszman. 1987, 13p
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 35, n8 p3368-3380, 15 Apr 87.

Keywords: Plasma, Recombination, Reprints, *Autoionization, *Dielectronic recombination, *Oxygen isoelectronic.

The rate coefficients for the dielectronic recombination of $\text{Ar}(10+)$, $\text{Fe}(18+)$, $\text{Kr}(28+)$, and $\text{Mo}(34+)$ of the

oxygen isoelectronic sequence are computed in the single-configuration, LS-coupled, frozen-core, corona-model approximation. Analytic interpolation formulas for the dielectronic-recombination rate coefficients of the oxygen isoelectronic sequence are given, and comparisons are made with other calculations.

700,423
PB87-203857 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Dielectronic-Recombination Rates for Some Ions of the Lithium Isoelectronic Sequence.
Final rept.,
L. J. Roszman. 1987, 16p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Physical Review A 35, n5 p2122-2137, 1 Mar 87.

Keywords: Reprints, *Atomic rates, *Dielectronic recombination, *Ion impurities.

The total dielectronic-recombination rates for Ne(7+), Ar(15+), Fe(23+), and Kr(33+), all members of the lithium isoelectronic sequence, are computed in the nonrelativistic, single-configuration, LS-coupling, frozen-core, corona model approximation. Comparison is made with other calculations, and differences are noted and analyzed. Analytic formulas for interpolating the total dielectronic recombination rates for other members of the lithium isoelectronic sequence are given.

700,424
PB87-210241 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
Standard Reference Data Publications, 1985-1986.
Special pub.
J. C. Sauerwein. Jun 87, 43p NBS/SP-708-SUPPL-1
See also PB86-155587. Also available from Supt. of Docs as SN003-003-02802-9.

Keywords: *Bibliographies, Chemical properties, Physical properties, Information systems, Indexes(Documentation), Computer programs, *Standard reference materials, Listings.

The National Bureau of Standards' Office of Standard Reference Data manages a network of data centers that prepare evaluated databases of physical and chemical properties of substances. Databases are available in printed form, on magnetic tapes, diskettes, and through on-line computer networks. The document provides a comprehensive list of the products available from the National Standard Reference Data System (NSRDS) for the years 1985-1986, including indexes qualified by author, material, and property terms. Ordering information and current prices can be found at the end of the document.

700,425
PB87-218913 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
How Do You Know That's the Atomic Weight.
Final rept.,
L. J. Powell, and T. J. Murphy. 1984, 5p
Pub. in Chemtech 14, n12 p726-730 1984.

Keywords: Mass spectroscopy, Silver, Accuracy, Reprints, *Atomic weights, Faraday, Calibration.

Calibrated mass spectrometry has been used at the National Bureau of Standards for the high accuracy re-determination of the atomic weights of 14 elements. The method, which focuses on the determination of absolute isotopic composition using thermal ionization mass spectrometry, is described. Particular emphasis is given to the recent determination of the absolute isotopic composition and atomic weight of silver and to the impact of this work on the Faraday.

700,426
PB87-219051 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Dielectronic Recombination of Highly Ionized Iron.
Final rept.,
D. C. Griffin, and M. S. Pindzola. 1987, 11p
Contract DE-AC05-84OR21400
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Physical Review A 35, n7 p2821-2831, 1 Apr 87.

Keywords: *Iron, Reprints, *Cross section calculations, *Dielectronic recombination, Electric fields.

Dielectronic recombination of the iron ions Fe(15+), Fe(23+), and Fe(25+) has been studied in the isolated-resonance, distorted-wave approximation. The cross-section calculations include the dielectronic transitions associated with the 3s -> 3l and 3s -> 4l excitations in Fe(15+), the 2s -> 2p and 2s -> 3l excitations in Fe(23+) and the 1s -> 2l excitations in Fe(25+). The effects of external electric fields have been included by employing intermediate-coupled, field-mixed eigenvectors for the doubly excited Rydberg states, determined by diagonalizing a Hamiltonian matrix which includes the internal electrostatic and spin-orbit terms, as well as the Stark matrix elements. The field effects are found to be quite large in Fe(25+), relatively small in Fe(23+), and negligible in Fe(25+). The calculations indicate that there are large resonances near threshold in Fe(23+) that are unaffected by external fields and may be measurable in new experiments currently being designed. In addition, the contributions of radiative recombination and the possible interference between radiative and dielectronic recombination in low-lying resonances are considered. Even though the radiative recombination cross sections may be appreciable near threshold in Fe(15+) and Fe(23+), the interference between these processes appears to be completely negligible.

700,427
PB87-219093 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
High Sensitivity, High-Resolution IR Laser Spectroscopy in Slit Supersonic Jets: Application to N₂H⁺ (nu sub 1) and (nu sub 5) + (nu sub 1) - (nu sub 5).
Final rept.,
C. M. Lovejoy, and D. J. Nesbitt. 1987, 15p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Chemical Physics 86, n6 p3151-3165, 15 Mar 87.

Keywords: Reprints, *Direct absorption, *Infrared spectroscopy, *Supersonic expansion, van der Waals molecules, Vibrational predissociation.

A difference frequency IR spectrometer is combined with a slit supersonic expansion for high resolution (less than or equal to 50 MHz FWHM) direct absorption investigations of jet-cooled species. The 1.25 cm long nozzle provides a long path length and high densities suitable for synthesis and observation of van der Waals clusters, with a gradual spatial temperature gradient that permits experimental control of low frequency vibrational populations. Due to collisional quenching of velocity distributions, absorption linewidths are reduced and peak absorbance increased five-to sevenfold compared to pinhole expansions. Minimum detectable concentrations of HF combining complexes are 2 times 10 to the ninth power molecules/cu. cm./quantum state in a 2.5 cm path length. The combination of high sensitivity, sub-Doppler resolution, long path lengths, and temperature control make direct absorption in slit nozzle expansions a powerful and general technique for high-resolution study of jet-cooled species. The spectrometer is used to obtain the near-infrared spectrum of N₂H⁺. The v₁ (HF stretch) fundamental is observed at 3918.2434(2)/cm, red shifted by 43.1795(2)/cm from the HF origin.

700,428
PB87-220505 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Time-Dependent Radiative Transfer.
Final rept.,
A. Streater, J. Cooper, and W. Sandle. 1987, 6p
Contract NGL-06-003-057
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 37, n2 p151-156 1987.

Keywords: Emission spectroscopy, Integral equations, Quantum interactions, Time dependence, Reprints, *Radiative transfer, Payne equation.

An integral equation is developed for application to time-dependent laboratory experiments in which partial redistribution effects are important. The equation of transport with the Heasley-Kneer emission coefficient and the equation of statistical equilibrium lead to a

time-dependent redistribution function containing an absorption - re-emission term which decays exponentially in time and a scattering term which is instantaneous. The integral equation does not agree with an equation written by Payne et al. (Phys. Rev. A 9, 1050 (1974)) that has been used to compare theory with experiments. The difference between the Payne equation and the equation developed here needs to be examined in detail, since it might under some circumstances be on the same order as the difference between partial and complete redistribution.

700,429
PB87-220539 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Absolute I* Quantum Yields for the ICN (A tilde) State by Diode Laser Gain-versus-Absorption Spectroscopy.
Final rept.,
W. P. Hess, and S. R. Leone. 1 Apr 87, 8p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Chemical Physics 86, n7 p3773-3780, 1 Apr 87.

Keywords: *Lasers, Reprints, *Iodine atom, *ICN, Quantum yield.

Absolute I* quantum yields have been measured as a function of wavelength for room temperature photodissociation of the ICN (A tilde) state continuum. The yields are obtained by the technique of time-resolved diode laser gain-vs-absorption spectroscopy. Quantum yields are evaluated at seven wavelengths from 248 to 284 nm. The yield at 266 nm is 66.0 plus or minus 2% and it falls off to 53.4 plus or minus 2% and 44.0 plus or minus 4% at 284 and 248 nm, respectively. The latter values are significantly higher than those obtained by previous workers using infrared fluorescence. Estimates of I* quantum yields obtained from analysis of CN photofragment rotational distributions, as discussed by other workers, are in good agreement with the I* yields reported here. The results are considered in conjunction with recent theoretical and experimental work on the CN rotational distributions and with previous I* quantum yield results.

700,430
PB87-220547 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Transient Gain-versus-Absorption Laser Probing of Spin-Orbit States, Kinetics and Dynamics.
Final rept.,
J. E. Smedley, W. P. Hess, H. K. Haugen, and S. R. Leone. 1987, 7p
Grants NSF-PHY82-00805, NSF-CHE84-04804
Sponsored by National Science Foundation, Washington, DC., National Aeronautics and Space Administration, Washington, DC., and Air Force Weapons Lab., Kirtland AFB, NM.
Pub. in Jnl. de Chimie Physique 84, n3 p385-391 1987.

Keywords: *Spin orbit interactions, Near infrared radiation, Gain, Reprints, *Bromine atoms, *Iodine atoms, Tunable lasers, Laser applications, Excited states, Stimulated emission.

A tunable F-center laser and a diode laser are used to probe the spin-orbit populations of excited (doublet P(1/2)) and ground (doublet P(3/2)) state Br and I atoms at 2714 nm and 1315 nm, respectively. The technique uses pulsed laser photolysis and time-resolved cw laser probing of the gain or absorption signals from the coupled pair of states in the halogen atoms. Transient laser gain-versus-absorption measurements provide highly accurate quantum yields of the spin-orbit states in the photodissociation of molecules such as Br₂, IBr, CH₃I, ICN and C₃F₇I. In Br₂, the continuum yields that result from absorption of vibrationally excited states are investigated as a function of temperature to determine the contributions to the absorption of individual upper excited states.

700,431
PB87-220570 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

CHEMISTRY

Physical & Theoretical Chemistry

High Rydberg States of an Atom in Parallel Electric and Magnetic Fields.

Final rept.,
R. L. Waterland, J. B. Delos, and M. L. Du. 15 Jun 87, 17p
Sponsored by National Science Foundation, Washington, DC.
Pub. in Physical Review A 35, n12 p5064-5080, 15 Jun 87.

Keywords: Electric fields, Magnetic fields, Zeeman effect, Stark effect, Diamagnetism, Reprints, *Rydberg states.

The authors have calculated the energy spectrum of a highly excited atom in parallel electric and magnetic fields. The eigenvalues were obtained by semiclassical quantization of action variables calculated from first-order classical perturbation theory. A classification scheme for the eigenstates is proposed. Comparison with first-order degenerate quantum perturbation theory verifies the accuracy of the semiclassical treatment.

700,432
PB87-220588

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Ultraviolet Absorption Spectrum of the (A tilde) ((sup 1)(A double prime, sub 2))(X tilde)((sup 1)(A' sub 1)) Transition of Jet-Cooled Ammonia.

Final rept.,
V. Vaida, M. McCarthy, P. C. Engelking, P. Rosmus, H. J. Werner, and P. Botschwina. 15 Jun 87, 8p
Sponsored by National Science Foundation, Washington, DC., and North Atlantic Treaty Organization, Brussels (Belgium).
Pub. in Jnl. of Chemical Physics 86, n12 p6669-6676, 15 Jun 87.

Keywords: *Ammonia, *Ultraviolet spectra, *Absorption spectra, Reprints.

The (A tilde) <-(X tilde) absorption spectra of NH₃ and ND₃, recorded in a cold molecular jet, are presented. Vibrational band progressions resolvable up to (v₁ sub 2) = 14 appear. No other vibrations are present, either alone or in combinations. Relative band intensities for (v₁ sub 2) progressions are recorded, and the homogeneous lifetime broadening of vibrational levels of the A state are reported. The FWHM linewidths span 34-293/cm over all bands of NH₃ and 30-135/cm over the (v sub 2) = 2 through 14 bands of ND₃. In general, the rate of dissociation increases nonlinearly with vibrational energy. The band intensity alternation, previously observed only in matrix spectra below 15 K, has been observed in these very cold gas phase samples.

700,433
PB87-223723

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Reinvestigation of the Laser-Initiated Cl₂/HBr Chain Reaction: Absolute Rate Constants and the v = 2/v = 1 Ratio from Cl + HBr Yields HCl(v) + Br.

Final rept.,
D. A. Dolson, and S. R. Leone. 1987, 8p
Grants NSF-CHE84-08043, NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC., and Department of Energy, Washington, DC.
Pub. in Jnl. of Physical Chemistry 91, n13 p3543-3550 1987.

Keywords: *Chlorine, *Hydrogen bromide, Kinetics, Lasers, Vibration, Reprints, *Chain reaction.

The Cl₂/HBr chain reaction is reinvestigated by using real time state-selected observations of delta upsilon = -1 chemiluminescence from the HCl(upsilon) products following pulsed laser photolysis of Cl₂. These state-selected observations are analyzed with a more complete kinetic treatment to obtain room temperature rate constants for the chain propagation steps and the vibrational deactivation of HCl(upsilon=1.2) by HBr. The chain propagation rate constants are kR₁ = (1.02 plus or minus 0.15) times 10 to the minus 11th power and kR₂ = (1.1 plus or minus 0.4) times 10 to the minus 15th power cu.cm. per molecule per s, respectively, for Cl + HBr -> HCl(v) + Br and Br + Cl₂ -> BrCl + Cl. Rate constants for vibrational deactivation of HCl(v=1) and HCl(v=2) by HBr are Kv₁ = (1.06 plus or minus 0.16) times 10th to the minus 12 power and Kv₂ = (2.09 plus or minus 0.50) times 10 to the minus 12th power cu. cm per molecule s. Relative intensity measurements of the HCl v = 2 -> 1 and 1 ->

0 vibrational fluorescence are used to obtain an HCl(v) product branching ratio. The kinetic analysis indicates that broad-band observations of infrared chemiluminescence may lead to erroneous rate constant determinations because of vibrational cascade, whereas the detection of individual vibrational states leads to correct results.

700,434
PB87-223731

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Laser Photolysis, Infrared Fluorescence Determination of CH₃(nu 3) Vibrational Deactivation by He, Ar, N₂, CO, SF₆, and (CH₃)₂CO.

Final rept.,
D. J. Donaldson, and S. R. Leone. 1987, 4p
Grants NSF-PHY86-04050, NSF-CHE83-08403
Sponsored by National Science Foundation, Washington, DC., and Department of Energy, Washington, DC.
Pub. in Jnl. of Physical Chemistry 91, n12 p3128-3131 1987.

Keywords: *Lasers, *Photolysis, *Deactivation, Methyl, Radical, Vibration, Reprints, Intramolecular.

Room temperature vibrational deactivation rate constants are reported for methyl radicals with antisymmetric stretch excitation, CH₃(v₃) + M -> CH₃ + M, where M = He, Ar, N₂, CO, SF₆, (CH₃)₂CO. Excimer laser photolysis of acetone at 193 nm is used to populate CH₃(v₃), and time-resolved infrared emission from the CH stretch is used to follow the deactivation kinetics. The rate constants obtained are (plus or minus 2 sigma) (2.6 plus or minus 0.5) times 10 the minus 13th power (He), (6.8 plus or minus 0.7) times 10 the minus 13th power (Ar), (6.1 plus or minus 0.6) X times 10 the minus 13th power (N₂), (3.6 plus or minus 0.7) times 10 the minus 13th power (CO), (6.9 plus or minus 0.7) times 10 the minus 13th power (SF₆), and (8.1 plus or minus 0.9) times 10 the minus 12th power (CH₃COCH₃) in units of cu.cm-per molecule per s. The deactivation probability is not controlled by long-range forces due to the lone electron on the radical, but rather by the probabilities for intramode vibrational energy flow in CH₃.

700,435
PB87-223772

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Direct IR Laser Absorption Spectroscopy of Jet-Cooled CO₂HF Complexes: Analysis of the (nu sub 1) HF Stretch and a Surprisingly Low Frequency (nu sub 6) Inter-molecular CO₂ Bend.

Final rept.,
C. M. Lovejoy, M. D. Schuder, and D. J. Nesbitt. 15 May 87, 13p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Chemical Physics 86, n10 p5337-5349, 15 May 87.

Keywords: *Molecular spectroscopy, Hydrogen fluoride, Molecular structure, Weak interactions, Hydrogen bonds, Chemical bonds, Reprints, Infrared laser spectroscopy, Carbon dioxide hydrogen fluoro.

High sensitivity, tunable laser direct absorption methods are exploited to obtain high resolution IR spectra (Delta nu approx = or < 0.001/cm) of weakly bound CO₂HF complexes in a pulsed supersonic slit jet expansion. Transitions from the ground vibrational state corresponding to a single quantum excitation of the (nu sub 1)HF stretch are observed and analyzed with a semirigid linear molecule Hamiltonian.

700,436
PB87-224069

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Rotational and Vibrational Excitation of Molecules by Low-Energy Electrons.

Final rept.,
D. W. Norcross. 1986, 21p
Contract DOE-EA-77-C-0610
Sponsored by Department of Energy, Washington, DC.
Pub. in Proceedings of the Int. Swarm Seminar and the Inelastic Electron-Molecule Collisions Symposium (4th), Tahoe City, CA, July 19-23, 1985 p217-237.

Keywords: *Excitation, *Electron-molecule collisions, Excited states, Vibrational excitation, Rotational excitation.

The purpose of the paper is to review and summarize recent advances (since about 1982) in theoretical and computational techniques, and to illustrate the application of some of these developments in practical calculations. Important features of recent work are increased interest in polar molecules and complex polyatomics, the development of more realistic and complete representations of the interaction at short as well as long range, and important progress in theory and calculations for the treatment of nuclear dynamics in general, and vibrational excitation in particular.

700,437

PB87-224150

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Vibrational Excitation in Molecule-Surface Collisions. Analytical Modeling versus Classical Trajectories.

Final rept.,
J. W. Gadzuk. 1987, 15p
Pub. in Jnl. of Chemical Physics 86, n9 p5196-5210, 1 May 87.

Keywords: *Surfaces, *Excitation, Scattering, Iodine, Reprints, *Molecule collisions, Charge transfer, Vibrational excitation.

The problem of translational to vibrational energy redistribution occurring in collisions between diatomic molecules and solid surfaces is considered. Attention is focused solely on a mechanism which is a consequence of a molecule-surface interaction giving rise to an intramolecular potential whose equilibrium separation is a function of distance from the surface. The 'three-body' chemical effect is totally unrelated to mechanical excitation due to spring compression. While past work has emphasized the specific process of charge transfer/harpooning as a means for obtaining such an interaction, the mechanism is more general in the sense that it depends only upon the topology of the potential energy surface (PES) and not on what electronic properties gave rise to the topology. I₂ is the molecule of choice in the work.

700,438

PB87-224168

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Heterodyne Frequency Measurements on N₂O Near 1060/cm.

Final rept.,
L. R. Zink, J. S. Wells, and A. G. Maki. 1987, 8p
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Jnl. of Molecular Spectroscopy 123, p426-433 1987.

Keywords: *Nitrous oxide, Molecular constants, Reprints, *Calibration tables, *Heterodyne frequency measurements.

The results of heterodyne frequency measurements are given for the 10 degrees 0.02 degrees 0 band of N₂O centered at 1056 per cm. Nine lines are measured and fit with an rms deviation of 1.3 MHz. The data are combined with other infrared and microwave data in a least-squares fit that gives accurate ro-vibrational constants for the two states involved in these transitions. The analysis of the data is based on a treatment that includes the effect of l-type resonance between the 02 degrees 0 and 02(2)0 states. Derived tables of wave numbers are given for the 02 degrees 0.00 degrees 0 band near 2460 per cm.

700,439

PB87-224184

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Fire Measurement and Research Div.

Detection of the Methyl Radical in a Methane/Air Diffusion Flame by Multiphoton Ionization Spectroscopy.

Final rept.,
K. C. Smyth, and P. H. Taylor. 1985, 5p
Pub. in Chemical Physics Letters 122, n5 p518-522, 20 Dec 85.

Keywords: *Diffusion, *Flame, *Spectroscopy, Ionization, Methyl, Multiphoton, Profile, Reprints.

Methyl radicals have been detected in an atmospheric pressure, methane/air diffusion flame by three-photon ionization. The origin band of the transition between the X(2)A₂' ground electronic state and the 3p(2)A₂' Rydberg state is observed at 333.5 nm via two-photon

excitation. A second peak at 340.8nm is likely due to both a methyl radical hot band in the same electronic transition and three-photon ionization of carbon atoms produced by photolysis. Spatial profiles are presented as a function of height above the burner and are discussed in terms of resonant and non-resonant ionization processes.

700,440

PB87-224192 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Fire Measurement and Research Div.
Multiphoton Ionization Spectra of Trans-1,3-Butadiene: Reassignment of a Rydberg Series.
Final rept.,
P. H. Taylor, W. G. Mallard, and K. C. Smyth. 15 Jan 86, 3p
Pub. in Jnl. of Chemical Physics 84, n2 p1053-1055, 15 Jan 86.

Keywords: *Butadiene, *Ionization, Reprints, Multiphoton, Polarization, Rydberg, Spectra.

A Rydberg series of 1,3-trans-butadiene has been recently observed using two-photon resonant, three-photon ionization in the 330-269 nm wavelength region. An ns assignment was originally made due to the spectral similarity of the proposed 4s and 5s origins and associated vibronic structure with that of the 3s origin region. Subsequent experiments on the polarization behavior of the Rydberg series are not consistent with an s series assignment. An nd spectroscopic assignment is proposed based on the polarization measurements in conjunction with an analysis of the allowed two-photon optical transitions from the ground state.

700,441

PB87-224200 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Selectivity of Elementary Molecular Processes In Molecule-Surface Collisions.
Final rept.,
J. W. Gadzuk. 1987, 5p
Pub. in Chemical Physics Letters 136, n5 p402-406, 15 May 87.

Keywords: *Surfaces, Molecular beams, Scattering, Reprints, *Molecule collisions.

Excitation of internal vibrational modes of molecules scattered from surfaces in which charge transfer between collision partners occurs, is considered. A mechanism is proposed which should lead to controllable selectivity in the fragmentation distributions of scattered polyatomic molecules.

700,442

PB87-224531 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Semiconductor Electronics Div.
Effect of Post-oxidation Anneal on the Electrical Characteristics of Thin Oxides.
Final rept.,
D. J. Mountain, K. F. Galloway, and T. J. Russell. 1987, 3p
Pub. in Jnl. of the Electrochemical Society 134, n3 p747-749 Mar 87.

Keywords: *Integrated circuit, *Annealing, Oxides, Silicon dioxide, Thermal oxidation, Reprints, *Thin oxides, Post oxidation annealing, Processing technology, Semiconductor processing.

The study, the effects of pre- and post-oxidation treatments on thin (approx. 20-nm) gate oxide properties have been made. Pre-oxidation cleans and post-oxidation anneal (POA) times and ambients were compared. Flatband voltage, oxide field breakdown, and average density of interface trap (Dit) measurements were used to evaluate the different sequences. The data indicate that an optimum oxidation sequence for thin gate oxides can be designed. A sacrificial oxidation cleaning procedure and a long (120-min) POA in nitrogen gave the oxide with the best electrical characteristics.

700,443

PB87-224564 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Opacity Effects on Near-Resonance-Rayleigh Scattering in a Barium Plasma.

Final rept.,
T. J. A. Nee, and G. Chen. 1987, 7p
Pub. in Jnl. Quant. Spectrosc. Radiat. Transfer 37, n5 p425-431 1987.

Keywords: Reprints, *Barium plasma, *Rayleigh scattering, Opacity.

Near-resonance-Rayleigh scattering (NRRS) was used to measure the effects of opacity on the resonance transition of Ba(1+). The influence of the oven temperature, pumping laser-beam size, and probe-laser detuning on the opacity of the transition was investigated. The experimental results indicate a minimum detuning from the Ba(1+) resonance line center to avoid opacity problems in NRRS.

700,444

PB87-224580 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Progress and Challenges in the Determination of Atomic Transition Probabilities.
Final rept.,
W. L. Wiese. 1987, 5p
Pub. in Physica Scripta 35, p846-850 1987.

Keywords: *Transition probabilities, Aluminum, Argon, Lithium, Reviews, Accuracy, Reprints, Oscillator strengths, Lifetime.

A brief review of advances in the determination of atomic transition probabilities during the last 20 years is given. Several frequently studied transitions are used as examples to indicate the remarkable advances in accuracy and consistency between independent results. Major developing trends and some challenges for the future are also briefly discussed.

700,445

PB87-225348 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Collisions of F(1+) with Ne.
Final rept.,
M. Hottoka, B. Roos, J. B. Delos, R. Srivastava, R. B. Sharma, and W. S. Koski. 1 Jun 87, 11p
Pub. in Physical Review A 35, n11 p4515-4525, 1 Jun 87.

Keywords: Differential cross sections, Inelastic scattering, Spin orbit interactions, Reprints, *Ion-atom collisions, *Iron ions, *Sodium atoms, Charge transfer.

Measurements of inelastic collisions of F(1+) with Ne have been made. Transitions between triplet P and singlet D terms of F+ are seen, with the inelastically scattered ions sharply focused in the forward direction. Potential energy curves of (FNe)(1+) have been calculated. Several curve crossings are identified, where transitions occur through spin-orbit coupling. Scattering angles and differential cross sections have been calculated, and they show the presence of a 'glory' (or halo) effect, which accounts for the forward scattering of ions.

700,446

PB87-225371 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Transition Probabilities (Atomic Physics).
Final rept.,
W. L. Wiese. 1987, 11p
Pub. in Encyclopedia of Physical Science and Technology, v14 p59-69 1987.

Keywords: *Transition probabilities, Hartree-Fock approximation, Spectral lines, Forbidden transitions, Oscillator strengths, Ion spectroscopy, Lifetime.

In atomic spectral line radiation, the transition probability is the quantity that determines the intensity of a spectral line, aside from light-source-dependent factors. A characteristic feature of the atomic quantity is that it is generally difficult to determine, so that many of the known data are rather uncertain.

700,447

PB87-230868 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Fluorescence Polarization Studies of Autoionization in CS2.

Final rept.,
E. D. Poliakov, J. L. Dehmer, A. C. Parr, and G. E. Leroi. 1987, 6p
Grants NSF-CHE83-10661, AFOSR-84-0261
Sponsored in part by Contract W-31-109-eng-38. Sponsored by National Science Foundation, Washington, DC., Air Force Office of Scientific Research, Bolling AFB, DC., Department of Energy, Washington, DC., and Office of Naval Research, Arlington, VA.
Pub. in Jnl. of Chemical Physics 86, nr p2557-2562, 1 Mar 87.

Keywords: *Carbon disulfide, Reprints, *Autoionization, Molecular spectroscopy, Photoionization, *Polarized fluorescence, Synchrotron radiation.

The polarization of the CS2+ (A2II -> X2II) transition was measured following photoionization of CS2 with synchrotron radiation excitation in the range 875 Å < λ < 967 Å. Autoionization features are prominent in the fluorescence polarization spectrum and were investigated in detail. The spectral assignments of the absorption spectrum by Ogawa and Chang (Can. J. Phys. 48,2455 (1970)) are supported by the current measurements. Although fluorescence excitation and fluorescence polarization profiles normally align precisely, exceptions have been found for many resonances (σ → nd π, n > 3), and comparisons between the line shapes are given for several features.

700,448

PB87-230942 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
C1-Kappa(beta) Emission of Chloromethanes and Comparison with Semiempirical and 'ab initio' MO Calculations.
Final rept.,
R. C. C. Perera, R. E. LaVilla, and G. V. Gibbs. 1987, 7p
Contract DE-AC03-76SF00098
Sponsored by Department of Energy, Washington, DC.
Pub. in Jnl. of Chemical Physics 86, n9 p4824-4830, 1 May 87.

Keywords: *Chloromethanes, Reprints, *MO calculations, X ray emissions, Free molecules.

The chlorine K beta emission in fluorescence from gas/vapor phase CCl4, CHCl3, CH2Cl2, and CH3Cl were measured with 'good statistics' and previously undetected weak x-ray emission features were observed. Results from ground state minimal and extended basis set ab initio (STO-3G) and MNDO MO calculations for these molecules are presented. The chlorine K beta emission spectra were analyzed by comparison with complementary spectral data and the MO calculations. In addition, weak features in Cl-K beta emission spectra resulting from self-absorption in the sample were identified.

700,449

PB87-231361 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Chemical Engineering Science Div.
Batch Extraction of Amines Using Emulsion Liquid Membranes: Importance of Reaction Reversibility.
Final rept.,
R. S. Baird, A. L. Bunge, and R. D. Noble. 1987, 11p
Pub. in American Institute of Chemical Engineers Jnl. 33, n1 p43-53 Jan 87.

Keywords: *Emulsion, *Extraction, Experiments, Mathematical models, Reprints, Interfacial adsorption, Liquid membranes, Multiple solutes, *Reversible reaction.

Experimental results for the batch extraction of amines using emulsion liquid membranes with an internal aqueous HCl solution are presented. Four amines and mixtures of one binary pair were studied. Reversibility of the acid-amine reaction within the internal droplets affected extraction rates. The reversible reaction model presented earlier satisfactorily predicts these experimental results.

700,450

PB87-231379 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Chemical Engineering Science Div.

Physical & Theoretical Chemistry

Thermal Conductivity of Liquid Hydrogen Filled Foam.

Final rept.,
D. E. Daney, and E. Mapoles. 1987, 2p
Contract SANL-423-005
Sponsored by Lawrence Livermore National Lab., CA.
Pub. in *Cryogenics* 27, p427-428 Aug 87.

Keywords: *Hydrogen, *Thermal conductivity, Reprints, *Aerogel foam, Deuterium.

The effective thermal conductivities of silica aerogel foam (0.1(10)-3kg m⁻³ nominal density) filled with liquid n-H₂, liquid n-D₂ and an equimolar mixture of liquid H₂-D₂ were measured near 19.6 K. The measured value of 97 mW m⁻¹ K⁻¹ for hydrogen filled foam is essentially the same as for the liquid alone. The result agrees with predictions for the thermal conductivity of porous systems which give a 2% enhancement in the effective thermal conductivity for the system relative to the liquid alone.

700,451
PB87-231544 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Tunneling Spectroscopy of a La-Sr-Cu-O Break Junction: Evidence for Strong-Coupling Superconductivity.
Final rept.,
J. Moreland, A. F. Clark, L. G. Goodrich, H. C. Ku, and R. N. Shelton. 1987, 3p
Contract N00014-86-F-0109
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in *Physical Review B* 35, n16 p8711-8713, 1 Jun 87.

Keywords: Superconductors, Reprints, *Break junction, *Electron tunneling, Tunneling spectroscopy, Vacuum tunneling.

Detailed structure in the quasiparticle tunneling has been observed in La-Sr-Cu-O superconductive tunneling junctions using the break-junction technique. Variability in the energy gap and associated structure in the current-voltage curves are observed indicating significant inhomogeneity in the superconducting properties. Large energy gaps (7.0 meV) and deep structure in the conductance derivative are evidence for a strong-coupling mechanism.

700,452
PB87-232013 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Effects of Pressure and Temperature on the Thermal Decomposition Rate and Reaction Mechanism of Beta-Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine.
Final rept.,
G. J. Piermarini, S. Block, and P. J. Miller. 1987, 7p
Sponsored by Army Research Office, Research Triangle Park, NC.
Pub. in *Jnl. of Physical Chemistry* 91, n14 p3872-3878, 2 Jul 87.

Keywords: *Explosives, High pressure, Kinetics, Temperature, Reprints, HMX, Reaction mechanism, Reaction rates, Thermal decomposition.

The effects of pressure and temperature on the thermal decomposition rate of Beta-HMX (HMX = octahydro-1,3,5,7-tetra-nitro-1,3,5,7-tetrazocine) in a diamond anvil high-pressure cell were measured by a FTIR method up to 6.5 GPa and 583 K. The observed alpha (mole fraction) vs. time curves were sigmoid and followed rate equations based on the theory of nuclei chain formation with branching interference suggesting an autocatalytic-type reaction. Pressure decreases the rate of thermal decomposition, while temperature increases the rate in typical Arrhenius behavior. The energy of activation decreases with increasing pressure linearly from 501 kJ/mol at 3.6 GPa to 150 kJ/mol at 6.5 GPa. The entropy of activation is positive but with a negative linear pressure dependence. At 3.6 GPa the entropy change at 583 K is 0.60 (kJ/mol)/K decreasing to 0.047 (kJ/mol)/K at 6.5 GPa. The volume of activation is positive (4.1 cu. cm./mol) and nearly constant over the P-T domain studied. The reactant increases in volume by about 3% in order to achieve the activated state. Between 3.6 and 5.5 GPa, the reaction mechanism is unimolecular and probably involves a ring expansion prior to bond scission. Above 5.5 GPa the mechanism is bimolecular. The change in molecularity can be explained by the introduction of strain into the kinetic model. The observed pressure

dependences of the entropy, activation energies, and volume appear to explain why beta-HMX can detonate at high pressures.

700,453
PB87-233342 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Methods for Accurate Determination of Emission Rate and Trap Concentration with Application to Platinum-Doped Silicon.
Final rept.,
W. R. Thurber, and J. R. Lowney. 1987, 7p
Pub. in *Jnl. of Applied Physics* 62, n2 p534-540, 15 Jul 87.

Keywords: Reprints, *Deep levels, *Emission rates, *Nonexponential transients, Platinum in silicon, Trap concentration.

A procedure for the analysis of junction capacitance was developed which allows one to extract accurate values of emission rate and trap concentration from isothermal transient capacitance measurements. Experiments to demonstrate the procedure were performed on silicon diodes doped with platinum. The capacitance-ratio method of determining the emission rate was used to remove the nonexponentiality due to large trap concentration from the capacitance transients. Arrhenius plots of scaled emission rate gave activation energies of $E_c - E_a = 0.2271 \pm 0.0002$ eV for the platinum acceptor level in n-type silicon and $E_a - E_u = 0.3215 \pm 0.0012$ eV for the platinum donor level in p-type silicon. A new method for determining the trap concentration is derived and verified by use of simulations and data. The method involves the subtraction of capacitance values obtained from two transients with the same fill voltage, but different reverse voltages. It is much simpler than methods which require iterative solutions of Poisson's equation and a priori knowledge of the trap energy.

700,454
PB87-233409 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
State-Specific Orbital Alignment Effects in Electronic Energy Transfer: Sr(5s6p singlet P(1)) + M Sr(5s6p triplet P(J), 4d5p triplet F(4), triplet F(3)) + M.
Final rept.,
W. Bussert, and S. R. Leone. 1987, 7p
Grant NSF-CHE83-08403
Sponsored by National Science Foundation, Washington, DC., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in *Chemical Physics Letters* 138, n2-3 p276-282, 17 Jul 87.

Keywords: *Strontium, Atomic orbitals, Energy transfer, Alignment, Hydrogen, Helium, Reprints.

Orbital alignment effects are investigated for an energy transfer process involving several competing pathways in the system Sr(5s6p singlet P(1)) + rare gases and H₂. Most of the cross sections to populate either (1) the combined 5s6p triplet P(J) and 4d5p triplet F(4) states or (2) the individual 4d5p triplet F(3) level show a marked preference for the perpendicular approach of the p orbital. However the cross section with He to populate the triplet F(3) state strongly favors the parallel orbital direction.

700,455
PB87-233417 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Orbital Alignment Effects in the Ca(4s5p singlet P(1)) to Ca(4s5p triplet P(J)) Electronic Energy Transfer with Molecular Collision Partners.
Final rept.,
W. Bussert, and S. R. Leone. 1987, 7p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in *Chemical Physics Letters* 138, n2-3 p269-275, 17 Jul 87.

Keywords: *Calcium, Atomic orbitals, Alignment, Energy transfer, Hydrogen, Deuterium, Nitrogen, Oxygen, Carbon monoxide, Carbon dioxide, Methane, Sulfur hexafluoride, Ethane, Reprints, Atom-molecule collisions, Polarization.

The effects of orbital alignment on the Ca(4s5p singlet P(1)) to Ca(4s5p triplet P(J)) electronic energy transfer

process are determined for molecular collision partners, H₂, D₂, N₂, O₂, CO, CO₂, CH₄, C₂H₆, and SF₆. Most of the molecules exhibit negligible effects, except for H₂(D₂) and CO₂, which show significant preferences for perpendicular and parallel initial orbital alignments, respectively. In the reverse transfer direction, hydrogen exhibits an even larger effect favoring the perpendicular laser polarization.

700,456
PB87-233474 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Core-Exciton-Induced Desorption from MgO.
Final rept.,
R. L. Kurtz, R. Stockbauer, R. Nyholm, S. A. Flodstrom, and F. Senf. 15 May 87, 4p
Sponsored by Swedish Natural Science Research Council, Stockholm, and Office of Naval Research, Arlington, VA.
Pub. in *Physical Review B* 35, n14 p7794-7797, 15 May 87.

Keywords: *Desorption, Magnesium oxide, Reprints, *Excitons, Photon stimulated desorption.

Core-exciton-induced desorption of O⁻ and H⁺ from MgO(100) and MgO(111) has been observed using photon excitation energies spanning the O K edge. Electron-yield data from partially oxidized Mg implies that these states are localized in the near-surface region. O⁺ and H⁺ desorption results from the decay of different O core-exciton states as well as the states produced by interband transition. The O excitonic levels are interpreted in terms of their related atomic origin.

700,457
PB87-233508 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Heats of Adsorption of Atomic C, N, and O on Ni(100) and Cu(100) from a (Z+1) Core-Level Shift Analysis (Summary Abstract).
Final rept.,
W. F. Egelhoff. Aug 87, 1p
Pub. in *Jnl. of Vacuum Science and Technology A* 5, n4 p700 Jul/Aug 87.

Keywords: *Carbon, *Copper, *Heat of adsorption, Nickel, Nitrogen, Oxygen, Reprints, XPS.

It has been demonstrated in several recent papers that the equivalent core approximation can be used in an energy cycle analysis to extract heats of adsorption from core-level shift data on adsorbed atoms and molecules on metal surfaces. The purpose of the present work is to apply such an analysis to the important cases of atomic C, N, and O on Ni(100) and Cu(100). These cases are important because the heats of adsorption of these atoms represent a fundamental (and at present largely unknown) parameter in the dissociative chemisorption, associative desorption, and chemical reactions of a number of simple molecules on these surfaces.

700,458
PB87-233516 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Vibrational Relaxation of Adsorbed Molecules: Comparison with Relaxation Rates of Model Compounds.
Final rept.,
R. R. Cavanagh, M. P. Casassa, E. J. Heilweil, and J. C. Stephenson. Aug 87, 4p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in *Jnl. of Vacuum Science and Technology A* 5, n4 p469-472 Jul/Aug 87.

Keywords: *Hydroxyl, *Vibration, Picosecond, Silanol, Solution, Reprints, *Relaxation.

Time-resolved measurements of vibrational relaxation rates are reviewed. Depopulation of the vibrationally excited OH oscillator (on high surface area SiO₂, ZSM-5, and ZnO) was found to occur on a time scale of 200 ps or less, depending on the substrate. The temperature dependence of both the OH and OD vibrational relaxation rates on SiO₂ was found to follow simple multiphonon relaxation models. However, the relative rates for the two isotopes did not scale as predicted by the same theoretical models. Measurements of isotopically substituted silanols and alcohols (i.e., R₃SiO(D)

and R3COH(D) dilute in CCl₄) also find OD decay times comparable to those of OH. Based on results from these model compounds, the observed relaxation rates for OH/SiO₂ appear to be dominated by processes which proceed through a SiOH bending mode.

700,459
PB87-233532 Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Facilitated Transport of CO₂ in Ion Exchange Membranes.

Final rept.,
J. D. Way, R. D. Noble, D. L. Reed, G. M. Ginley, and L. A. Jarr. 1987, 8p
Contract DE-AC21-84MC21271
Sponsored by Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
Pub. in AIChE Jnl. 33, n3 p480-487 Mar 87.

Keywords: *Carbon dioxide, *Membranes, Separation, Mathematical models, Transport, Reprints, *Acid gas separation, Ion exchange membranes.

The facilitated transport of CO₂ through ion exchange membranes containing organic amine counterions was studied. Steady state CO₂ fluxes were measured from pure gas streams and mixtures with CH₄. Facilitation factors for CO₂ up to 26.7 were calculated from transport data. Transport measurements were binary mixtures of CO₂ and CH₄ yielded ratios of CO₂ flux to CH₄ flux ranging from 29.0 to 264. Conversion of flux ratios to permeabilities yielded separation factors up to 551 for CO₂ over CH₄, which are compared to literature data for polymeric membranes. The transport data support a mobile, reactive-carrier facilitated transport mechanism with a carbamate zwitterion complex. Effective diffusivities for CO₂ and the carrier-gas complex were determined from transport data. A reaction equilibrium model predicted facilitation factors that were in very good agreement with experimental values. Potential applications are also discussed.

700,460
PB87-233565 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Scanning Electron Microscope with Polarization Analysis Studies of Magnetic Materials (Summary Abstract).

Final rept.,
J. Unguris, G. G. Hembree, R. J. Celotta, and D. T. Pierce. 1987, 2p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Jnl. of Vacuum Science and Technology A5, n4 p1976-1977 Jul/Aug 87.

Keywords: *Electron microscopy, Reprints, *Magnetic microstructure, *Polarized electron.

The technique of Scanning Electron Microscopy with Spin Polarization Analysis (SEMPA) is summarized. By measuring the spin polarization of secondary electrons generated in an SEM, SEMPA can directly image magnetic domain structures with a spatial resolution of about 100 Angstroms. The apparatus and its applications to the study of magnetic domains in Ge-Si are described.

700,461
PB87-233599 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

C1-K(beta) (K-V) Emission of CFC13 Excited by Synchrotron Radiation Below and Above C1-1s Binding Energy: Perturbation Effects in a Highly Excited Neutral Molecule.

Final rept.,
R. C. C. Perera, R. E. LaVilla, P. L. Cowan, T. Jach, and B. Karlin. 1987, 3p
Contract DE-AC03-76SF00098
Sponsored by Department of Energy, Washington, DC. Pub. in Physica Scripta 36, p132-134 1987.

Keywords: *Chlorine, Synchrotron radiation, Perturbation, Absorption spectra, Emission spectra, Fluorescence, Reprints, *Methane/fluoro-trichloro.

The Cl K(beta) (K-V) fluorescent emission and K absorption spectra from CFC13 vapor were measured using monochromatic synchrotron radiation. Weak supra-threshold features were observed in the Cl K absorption spectrum. The Cl 1s binding energy of CFC13 was estimated to be 2829.4eV.

700,462
PB87-233714 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Dropletwise Evaporative Cooling of High Thermal Conductivity Materials.

Final rept.,
M. di Marzo, and D. D. Evans. 1987, 11p
Pub. in Heat and Technology 5, n1-2 p126-136 1987.

Keywords: *Conduction, *Droplets, Evaporation, Extinction, Fire models, Reprints, *Thermal conductivity, Spray quenching.

Transient cooling of solid surfaces by water droplet evaporation has been investigated through controlled experiments using a large heated aluminum cylinder. Quantitative prediction of droplet evaporation time and in-depth transient temperature distribution in the solid have been made. In the case studied, a single droplet is deposited on a horizontal nonporous surface with initial temperatures in the range of 75 C to 100 C. The liquid-vapor interfacial temperature and the water vapor molar fraction in the air at the exposed surface of the water droplet are deduced from the coupled heat and mass transfer energy balance at the interface. Spatial and temporal integration of the overall droplet energy equation is used to predict the instantaneous evaporation rate and the droplet evaporation time. The boundary conditions for the wetted region proposed by Seki are used to obtain the transient temperature distribution for a semi-infinite solid.

700,463
PB87-233722 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Accurate Energies for the 4p (5)5s5p Quartet S(3/2) and 4p (5)5s4d Quartet P(5/2) Levels of Neutral Rubidium (Rb I).

Final rept.,
J. Reader. 1987, 2p
Pub. in Physical Review A 36, n1 p415-416, 1 Jul 87.

Keywords: Reprints, *Core excited states, *Energy levels, Rubidium, Spectrum, Ultraviolet vacuum, Wavelengths.

Accurate wavelengths for the 4p(sup 6)5p(sup 2)P1/2-4p(sup 5)5s5p(sup 4)S3/2, 4p(sup 6)5p(sup 2)P3/2-4p(sup 5)5s5p(sup 4)S3/2, and 4p(sup 6)4d(sup 2)D3/2,5/2-4p(sup 5)5s4d(sup 4)P5/2 transitions of Rb1 have been measured by photographing a sliding-spark light source with a 10.7-m normal-incidence vacuum spectrograph. The energies of the 4p(sup 5)5s5p(sup 4)S3/2 and 4p(sup 5)5s4d(sup 4)P5/2 levels were determined as 134250.1 plus or minus 0.4 cm-1 and 136806.4 plus or minus 0.4 cm-1, respectively.

700,464
PB87-233912 Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Relationship between Least-Squares-Surface and Celles-Darling's Hyperspherical Coordinates.

Final rept.,
G. A. Natanson. 27 Feb 87, 6p
Pub. in Chemical Physics Letters 134, n3 p301-306, 27 Feb 87.

Keywords: *Atoms, Reprints, *Bending motion, *Linear path, Molecular vibration, Reaction theory, Saddle points.

The Carrington-Miller reaction-surface approach to a nearly collinear reaction in a triatomic system is used to substantiate the bending-corrected rotating linear model of Walker and Hayes. To avoid couplings between mutually perpendicular bending vibrations the change of variables suggested by Carrington and Miller is slightly modified by describing overall rotation of the triatomic by means of the body-fixed frame with the polar angle of the double degenerate bending mode used as the third Euler angle. It is proved that axes of the frame defined in such a way are directed along the principal axes of the triatomic and that the appropriate parameterization of the collinear reaction surface leads to Celles-Darling's hyperspherical coordinates zeta, eta, chi.

700,465
PB87-233953 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

T-V Energy Transfer and the Exchange Reaction of H(D) + HF at 2.2(2.1)eV: Vibrational State Distributions by Time and Wavelength Resolved Infrared Fluorescence.

Final rept.,
L. M. Cousins, and S. R. Leone. 1987, 7p
Grants NSF-PHY86-04504, NSF-CHE84-08403
Sponsored by National Science Foundation, Washington, DC., and Army Research Office, Research Triangle Park, NC.
Pub. in Jnl. of Chemical Physics 86, n12 p6731-6737, 15 Jun 87.

Keywords: *Hydrogen fluoride, *Hydrogen, *Deuterium, Energy transfer, Excitation, Reprints, *Atom-molecule collisions, Hot atom chemistry, Laser applications.

The product state distributions for hot atom collisions of H(D) + HF were measured by the laser photolysis-infrared emission technique. It was found that H atoms are 3.0 times more efficient than D atoms at exciting HF vibrations for the same kinetic energy. Although the vibrational distributions are similar, the D + HF T-V channel deposits approximately two times as much energy in the HF molecules as the vibrational exchange channel leaves in the DF molecules. The agreement between experiment and theory is excellent. The theoretical results show that significantly different mechanisms are responsible for T-V energy transfer on the reactive and unreactive portions of the potential energy surface.

700,466
PB88-109301 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Polarization Diffusion and Dielectric Friction in Polar Liquids.

Final rept.,
P. J. Stiles, and J. B. Hubbard. 1984, 9p
Pub. in Chemical Physics 84, p431-439 1984.

Keywords: Reprints, *Dielectric friction, Dielectric relaxation, *Polarization dynamics, Polar molecule, Rotational diffusion, Translational diffusion.

The authors introduce a new mechanism for collective polarization dynamics in a polar liquid. The continuum model couples hydrodynamic motions of the liquid to dielectric relaxation by both rotational and translational diffusion of polar molecules. As an application of the theory the authors calculate the dielectric friction on an ion in a solvent that relaxes only by the translational diffusion mechanism. The result is quite different from dielectric friction dominated by rotational (Debye) relaxation.

700,467
PB88-109319 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Conceptual Design of Low Gravity Experiments on Phase Transition and Critical Phenomena in Fluids.

Final rept.,
M. R. Moldover, and R. W. Gammon. 1983, 103p
Pub. in NASA Contractor's Report CR174637, 103p 1983.

Keywords: *Capillary rise, *Critical phenomena, *Dielectric constant, Gravity effects, Light scattering.

Four experimental areas are discussed in the context of possible low-g studies of phase transition and critical phenomena in fluids. They are: (1) photographic and light scattering studies of phase separation dynamics near the liquid-vapor critical point; (2) light scattering from critical fluctuations in equilibrium; (3) wetting films on container walls near the critical point; and (4) dielectric constant anomalies near the critical point. New results, heretofore unpublished, have been obtained in areas (1), (2), and (3). In the optical studies of phase separation near the critical point, hydrodynamic processes are observed. Proximity to the critical point determines the values of the thermodynamic and transport properties that enter into the hydrodynamic equations. The authors imaging and scattering measurements are at too late a time and at too large a size scale to be influenced by microscopic fluctuations. Furthermore, when the volume fractions of the new phases forming are roughly equal, the extreme turbidity of the fluid prevents us from making meaningful observations of phase separation in the absence of severe wall effects which have not been modeled. The authors conclude that optical studies of a phase separating pure fluid, in a low-g environment, could not be

justified as a means of extending our understanding of fluctuations in the critical region.

700,468

PB88-109327

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Thermophysics Div.

Viscosity and Density of Two Alkali Metal Mixtures.

Final rept.,

R. F. Berg, M. R. Moldover, S. Rabinovich, and A.

Voronel. 1987, 6p

Contract NASA-C-86129-D

Sponsored by National Aeronautics and Space Admin-

istration, Cleveland, OH. Lewis Research Center.

Pub. in Jnl. of Physics F: Metal Physics 17, p1861-

1866 1987.

Keywords: *Viscosity, Sodium, Reprints, *Alkali metal mixtures, *Cesium, *Density, Glass formation, Hard sphere models, Packing fraction, Potassium.

The authors have measured the density and viscosity of a K-Cs binary mixture and a Na-K-Cs ternary mixture from their crystallization points (234 K and 199 K respectively) to 300 K. Extrapolations of the fluidity data indicate that the effective glass temperatures are only 39 K and 12 K below the minimum melting and eutectic temperatures for the binary and ternary mixtures, respectively. The extrapolated liquid densities at these temperatures agree well with predictions based on hard-sphere models.

700,469

PB88-109335

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Thermophysics Div.

Scaled Fundamental Equation for the Thermodynamic Properties of Carbon Dioxide in the Critical Region.

Final rept.,

P. C. Albright, T. J. Edwards, Z. Y. Chen, and J. V.

Sengers. 1987, 9p

Pub. in Jnl. of Chemical Physics 87, n3 p1717-1725, 1

Aug 87.

Keywords: *Carbon dioxide, Reprints, *Critical phenomena, *Parametric model, Equation of state, Specific heat.

A scaled fundamental equation is presented for the thermodynamic properties of carbon dioxide in the critical region. The equation is constructed by combining earlier experimental pressure data of Michels and co-workers with new specific heat data obtained by one of the authors and represents the thermodynamic properties of carbon dioxide in the critical region at temperatures from 301.15 to 323 K and at densities from 290 to 595 kg/cu. m.

700,470

PB88-109343

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Thermophysics Div.

Crossover from Singular to Regular Thermodynamic Behavior of Fluids in the Critical Region.

Final rept.,

P. C. Albright, Z. Y. Chen, and J. V. Sengers. 1987,

4p

Grant NSF-DMR82-05356

Sponsored by National Science Foundation, Wash-

ington, DC.

Pub. in Physical Review B 36, n1 p877-880, 1 Jul 87.

Keywords: *Carbon dioxide, Reprints, *Critical phenomena, *Equation of state, Specific heat, Supercritical fluids, Thermodynamic properties.

A procedure is presented for constructing equations for the thermodynamic properties of fluids in the critical region which incorporates the crossover from Ising-like scaled behavior near the critical point to regular (i.e., classical) behavior away from the critical point in a theoretically consistent manner. When the procedure is applied to a truncated classical Landau expansion, the authors obtain an accurate representation of the thermodynamic properties of carbon dioxide in both the asymptotic critical region and in the crossover regime.

700,471

PB88-110051

PC A03/MF A01
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.

NO2 Heterodyne Frequency Measurements with a Tunable Diode Laser, a CO Laser Transfer Oscillator, and CO2 Laser Standards.

L. R. Zink, M. Vanek, and J. S. Wells. Apr 87, 28p

NBS/TN-1308

Also available from Supt. of Docs. Sponsored by National Aeronautics and Space Administration, Washington, DC.

Keywords: *Nitrogen dioxide, *Frequency measurement, Molecular spectra, Intermediate infrared radiation, Heterodyning, Carbon dioxide lasers, Calibration, Tunable lasers, Carbon monoxide lasers.

Heterodyne frequency measurements have been made on selected groups of nitrogen dioxide rovibronic transitions between 1580.8 and 1650.7/cm. The groups are separated by 7 to 10/cm, and the intent is to provide a limited (and interim) calibration table for the region. In addition to a table of measured frequencies in the region, the authors have included figures of spectra in the vicinity of the measured lines to provide a map for identifying the transitions measured.

700,472

PB88-110713

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Thermodynamics Div.

Ionic Hydrogen Bond. 3. Multiple NH(1+)...O and CH(delta+)...O Bonds. Complexes of Ammonium Ions with Polyethers and Crown Ethers.

Final rept.,

M. Mautner. 1983, 4p

See also PB85-230431.

Pub. in Jnl. of the American Chemical Society 105, n15 p4912-4915 1983.

Keywords: *Hydrogen bonds, *Proton reactions, *Ethers, *Ketones, *Polyethers, Reprints, *Proton affinity.

Complexes of ammonium ions RNH_3^+ ($R=CH_3$, C_6H_{11}), $(CH_3)_3NH^+$, and pyridine H^+ with polyethers and crown ethers are observed in the gas phase in the absence of solvent effects. The dissociation energies, ΔH of the RNH_3^+ polyether complexes range from 29.4 kcal mol⁻¹ (for $RNH_3^+ \cdot CH_3OCH_2CH_2OCH_3$) to 46 kcal mol⁻¹ ($RNH_3^+ \cdot 18\text{-crown-6}$). The large ΔH values for complexes of polydentate ligands indicate multiple $-NH^+ \cdots O-$ hydrogen bonding. Such multiple bonding can contribute up to 18 kcal mol⁻¹ to the bonding in $RNH_3^+ \cdot CH_3OCH_2CH_2OCH_3$ and 21 kcal mol⁻¹ in $RNH_3^+ \cdot 18\text{-crown-6}$. Multiple interactions are also evident in the $(CH_3)_3NH^+ \cdot$ polyether complexes where $-CH \cdots O-$ hydrogen bonding seems to occur; and consecutive $-CH \cdots O-$ bonds contribute approximately 6.4, and 2 kcal/mol-1 respectively for up to three such bonds. Total ΔH values in the $(CH_3)_3NH^+ \cdot$ polyether complexes thus range from 26.7 kcal mol⁻¹ in $(CH_3)_3NH^+ \cdot CH_3O-(CH_2)_2OCH_3$ to 41 kcal mol⁻¹ in $(CH_3)_3NH^+ \cdot 18\text{-crown-6}$. Multiple interaction effects, possibly including van der Waals dispersion forces, are observed also in pyridine $H^+ \cdot$ polyether complexes. Large negative entropies in $RNH_3^+ \cdot$ acyclic polyether complexes vs. $RNH_3^+ \cdot$ cyclic crown ethers make the acyclic polyethers less efficient ligands.

700,473

PB88-110721

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Thermodynamics Div.

Ionic Hydrogen Bond. 4. Intramolecular and Multiple Bonds. Protonation and Complexes of Amides and Amino Acid Derivatives.

Final rept.,

M. Mautner. 1984, 6p

See also PB88-110713.

Pub. in Jnl. of the American Chemical Society 106, n2 p278-283 1984.

Keywords: *Amides, *Amino acids, Clusters, Complexes, Hydrogen bonding, Solvation, Reprints.

The thermochemistry of protonation and ion-neutral interactions of $CH_3CON(CH_3)_2(DMA)$ and of the peptide-like alanine derivative $CH_3CONHCH(CH_3)COOCH_3(1)$ are models for ionic interactions in proteins. High proton affinity and negative entropy of protonation of 1 vs. DMA indicate intramolecular hydrogen bonding in $1H^+$. The internal hydrogen bond decreases the availability of the proton for external hydrogen bonding. Thus, the attachment energy of H_2O to $1H^+$, 13.0 kcal mol⁻¹, is lower than

that to $DMAH^+$, 16.5 kcal mol⁻¹. The thermochemistry of the $1H^+ \cdot H_2O$ complex suggests a T-shaped structure, or one where H_2O bridges between the two carbonyl groups. In other complexes 1 can serve as a neutral ligand. In such a complex, $CH_3NH_3^+ \cdot 1$, the unusually large experimental enthalpy of complexation, -40.1 kcal mol⁻¹, suggests multiple hydrogen bonding. These results, combined with the thermochemistry of protonated amide dimers, suggest that intramolecular and multiple ionic hydrogen bonds can contribute significantly to the stabilities of ionic intermediates in protein and enzyme environments. Such contributions can range, per single hydrogen bond, from 5 kcal mol⁻¹ for strained and distorted bonds to 30 kcal mol⁻¹ for geometrically optimized bonds.

700,474

PB88-110754

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Temperature and Pressure Div.

Measurement and Rate Law Analysis of D2 Q-Branch Line Broadening Coefficients for Collisions with D2, He, Ar, H2, and CH4.

Final rept.,

K. C. Smyth, G. J. Rosasco, and W. S. Hurst. 1987,

11p

Sponsored by Army Research Office, Research Triangle Park, NC.

Pub. in Jnl. of Chemical Physics 87, n2 p1001-1011, 15 Jul 87.

Keywords: *Gas analysis, Raman spectroscopy, Resolution, Inelastic scattering, Vibrational spectra, Gases, Rare gases, Reprints.

Continuous-wave stimulated Raman spectroscopy has been used to obtain high resolution vibrational Q-branch spectra at room temperature for pure D2 and D2:He, D2:H2, D2:Ar, and D2:CH4 mixtures. Measurements have been made for $J=0-5$ in the density region of 0.5-20.0 amagat, from which line broadening coefficients have been determined. These coefficients have been analyzed using a modified exponential energy gap rate law to identify the contributions of rotationally inelastic collisions and vibrational dephasing collisions to the linewidth. The analysis has assumed that vibrational dephasing is independent of rotational state, in accord with available theoretical studies. Results are compared with experimental and theoretical work on H2, HD, and D2, thereby characterizing the contributions of rotationally inelastic and vibrational dephasing collisions to the line broadening coefficients as a function of both rotational level and collision partner.

700,475

PB88-110846

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.

Use of Angle Resolved Electron and Photon Stimulated Desorption for the Determination of Molecular Structure at Surfaces.

Final rept.,

T. E. Madey, and R. Stockbauer. 1983, 13p

Sponsored by Office of Naval Research, Arlington,

VA., and Department of Energy, Washington, DC.

Pub. in Rev. Brasil. Apl. Vac. 3, n1-2 p47-59 1983.

Keywords: *Desorption, Chemisorption, Adsorption, Surfaces, Molecular structure, Synchrotron radiation, Reprints, Electron stimulated desorption.

The paper is a brief review of recent data related to the use of angle-resolved electron stimulated desorption and photon stimulated desorption in determining the structures of molecules at surfaces. Examples include a variety of structural assignments based on ESDIAD (electron stimulated desorption ion angular distributions), the observation of short-range local ordering effects induced in adsorbed molecules by surface impurities, and the application of photon stimulated desorption to both ionic and covalent adsorbate systems.

700,476

PB88-112511

Not available NTIS
American Chemical Society, Washington, DC.

Journal of Physical and Chemical Reference Data, Volume 16, Number 1, 1987.

Quarterly rept.

c1987, 168p

See also PB88-112529 through PB88-112578 and PB87-109963. Prepared in cooperation with American Inst. of Physics, New York. Sponsored by National Bureau of Standards, Gaithersburg, MD.

Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Research projects, *Chemical industry, Thermodynamic properties, Thermochemistry, Chemical shieldings, *Foreign technology.

Contents: Thermochemical data on gas phase compounds of sulfur, fluorine, oxygen, and hydrogen related to pyrolysis and oxidation of sulfur hexafluoride; The thermochemical measurements on rubidium compounds: A comparison of measured values with those predicted from NBS tables of chemical and thermodynamic properties; Standard thermodynamic functions of gaseous polyatomic ions at 100-1000 K; Thermodynamic properties of manganese and molybdenum; Thermodynamic properties of selected binary aluminum alloy systems; ¹³C chemical shieldings in solids.

700,477
PB88-112685 Not available NTIS
American Chemical Society, Washington, DC.

Journal of Physical and Chemical Reference Data, Volume 16, Number 3, 1987.

Quarterly rept.
c1987, 188p
See also PB88-112693 through PB88-112743 and PB88-112586. Prepared in cooperation with American Inst. of Physics, New York. Sponsored by National Bureau of Standards, Gaithersburg, MD.
Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC 20036.

Keywords: *Research projects, *Chemical industry, Thermodynamic properties, Combustion, Transport properties, Vaporization, Thermochemistry, *Foreign technology.

Contents: Standard chemical thermodynamic properties of alkane isomer groups; High-temperature vaporization behavior of oxides II. Oxides of Be, Mg, Ca, Sr, Ba, B, Al, Ga, In, Tl, Si, Ge, Sn, Pb, Zn, Cd, and Hg; Equilibrium and transport properties of eleven polyatomic gases at low density; The thermochemistry of inorganic solids IV. Enthalpies of formation of compounds of the formula MX₂Y₂; Chemical kinetic data base for combustion chemistry, Part 2. Methanol; Phase diagrams and thermodynamic properties of the 70 binary alkali halide systems having common ions; Cumulative listing of reprints and supplements.

700,478
PB88-112693 Not available NTIS
Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

Standard Chemical Thermodynamic Properties of Alkanol Isomer Groups.

R. A. Alberty, M. B. Chung, and T. M. Flood. c1987, 27p

Sponsored by National Bureau of Standards, Gaithersburg, MD.
Included in Jnl. of Physical and Chemical Reference Data, v16 n3 p391-417 1987. Available from American Chemical Society, 1155 Sixteenth St., NW, Washington, DC. 20036.

Keywords: *Thermodynamic properties, *Alkanol isomer groups, Benson method, Enthalpy of formation.

The chemical thermodynamic properties of alkanol (ROH) isomer groups from CH₄O to C₄H₁₀O in the ideal gas phase have been calculated from 298.15 to 1000 K from tables of Stull, Westrum, and Sinke. In the absence of literature data on all isomers of higher isomer groups, the properties of isomers of C₅H₁₂O to C₈H₁₈O have been estimated using Benson group values. Equilibrium mole fractions within isomer groups have been calculated for the ideal gas state from 298.15 to 1000 K. For isomer group properties increments per carbon atom have been calculated to show the extent to which thermodynamic properties of higher isomer groups may be obtained by linear extrapolation. Values of Cp, S, delta(H), and delta(F)G are given for all species of alkanols from CH₄O to C₈H₁₈O in SI units for a standard state pressure of 1 bar.

700,479
PB88-113738 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Structure of the Mixed Crystal (KCN)0.7(KBr)0.3 Determined by Neutron Powder Diffraction.
Final rept.,
J. Bouilliot, J. M. Rowe, and J. J. Rush. 1987, 6p
Pub. in Physical Review B 36, n3 p1766-1771, 15 Jul 87.

Keywords: Reprints, *Alkali cyanide/holide mixtures, *Ionic crystals, Mixed crystals, Neutron diffraction, Powder diffraction.

Neutron powder diffraction patterns of (KCN)0.7(KBr)0.3 measured at various temperatures in the range 17-200 K reveal a transition at Tc approx. 113 K between a cubic phase above Tc and a mixed rhombohedral-monoclinic phase (below Tc), in general agreement with recent x-ray studies (K. Knorr, A. Loidl, and J.K. Kjems, Phys. Rev. Lett. 55, 2445 (1985)). In the low-temperature rhombohedral structure, the (CN)-ions lie in the plane perpendicular to the threefold axis. Structural data are given and discussed.

700,480
PB88-117379 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Powder Neutron Diffraction Study of ZrTiO₄, Zr₅Ti₇O₂₄, and FeNb₂O₆.
Final rept.,
P. Bordet, A. McHale, A. Santoro, and R. S. Roth. 1986, 17p
Pub. in Jnl. of Solid State Chemistry 64, p30-46 1986.

Keywords: *Diffraction, Reprints, *Powder neutron diffraction, Zirconium titanates, Iron niobate.

The zirconium titanates ZrTiO₄ and Zr₅Ti₇O₂₄ and the iron niobate FeNb₂O₆ have been investigated with the neutron diffraction powder technique and the Rietveld method. All three compounds crystallize with the symmetry of space group Pbcn and have lattice parameters a = 4.8042(2), b = 5.4825(3), c = 5.0313(2) Å for ZrTiO₄; a = 14.3574(6), b = 5.3247(3), c = 5.0200(2) Å for Zr₅Ti₇O₂₄; and a = 14.2661(2), b = 5.7334(1), c = 5.0495(1) Å for FeNb₂O₆. Pure zirconium titanate, ZrTiO₄, has the a-PbO₂-type structure with a random distribution of the two cations. The compounds Zr₅Ti₇O₂₄ and FeNb₂O₆ are ordered superstructures of alpha-PbO₂ and in these two cases the observed distortions depend on the differences between ionic radii, leading to a fersmite-type structure in the case of Zr₅Ti₇O₂₄ and to a columbite-type structure in the case of FeNb₂O₆.

700,481
PB88-117403 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Effects of Configuration Mixing on Computed Dielectronic-Recombination Rates.
Final rept.,
R. D. Cowan, and D. C. Griffin. 1987, 7p
Contract DE-AC05-84OR21400
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 36, n1 p26-32, 1 Jul 87.

Keywords: Reprints, *Configuration mixing, *Dielectronic recombination rates.

The authors investigate qualitatively and semiquantitatively the effects on computed dielectronic-recombination rate coefficients of including mixing between basis states of two or more configurations, as opposed to the single-configuration approximation. The authors have made model-parameter studies for two-electron systems, and have also considered physically realistic three- and four-electron systems. The authors have attempted to categorize the various circumstances under which configuration-interaction effects are significant, but overall effects appear to be generally small-usually no more than 10-20%.

700,482
PB88-117486 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Frozen Fragment Reduced Variational Space Analysis of Hydrogen Bonding Interactions. Application to the Water Dimer.
Final rept.,
W. J. Stevens, and W. H. Fink. 1987, 8p
Pub. in Chemical Physics Letters 139, n1 p15-22, 14 Aug 87.

Keywords: *Hydrogen, *Coulomb interactions, Chemical bonds, Polarization(Waves), Dimerization, Reprints.

A reduced variational space method is presented for analyzing hydrogen bonding interactions in terms of Coulomb and exchange, polarizability, and charge-transfer components. The method relies on the use of SCF optimized monomer orbitals in dimer calculations

in which the wavefunction of one monomer is held frozen while the other is optimized with a basis set including selected subsets of the unoccupied monomer orbitals. Freezing the monomer wavefunctions allows the polarizability and charge-transfer interactions to be ascribed to specific monomers. Applications are presented for the interaction energy and dipole moment of the water dimer.

700,483
PB88-117494 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Pulsed Beam Fourier Transform Microwave Measurements on OCS and Rare Gas Complexes of OCS with Ne, Ar, and Kr.
Final rept.,
F. J. Lovas, and R. D. Suenram. 1987, 11p
Pub. in Jnl. of Chemical Physics 87, n4 p2010-2020, 15 Aug 87.

Keywords: *Rare gases, *Microwave spectroscopy, Measurements, Van der Waals equation, Neon, Argon, Krypton, Reprints, *Carbonyl sulfide.

A pulsed molecular beam Fourier transform microwave spectrometer, which has been recently constructed at NBS, was employed for measurements on several monomer and van der Waals species of OCS. The absorption-emission cell consists of a Fabry-Perot resonant cavity inside a high vacuum chamber. A pulsed nozzle is used to generate a supersonic molecular beam of a seeded inert gas.

700,484
PB88-117502 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Analysis of the Vibrational Spectrum of the Nitromethyl Free Radical.
Final rept.,
M. E. Jacox. 1987, 4p
Contract N00014-84-F-0159
Sponsored by Army Research Office, Research Triangle Park, NC., and Office of Naval Research, Arlington, VA.

Pub. in Jnl. of Physical Chemistry 91, n19 p5038-5041, 10 Sep 87.

Keywords: Vibrational spectra, Chemical bonds, Molecular structure, Reprints, *Nitromethyl radical.

The vibrational spectra previously reported for the nitromethyl free radical, CH₂NO₂, and its isotopically substituted counterparts have been assigned. The agreement obtained in a least-squares force constant adjustment calculation is sufficiently good to provide strong support both for the assignment and for the assumed C₂ nu symmetry of nitromethyl. The magnitude of the CN-stretching force constant is appropriate for a C-N single bond.

700,485
PB88-117718 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Adsorption of H₂O on Planar and Stepped Si(100): Structural Aspects.
Final rept.,
C. U. S. Larsson, A. L. Johnson, A. Flodstrom, and T. E. Madey. 1987, 5p
Sponsored by Department of Energy, Washington, DC.
Pub. in Jnl. of Vacuum Science and Technology A 5, n4 p842-846 Jul/Aug 87.

Keywords: *Silicon, *Water, *Adsorption, Reprints, Low energy electron diffraction, Temperature dependence.

The adsorption of water on two silicon surfaces reconstructed planar (100)2x1 and single domain stepped (100)2x1 cut 5 degrees towards (011) was studied using low-energy electron diffraction and digital imaging electron stimulated desorption ion angular distributions (ESDIAD) as a function of temperature (145-700 K) and coverage. An interpretation is presented based on the dimer model of the Si(100) reconstruction in which the OH bond axis azimuths are oriented nearly perpendicular to the dimer azimuths.

700,486
PB88-120936 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

CHEMISTRY

Physical & Theoretical Chemistry

Polarized Fluorescence Spectroscopy of O₂(1+).

Final rept.,
J. W. Keller, W. T. Hill, D. L. Ederer, T. J. Gil, and P. W. Langhoff. 1987, 5p
Grants NSF-PHY84-51284, NSF-RII84-06192
Sponsored by National Science Foundation, Washington, DC.
Pub. in *Jnl. of Chemical Physics* 87, n6 p3299-3303, 15 Sep 87.

Keywords: *Alignment, *Autoionization, Molecular oxygen, Polarized fluorescence, Synchrotron radiation, Vacuum ultraviolet, Reprints.

Polarized fluorescence from the A2llu and b 4 sigma-g states of O₂+ following photoionization of O₂(X3sigma-g-) in the 17-21 eV region has been employed to determine population alignment in the O₂+ photoion. The measured A-channel polarization exhibits pronounced structure which correlates well with the known positions of (autoionizing) Rydberg states, whereas polarization signal in the b channel has broad and less prominent features. The measured b-channel polarization values (ranging from -0.02 to -0.05) are consistent with single-channel calculations, while the A-channel polarization measurements (which range from 0 to 0.09) are of opposite sign to the previously reported single-channel calculations. The results of more involved calculations show that this sign reversal in the A channel can be attributed to the presence of intravalent 3 sigma U- states which autoionize into the A channel in the near-threshold region.

700,487

PB88-121033 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.

High-Resolution Spectroscopy of HF from 40 to 1100/cm: Highly Accurate Rotational Constants.

Final rept.,
D. A. Jennings, K. M. Evenson, L. R. Zink, C. Demaynick, J. L. Destombes, B. Lemoine, and J. W. Johns. 1987, 4p
Contract NASA-W-45047
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Jnl. of Molecular Spectroscopy* 122, p477-480 1987.

Keywords: *Hydrogen fluoride, *Infrared spectroscopy, Far infrared radiation, Reprints, High resolution, Rotational states.

Highly accurate spectra of ground state rotational transitions in HF have been combined with earlier spectra to yield accurate rotational constants and frequencies of HF from 1 to 33 THz (40 to 1100/cm). These lines can be used for accurate secondary frequency references for IR and FIR spectroscopy. Direct frequency measurements provided the references for the most accurate of these data.

700,488

PB88-121082 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Dielectronic Recombination of the Be-Like Ions: C(2+), N(3+), O(4+), and F(5+).

Final rept.,
P. F. Dittner, S. Datz, H. F. Krause, P. D. Miller, P. L. Peppmiller, C. Bottcher, C. M. Fou, D. C. Griffin, and M. S. Pindzola. 1987, 7p
Contract DE-AC05-84OR21400
Sponsored by Department of Energy, Washington, DC.
Pub. in *Physical Review A* 36, n1 p33-39, 1 Jul 87.

Keywords: Reprints, *Beryllium ions, *Dielectronic recombination, Metastable states, Rate coefficients.

The first measurements of dielectronic recombination rate coefficients associated with the 2s yields 2p excitation in the Be-like ions C²⁺, N³⁺, O⁴⁺, and F⁵⁺ are reported. The authors observed the amount of electron capture attending the passage of MeV/nucleon ion beams through a collinear, magnetically confined, space-charged-limited electron beam as a function of relative energy. The initial beams contained large numbers of ions for which the metastable states of the term 2s2p(3P) were populated, and the fraction of ions in the metastable states to those in the ground-state configuration 2s² were measured. The experimental rate coefficients are consistent in magnitude and shape with rates determined from distorted-wave calculations of the dielectronic recombination cross sections. The large fraction of metastable states in the initial ion beams had a pronounced effect on the shape and magnitude of the rate coefficients.

700,489

PB88-121124 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Near-Infrared Spectrum of ONNHf-Direct Evidence for Geometric Isomerism in a Hydrogen Bonded Complex.

Final rept.,
C. M. Lovejoy, and D. J. Nesbitt. 1987, 2p
Grants NSF-CHE86-05970, NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.
Pub. in *Jnl. of Chemical Physics* 87, n2 p1450-1451, 15 Jul 87.

Keywords: Reprints, *Absorption spectroscopy, *Laser absorption, Geometrical isomers, Hydrogen bonded dimers.

The near-IR spectrum and equilibrium structure of a novel hydrogen bonded complex between nitrous oxide and hydrogen fluoride is described. In contrast to a previously reported structure, in which the HF bonds to the oxygen end of NNO, the present structure has the HF bonded to the nitrogen end of NNO. The structure is unambiguously confirmed by isotopic substitution. The identification of the two stable, spectroscopically distinct structures represents the first demonstration of geometric isomerism in a hydrogen-bonded complex.

700,490

PB88-121132 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Excitation of the 1s(5) and 1s(4) Levels of Neon by Low-Energy Electrons.

Final rept.,
K. Tachibana, and A. V. Phelps. 1987, 9p
Contract N00014-76-C-123
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in *Physical Review A* 36, n3 p999-1007, 1 Aug 87.

Keywords: *Electrons, Excitation, Reprints, *Boltzmann equation, Cross sections, Metastables, Neon.

Excitation coefficients for production of 1s5 and 1s4 levels (Paschen notation) of neon in collisions with low-energy electrons have been measured using a drift-tube technique combined with laser absorption and laser-induced fluorescence techniques. The absorption and fluorescence signals have been analyzed using coupled rate equations which include the effects of population mixing among these levels in collisions with neon atoms. The excitation coefficients for the metastable and resonance levels alpha m/N and alpha R/N have been obtained as functions of the electric field to gas density ratio E/N. The measured values of alpha m/N vary from 1.3 times 10 to the minus 24th power sq. m. at E/N=1.6 times 10 to the minus 21 power V sq. m. to 6.5 times 10 to the minus 22 power sq. m. at 3.0 times 10 to the minus 19 th power V sq. m. The values of alpha R/N are comparable in the experimental E/N range. The experimental excitation coefficients are in agreement with values calculated from a Boltzmann analysis using a recommended set of electron excitation cross sections derived from published experimental electron beam data.

700,491

PB88-121140 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Theoretical (A sup 1)(A sub 2)^(X sup 1)(A sub 1) Absorption and Emission Spectra of Ammonia.

Final rept.,
P. Rosmus, P. Botschwina, H. J. Werner, V. Vaida, P. C. Engelking, and M. I. McCarthy. 1987, 16p
Contract NSF-CHE83-18605
Sponsored by National Science Foundation, Washington, DC.
Pub. in *Jnl. of Chemical Physics* 86, n12 p6677-6692, 15 Jun 87.

Keywords: *Absorption, *Emission, Reprints, *Ab initio calculation, *Ammonia A.

Potential energy, electric dipole moment, and electronic transition moment surfaces have been calculated for the A and X states of NH₃ from CASSCF and CEPA electronic wave functions. Anharmonic vibrational term values, Franck-Condon factors, and A-X radiative transition probabilities for the symmetric stretching and bending modes of NH₃ and ND₃ have been evaluated. The theoretical absorption spectra at room and low

temperatures agree well with experimental data. The symmetric stretching mode in the A state has only small intensities in the A-X absorption spectrum. Emission rates from various initial vibronic levels of the A state are given. The ab initio electric dipole moment surfaces for the ground state of NH₃ have been used to compute transition moments, which are in good agreement with experimental data.

700,492

PB88-122007 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Effects of Substituents on the Length of Central C(sp sup 3)-C(sp sup 3) Bond in Anthracene Photodimers and Related Molecules.

Final rept.,
D. A. Dougherty, C. S. Choi, G. Kaupp, A. B. Buda, J. M. Rudzinski, and K. Osawa. 1986, 8p
Pub. in *Jnl. of the Chemical Society, Perkin Transactions 2*, p1063-1070 1986.

Keywords: *Anthracene, *Photodimers, *Substituents, Reprints.

Effects of substituents on the lengths of the central C-C single bond in the butterfly-shaped anthracene photodimers (1)-(7) and lepidopterenes (8) are studied. X-Ray analysis of the photodimer (10) of 9,10-difluoroanthracene gave a C(9)-C(10') bond length of 1.631(3) A. An attempt to re-determine molecular structure of the photoisomer (5) of (2,2)(9,10) anthracenophane (12) by neutron diffraction analysis is also reported (C(9)-C(10'); obs. 1.64(1), calc. 1.63(1) A). The D2 structure that had been proposed for the minimum-energy conformation of (5) is questioned and the D2h symmetric conformation is suggested on the basis of the diffraction results and MNDO calculations. The experimentally determined distances of the long central C-C bonds in these butterfly compounds including dianthronyl (9) are well reproduced by MNDO calculations with a standard deviation of 0.013 A. Small but significant further elongation of the central C-C bond by up to 0.07 A resulting from annulation of cyclobutane or cyclopentane ring in anthracene photodimers and from remote chlorine substitution in lepidoptere are interpreted in terms of the increased pi yields sigma orbital interaction.

700,493

PB88-122080 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Chemical Engineering Science Div.

Hydrogen Sulfide Facilitated Transport in Perfluoro-sulfonic Acid Membranes.

Final rept.,
J. D. Way, and R. D. Noble. 1987, 15p
Contract DE-AI21-84MC21271
Sponsored by Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
Pub. in *ACS (American Chemical Society) Symposium Series* 347, Liquid Membranes: Theory and Applications, Chapter 9, p123-137 1987.

Keywords: *Membranes, *Hydrogen sulfide, *Cation exchanging, Mathematical models, Liquid phases, Sulfonic acid/perfluoro, Liquid membranes.

Hydrogen sulfide and methane fluxes were measured at ambient conditions for 200 micrometers perfluoro-sulfonic acid cation exchange membranes containing monovalent EDA counterions as carriers. Facilitation factors up to 26.4 and separation factors for H₂S/CH₄ up to 1200 were observed. The H₂S transport is diffusion limited. The data are well represented by a simplified reaction equilibrium model. Model predictions indicate that H₂S facilitated transport would be diffusion limited even at a membrane thickness of 1 micrometers.

700,494

PB88-122098 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Chemical Engineering Science Div.

Liquid Membrane Technology: An Overview.

Final rept.,
R. D. Noble, and J. D. Way. 1987, 26p
Pub. in *ACS (American Chemical Society) Symposium Series* 347, Liquid Membranes: Theory and Applications, Chapter 1, p1-26 1987.

Keywords: *Membranes, Liquid phases, Surveys, *Liquid membranes, Technology assessment.

Physical & Theoretical Chemistry

Liquid membrane technology is introduced and is identified as a subset of membrane science. A tutorial section discusses configurations, transport mechanisms, experimental techniques, and a survey of basic theoretical approaches. The concepts of reactive liquid membranes which combine traditional unit operations such as extraction or absorption with stripping are discussed. The chapters to follow in the volume are summarized and the subject of each is placed in perspective to the field of liquid membrane technology.

700,495
PB88-124433

(Order as PB88-124409, PC A04/MF A01)
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Moessbauer imaging,
S. J. Norton. 1987, 10p
Included in Jnl. of Research of the National Bureau of Standards, v92 n5 p325-334 Sep-Oct 87.

Keywords: *Mossbauer effect, *Image reconstruction, *Tomography.

In a Mossbauer experiment, if a spatially-extended absorbing sample is rotated relative to a moving gamma-ray Doppler shift are generated through the absorber parallel to the motion of the source. As a result, resonant absorption takes place along a series of parallel lines cutting through the absorber, where a particular line is determined by the velocity of the source. The result is a series of measurements of line integrals of the absorption coefficient through the absorber. An image or spatial map of the absorption coefficient distribution may then be reconstructed using tomographic image-reconstruction algorithms. Moreover, when measurements are recorded both as a function of the source velocity and the absorber rotational velocity, spectra information may also be recovered as a function of position. Spatial resolution is proportional to the rate of rotation of the absorber, but is ultimately signal-to-noise limited.

700,496
PB88-129663

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
New Comparative Method for the Determination of Activation Energies.

Final rept.,
W. Braun, and M. D. Scheer. 1985, 6p
Pub. in Chemical Physics Letters 118, n3 p229-234, 20 Jul 85.

Keywords: Reaction kinetics, Thermal radiation, Measurement, Excitation, Computation, Comparative analysis, Chemical reactors, Simulation, Reprints, *Activation analysis, Laser application, Computer applications.

The thermal emission of radiation from the surface of a rapid flow reactor is used as a reference standard in a new comparative method for determining chemical activation energies. The reactor consists of a fused silica, conical nozzle whose inner surface was heated to incandescence by CO₂ laser radiation. The surface temperature and hence the thermal radiation are modulated by a periodic on-off switching of the laser. After coming in thermal contact with the periodically heated reactor surface, a reactive gas forms products at a rate that is also modulated at the laser switching frequency. The chemical activation energy could then be calculated from the energy of the thermal photons selected for observation and the measured temperature dependence of both the product formation rate and spectral radiance of the reactor surface. The method was illustrated by some experimental measurements. A computer simulation was used to assess the error in the measured activation energy resulting from time-varying temperature gradients generated on the reactor surface.

700,497
PB88-129721

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Mass Spectrometric Investigation of the Thermal Oxidative Reactivity of Ethylene Glycol.

Final rept.,
P. W. Brown, W. J. Rossiter, and K. G. Galuk. 1986, 6p
Sponsored by Department of Energy, Washington, DC. Pub. in Solar Energy Materials 13, n3 p197-202 Apr 86.

Keywords: *Ethylene glycol, *Thermal degradation, Mass spectroscopy, Chemical reactivity, Solar energy,

Materials, Copper, Oxidation, Carbon dioxide, Oxygen consumption, Reprints.

The thermal oxidative degradation of ethylene glycol at temperatures above 100 degrees C results in the evolution of CO₂ as one of the degradation products. The rate of O₂ consumption during the process appears to follow zero order kinetics. This implies that the rate limiting step is independent of O₂ concentration and that a mechanism involving free radical nitration may be rate limiting. Both the rate of O₂ consumption and the rate of CO₂ evolution are accelerated in the presence of copper.

700,498
PB88-129739

Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Infrared and Far-Infrared Laser Magnetic Resonance Spectroscopy of the GeH Radical: Determination of Ground State Parameters.

Final rept.,
J. M. Brown, K. M. Evenson, and T. J. Sears. 1985, 10p
Pub. in Jnl. of Chemical Physics 83, n7 p3275-3284, 1 Oct 85.

Keywords: *Germanium hydrides, *Free radicals, Ground state, Intermediate infrared radiation, Far infrared radiation, Reprints, Laser magnetic resonance.

The GeH radical has been detected in its ground doublet state in the gas phase reaction of fluorine atoms with GeH₄ by laser magnetic resonance techniques. Rotational transitions within both doublet Pi(1/2) and doublet Pi(3/2) manifolds have been observed at far infrared wavelengths and rotational transitions between the two fine structure components have been detected at infrared wavelengths (10 micrometers). Signals have been observed for all five naturally occurring isotopes of germanium. Nuclear hyperfine structure for (1)H and (73)Ge has also been observed. The data for the dominant isotope ((74)GeH) have been fitted to within experimental error by an effective Hamiltonian to give a set of molecular parameters for the X doublet Pi state which is very nearly complete. In addition, the dipole moment of GeH in its ground state has been estimated from the relative intensities of electric and magnetic dipole transitions in the 10 micrometer spectrum to be 1.24 (+ or - 0.10) Debyes.

700,499
PB88-129754

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
3p-Core Hole State Sensitivity In Ion Desorption from Oxidized Cr.

Final rept.,
E. Bertel, R. Stockbauer, R. L. Kurtz, T. E. Madey, and D. E. Ramaker. 1985, 5p
Pub. in Springer Series in Surface Sciences 4, p84-88 1985.

Keywords: *Surface chemistry, *Chromium oxides, *Chromium, Ions, Reprints.

The desorption of ions induced by electronic transitions involving core levels has been studied intensively during the last decade. It is well recognized, that Auger decay is an important mechanism to produce active states for ion desorption in ionic as well as covalent compounds. However, it is also clear that the ion desorption yield induced by core excitation is not proportional to the total core hole production rate. Therefore a detailed analysis of initial excited states, their decay channels and the corresponding final states is needed for further progress towards a comprehensive knowledge of the basic mechanisms and possible applications of photon and electron stimulated ion desorption (PSD and ESD). The present study is intended to provide an example of such an analysis.

700,500
PB88-134549

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
XPS (X-ray Photoelectron Spectroscopy) Searchlight Effect: A New Analytical Tool for Layered Structures, Epitaxy, and Interfaces.

Final rept.,
W. F. Egelhoff. 1985, 5p
Sponsored by Materials Research Society, Pittsburgh, PA.
Pub. in Proceedings of Layered Structures, Epitaxy, and Interfaces Symposium, Boston, MA., November 26-30, 1984, p443-447 1985.

Keywords: *Surfaces, Epitaxy, Copper, Nickel, Interfaces, *X ray photoelectron spectroscopy, *Photoelectron spectroscopy, Layered structures.

Enhanced core-level peak intensities at angles corresponding to the internuclear axes among the near surface atoms is a characteristic feature of angle resolved XPS. The phenomenon, which is due to constructive interference in forward scattering of photoelectrons, acts, in effect, as a searchlight allowing relatively easy mapping out of the structural arrangement atoms in the near-surface region. Examples which illustrate the usefulness of the XPS searchlight effect are presented.

700,501

PB88-134564
Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Imaging Properties and Energy Aberrations of a Double-Pass Cylindrical-Mirror Electron Energy Analyzer.

Final rept.,
N. E. Erickson, and C. J. Powell. 1986, 6p
Pub. in Jnl. of Vacuum Science and Technology A 4, n3 p12 p1551-1556 1986.

Keywords: Electron energy, Analyzers, Surfaces, Reprints, *Auger electron spectroscopy, *X ray photoelectron spectroscopy, *Photoelectron spectroscopy.

The imaging properties and energy aberrations of a commercial double-pass cylindrical-mirror analyzer have been characterized, using an extension of the method recently reported by Seah and Mathieu. The electron beam from the coaxial electron gun was rastered across a test surface and the intensity of either elastically-scattered electrons or of electrons at other selected energies was stored in a computer as a function of beam position on the specimen and other experimental parameters. The intensity data was later plotted to provide an 'image' of the detected intensity. Images are presented for electron energies of 100, 500, and 1000 eV and for the application of small offset voltages (typically between -1 and 5 V) applied to the gun cathode with the instrument operated in conditions appropriate for XPS or AES. The images obtained with elastically and inelastically scattered electrons provide a convenient and quantitative means of assessing instrument performance and of defining the specimen area being analyzed for the particular combination of instrument operating conditions and the energy width of AES or XPS features from the specimen.

700,502

PB88-134598
Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Effect of Orbital Alignment on the Forward and Reverse Electronic Energy Transfer Ca(4s5p singlet P(1)) + M (Reversible Process) Ca(4s5p triplet P(J)) + M with Rare Gases.

Final rept.,
W. Bussert, D. Neuschafer, and S. R. Leone. 1987, 10p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Chemical Physics 87, n7 p3833-3842, 1 Oct 87.

Keywords: Atomic orbitals, Electron transitions, Helium, Neon, Argon, Xenon, Energy transfer, Reprints, *Calcium atoms, Atom-atom collisions, Laser radiation.

Effects of orbital alignment on the relative cross sections for electronic energy transfer are determined for the near resonant transfer between Ca (4s5p singlet P(1)) and Ca (4s5p triplet P(J)) states with rare gas collision partners. The experiments are carried out by pulsed laser excitation in a crossed beam. The results for the forward direction, singlet P to triplet P, formulated in terms of the ratio of the maximum to minimum transfer probability, are given. The energy transfer is also carried out in the reverse direction, triplet P(1) to singlet P, for He and Xe. The alignment results provide a first experimental determination of the dominant electronic states involved in a collisional energy transfer process.

700,503

PB88-138920
Not available NTIS

CHEMISTRY

Physical & Theoretical Chemistry

National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Extinction Coefficient of H₂CC(sup 3)B(sub2)) at 137 nm.

Final rept.,
A. Fahr, and A. H. Laufer. 1985, 3p
Pub. in Jnl. of Chemical Physics 83, n2 p908-910 Jul 85.

Keywords: Reprints, *Extinction coefficient, *Metastable, Spectra, Vacuum ultraviolet, Vinylidene.

The extinction coefficient of H₂CC(3B₂) was obtained at 137 nm. The vinylidene radicals were produced from the flash photolysis of C₂H₃Cl and their concentration from the equal quantity of HCl produced in the photolysis. The measured extinction coefficient is 694 ± or - 218/atm·cm.

**700,504
PB88-139118** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Elemental Characterization of the National Bureau of Standards Milk Powder Standard Reference Material by Instrumental and Radiochemical Neutron Activation Analysis.

Final rept.,
R. R. Greenberg. 1986, 6p
Pub. in Analytical Chemistry 58, n12 p2511-2516 1986.

Keywords: *Milk, Reprints, *Neutron activation analysis, Radiochemical, *Standard reference materials, Trace element analysis, Ultratrace levels.

The Milk Powder Standard Reference Material, SRM 1549, recently prepared by the National Bureau of Standards has been analyzed by instrumental and radiochemical neutron activation analysis (INAA and RNAA). The extremely low levels of many of the elements of interest, combined with the high levels of the matrix elements, necessitated improvements in many of the existing analytical procedures. Special attention has been given to reducing and evaluating the analytical uncertainties. Bovine Liver, SRM 1577, was analyzed as a control and the results obtained were compared with the literature and the NBS certified values.

**700,505
PB88-140850** Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Ultraviolet Absorption Spectroscopy of Dissociating Molecules: Effects of Cluster Formation on the Photodissociation of CH₃I.

Final rept.,
D. J. Donaldson, V. Vaida, and R. Naaman. 1987, 9p
Pub. in Jnl. of Chemical Physics 87, n5 p2522-2530, 1 Sep 87.

Keywords: *Clusters, *Dimers, Methyl iodide, Ultraviolet absorption, Reprints.

The ultraviolet absorption spectra of jet-cooled CH₃I, (CH₃)₂, and (CH₃)_n, N > 2 are measured in the valence A state and the Rydberg B state. A significant blue shift of the valence state is observed upon cluster formation. The magnitude of the shift yields a dimer bond strength of at least 500 cm⁻¹ which implies extensive dimer formation at room temperature and moderate pressures. The methyl iodide B-state spectrum consists of a single progression in the v₂ mode. Dimerization retards the predissociation and therefore increases the excited state lifetime; consequently many new modes are observed which in the monomer are coupled to the dissociation. The implications of the result to the photodissociation dynamics are discussed. The Rydberg spectra of (CH₃)_n, n > 2 show asymmetric line shapes which may be due to interferences between the B state and an underlying continuum. The nature of these interferences and the possible identity of the continuum are discussed.

**700,506
PB88-140900** Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Laser Determinations of 'Hot Band' Quantum Yields: Br* doublet P(1/2) Formation in the Continuum Absorption of Br₂ at 510-550 nm.
Final rept.,
J. E. Smedley, H. K. Haugen, and S. R. Leone. 1987, 9p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.

Pub. in Jnl. of Chemical Physics 87, n5 p2700-2708, 1 Sep 87.

Keywords: *Bromine, Absorption spectra, Quantum efficiency, Reprints, Photodissociation, Vibrational states, Laser applications.

Absolute quantum yields of Br* in the photodissociation of thermally excited vibrational levels of Br₂ are measured by transient gain vs absorption probing of the Br* (doublet P(1/2))-Br(doublet P(3/2)) transition at 2.7 micrometers with an F-center laser. An etalon-narrowed pulsed dye laser with a linewidth of 0.04/cm is used to excite continuum regions between the bound Br₂(B-X) transitions of isotopic Br₂ (about 81% (81)Br₂) at selected wavelengths between 510 and 550 nm.

**700,507
PB88-140983** Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.
Studies of Collision-Induced Emission in the Fundamental Vibration-Rotation Band of H₂.

Final rept.,
G. E. Caledonia, R. H. Krech, T. Wilkerson, R. L. Taylor, and G. Birnbaum. 1986, 7p
Sponsored by National Science Foundation, Washington, DC.
Pub. in Proceedings of the International Symposium of Shock Waves and Shock Tubes (15th), Berkeley, CA., July 28-August 2, 1985, p835-841 1986.

Keywords: *Hydrogen, Near infrared radiation, Emission spectra, Shock tubes, Argon, Vibrational states, Rotational states.

Measurements are presented of the collision induced emission (CIE) from the fundamental vibration-rotation band of H₂ taken over the temperature range of 900-3000 K. The spectral shape and strength of this infrared band centered about 2.4 micrometers has been measured behind reflected shocks in mixtures of H₂/Ar. The observed radiation at elevated temperatures is found to be dominantly in the Q branch. The results have been compared with theory. These comparisons show that radiation at elevated temperatures is primarily the results of an induced dipole moment in H₂ induced by the overlap between the H₂ and Ar electron clouds during collision. The strength of this interaction has been evaluated by an analysis of the measured temperature dependence of the absolute band-strength.

**700,508
PB88-141015** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Microwave Spectrum of the Ar...Vinyl Cyanide Van Der Waals Complex.

Final rept.,
R. D. Suenram, and F. J. Lovas. 1987, 9p
Pub. in Jnl. of Chemical Physics 87, n8 p4447-4455, 15 Oct 87.

Keywords: Reprints, *Acrylonitrile, *Vinylcyanide, Fourier transform microwave spectroscopy, *Microwave spectra, van der Waals.

The microwave spectrum of the Ar...vinyl cyanide van der Waals complex has been observed using a pulsed Fourier transform microwave spectrometer. Two vibrational states have been identified. Centrifugal distortion and (14)N quadrupole hyperfine analyses of the observed transitions have been performed for both states. The lower (ground) state fits an asymmetrical top Hamiltonian significantly better than the upper state. The two states are believed to arise because of a tunneling motion within the complex. The preferred structure of the complex has the Ar atom located approximately equidistant from the methylene carbon and nitrogen atoms and about 34 degrees out of the plane of the vinyl cyanide subunit.

**700,509
PB88-141197** Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.
Decay Rate of Critical Fluctuations in Ethane + Carbon Dioxide Mixtures Near the Critical Line Including the Critical Azeotrope.
Final rept.,
R. F. Chang, T. Doiron, and I. L. Pegg. 1986, 10p
See also PB84-222884.
Pub. in International Jnl. of Thermophysics 7, n2 p295-304 1986.

Keywords: *Carbon dioxide, *Ethane, *Azeotropes, Liquids, Fluids, Mixtures, Critical point, Thermophysical properties, Reprints.

Near a critical point, the order parameters of fluctuations are, respectively, density and concentration for simple fluids and binary liquid mixtures. The order parameter for binary fluid mixtures near a plait point is not clear because of the presence of two coupled diffusive modes of fluctuations, namely heat and mutual diffusion. A mixture near a critical azeotrope is interesting because the concentration fluctuations are suppressed. Consequently, an azeotropic mixture is expected to behave like a simple fluid near a critical point. Using the technique of photon correlation spectroscopy the authors have measured the decay rate of critical fluctuations in mixtures of ethane and carbon dioxide of various compositions including a near-azeotropic mixture.

**700,510
PB88-141205** Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Corona-Induced Decomposition of Dielectric Gases.

Final rept.,
R. J. Van Brunt, J. T. Herron, and C. Fenimore. 1987, 10p
Sponsored by Department of Energy, Washington, DC. Div. of Electric Energy Systems.
Pub. in Proceedings of International Symposium on Gaseous Dielectrics (5th), Gaseous Dielectrics V, Knoxville, TN., May 3-7, 1987, p163-172.

Keywords: *Sulfur hexafluoride, *Gas discharges, *Electric corona, Dielectric properties, Chemical reactions, Water vapor, *Corona discharges.

A three-zone model for chemical decomposition of electronegative gases in negative point-plane corona discharges is proposed which considers the discharge glow, ion-drift, and main gas volumes respectively as separate regions of diminishing chemical activity and increasing relative size. The proposed model is shown to be useful in predicting discharge by-product yields and the dependences of these yields on discharge current and gas mixture composition. As an example, the model is applied here to the decomposition of pressurized SF₆ containing trace levels of water vapor and is shown to yield results for oxyfluoride production that are in satisfactory agreement with observations.

**700,511
PB88-147210** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Incoherent Inelastic Neutron Scattering: Vibrational Spectroscopy of Adsorbed Molecules on Surfaces.

Final rept.,
R. R. Cavanagh, J. J. Rush, and R. D. Kelley. 1987, 40p
Sponsored by Department of Energy, Washington, DC. Office of Basic Energy Sciences.
Pub. in Vibrational Spectroscopy of Molecules on Surfaces, Chapter 5, p183-222 1987.

Keywords: *Adsorbates, *Neutron scattering, Adsorption, Inelastic scattering, Surfaces, Probes, Vibrational states.

An introduction to neutron scattering as a probe of adsorbates at surfaces is presented. Emphasis is placed on experimental aspects of triple axis and time-of-flight techniques along with a single phonon model for the spectral features. Wilson FG methods for constructing molecular force fields relevant to the molecular modes of the adsorbate are presented. The applicability of neutron scattering for exploring rotational diffusion and adsorbate torsions is also examined.

**700,512
PB88-147228** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Kinetics and Dynamics of the Nitric Oxide/Ammونيا Interaction on Pt(111).
Final rept.,
D. Burgess, D. S. King, and R. R. Cavanagh. 1987, 2p
Contract DE-AL05-84ER13150
Sponsored by Department of Energy, Washington, DC.

Pub. in Jnl. of Vacuum Science and Technology A 5, n5 p2959-2960 Sep/Oct 87.

Keywords: *Surface chemistry, *Platinum, *Nitrogen oxide(NO), *Ammonia, Reaction kinetics, Desorption, Fluorescence, Thermodynamic properties, Reprints.

The kinetics and dynamics of the nitric oxide/ammonia interaction on Pt(111) were studied using a combination of temperature-programmed desorption (TPD) and laser-excited fluorescence techniques. Although NO desorption kinetics are significantly altered by interaction with preadsorbed NH₃, no effect was seen in the dynamical accommodation of rotational energy with the surface.

700,513
PB88-147244 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Orientation of CH₃NC Adsorbed on Ag(311).

Final rept.,
S. T. Ceyer, and J. T. Yates. 1985, 4p
Pub. in Jnl. of Physical Chemistry 89, n18 p3842-3845 1985.

Keywords: *Surface chemistry, Desorption, Spectroscopy, Reprints, *Methyl isocyanides, Silver 311.

The adsorption of methyl isocyanide on the Ag(311) surface at 95K has been studied by high resolution electron energy loss spectroscopy, electron stimulated desorption ion angular distribution (ESDIAD) and thermal desorption spectroscopy. Examination of the intensities of the loss features in the HREEL spectrum within the selection rule for a dipolar scattering mechanism, and the behavior of the ESDIAD patterns as a function of coverage lead to the conclusion that CH₃NC adsorbs on Ag(311) in two distinct bonding geometries. The more strongly bound CH₃NC interacts with the surface through the pi-type orbitals leading to the CH₃NC molecule bound with its axis close to parallel with the surface. The more weakly bound state interacts through the sigma-type orbital on the carbon end of the molecule leading to the CH₃NC molecule bound with its C3v axis perpendicular to the macroscopic surface. The thermal desorption data exhibit two peaks which correlate with these bonding geometries.

700,514
PB88-147251 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Influence of Atomic Corrugations on Alkali Chemisorption (Summary Abstract).

Final rept.,
N. D. Shinn, and P. D. Szurmi. 1987, 2p
See also DE87002491. Sponsored by Department of Energy, Washington, DC. Office of Basic Energy Sciences.
Pub. in Jnl. of Vacuum Science and Technology A 5, n4 p796-797 Jul/Aug 87.

Keywords: *Alkali metals, *Copper, *Chemisorption, Auger electron spectroscopy, Desorption, Electron diffraction, Electronic structure, Reprints.

Low energy electron diffraction, Auger electron and thermal desorption spectroscopies, and electron stimulated desorption ion angular distribution were used to study the alkali-induced reconstructions and ordered overlayers on Cu(311). Both (1x3) and (1x2) reconstructions are observed at low coverages of K, Na and Li, implying that charge donation alone induces the surface reordering. High coverage ordered overlayers are observed for both Na and K, reflecting the atomic corrugations of Cu(311) and steric packing constraints.

700,515
PB88-147269 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Surface Harpooning.

Final rept.,
J. W. Gadzuk. 1985, 22p
Pub. in Comments on Atomic and Molecular Physics 16, n5 p219-240 1985.

Keywords: Excitation, Reprints, *Surface scattering, *Charge exchange, Vibrational states, Atomic collisions, Molecular collisions, Charge state.

The principles involved in charge transfer/harpooning collisions between atoms or molecules and surfaces are presented in terms of concepts drawn from gas

phase atomic and molecular collision theory. As specific examples, the charge state of atoms and the vibrational excitation or dissociation of molecules which have experienced harpooning while scattering from a surface are considered.

700,516
PB88-147285 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Scattering Properties of a Model Bicontinuous Structure with a Well Defined Length Scale.

Final rept.,
N. F. Berk. 1987, 4p
Pub. in Physical Review Letters 58, n25 p2718-2721, 22 Jun 87.

Keywords: Neutron scattering, Emulsions, Porosity, Reprints, *Microemulsions, Small angle scattering.

Cahn's scheme for simulating the morphology of isotropic spinodal decomposition is adapted to a mathematical model of bicontinuous partitioning of space by interfacial pairs that may be useful for problems of microdispersed and microporous systems distinguished by a morphology with a well defined length scale, including surfactant films in microemulsions and coatings in porous media. Real-space and scattering properties are analyzed, and qualitatively the model accounts for the principal features of recent contrast-variation small-angle neutron-scattering experiments on Winsor III type microemulsions.

700,517
PB88-147343 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Crossover Description for the Thermodynamic Properties of Fluids in the Critical Region.

Final rept.,
P. C. Albright, J. V. Sengers, J. F. Nicoll, and M. Ley-Koo. 1986, 11p
Pub. in International Jnl. of Thermophysics 7, n1 p75-85 Jan 86.

Keywords: Specific heat, Reprints, *Critical phenomena, *Crossover theory, Renormalization, Equation of state, van der Waals equation.

The authors have developed a 'crossover' formalism that reconciles the singular asymptotic critical behavior of the thermodynamic properties of fluids with the classical behavior of these properties well away from the critical point. The proposed formalism is based on theoretical predictions for the crossover behavior suggested by the renormalization group theory of critical phenomena. The authors demonstrate the formalism for a fluid whose classical behavior away from the critical point is represented by the equation of state of van der Waals.

700,518
PB88-147368 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Molecular-Dynamics Study of Glassy and Supercooled States of a Binary Mixture of Soft Spheres.

Final rept.,
R. D. Mountain, and D. Thirumalai. 1987, 12p
Grant NSF-CHE86-09722
Sponsored by National Science Foundation, Washington, DC.
Pub. in Physical Review A 36, n7 p3300-3311, 1 Oct 87.

Keywords: *Glass, *Supercooling, Fluids, Spheres, Reprints, Binary mixtures.

A series of molecular-dynamics simulations of binary-fluid mixtures composed of softly repelling spheres have been made as part of an investigation of the glass-forming properties of mixtures. These mixtures are simple prototypes of glass-forming systems, as both randomness and frustration are intrinsic to them. The randomness is inherent in the fluid and frustration is due to the large, local rearrangement of atoms required for the formation of a crystal from a fluid or glassy configuration. The equation of state, pair and triplet correlation functions, single-particle velocity time autocorrelation functions, and some measures of local glassy order have been determined for a range of compositions, and effective reduced densities. In addition, attention has been focused on the relaxation of some anisotropic correlation functions characterizing the local environment. Attempts have been made to analyze some of these quantities using plausible phe-

nomenological models. The changes in these quantities which occur as the fluid is supercooled and finally forms a glass are examined, and the possible implication of these findings for certain dynamical theories of the glass transition are discussed.

700,519
PB88-147665 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Detection of SiF Radicals with Multiphoton Ionization Spectroscopy.

Final rept.,
C. S. Dulcey, and J. W. Hudgens. 1985, 4p
Pub. in Chemical Physics Letters 118, n4 p444-447, 2 Aug 85.

Keywords: Spectra, Spectroscopy, *Silicon monofluoride, *Multi-photon processes.

The authors report the resonance enhanced multiphoton ionization spectrum of SiF between 430 and 492 nm. SiF radicals absorbed at least three photons to generate the observed m/z 47 SiF ion.

700,520
PB88-147673 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Proton Affinities of Diacetylene, Cyanoacetylene, and Cyanogen: Experimental and Ab initio Studies.

Final rept.,
C. A. Deakynne, M. Mautner, T. A. Buckley, and R. Metz. 1987, 9p
Pub. in Jnl. of Chemical Physics 86, n4 p2334-2342, 15 Feb 87.

Keywords: *Acetylene, *Mass spectroscopy, *Molecular spectroscopy, Chemical bonds, Reprints, *Cyano compounds, Diacetylene, Propiolonitriles, Acetylene/cyano, Cyanogen radical, Molecular orbitals.

The proton affinities of cyanoacetylene, diacetylene and cyanogen were determined by pulsed high pressure mass spectrometry and by ion cyclotron resonance spectrometry as 180, 180 and 161 kcal/mol, respectively. Ab initio calculations at the 6-31G** level show that the high proton affinity of diacetylene results partially in destabilizing antibonding interactions between the triple bonds in the molecule, which changes into an attractive interaction upon protonation at the terminal carbon.

700,521
PB88-147681 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.

Structural and Electronic Properties of Clean and Water-Dosed SnO₂(110).

Final rept.,
D. F. Cox, S. Semancik, and P. D. Szurmi. 1986, 2p
Pub. in Jnl. of Vacuum Science and Technology A 4, n3 p627-628 May/Jun 86.

Keywords: *Tin oxides, Sputtering, Water, Adsorption, Desorption, Reprints, Low energy electron diffraction, Band theory, Photoemission.

The ion sputtered SnO₂(110) surface is found to exhibit (4x1) and (1x1) LEED patterns following annealing at 900K and 1000K, respectively. Downward surface band bending observed with ultraviolet photoemission reveals the formation of an accumulation layer in the presence of the (4x1) LEED pattern. Molecular adsorption at 90K on the (1x1) surface bends the bands down indicating the formation of a H₂O-surface donor complex. A comparison with thermal desorption measurements shows that the band bending reaches a maximum on completion of the first water overlayer. No water induced band bending is observed for the (4x1) structure where the clean surface exhibits an accumulation layer prior to adsorption. The lack of any apparent donor/acceptor characteristics for H₂O on the (4x1) surface is accompanied by the formation of a more weakly bound overlayer as observed in thermal desorption spectroscopy.

700,522
PB88-147699 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

CHEMISTRY

Physical & Theoretical Chemistry

Argon K Suprathreshold Structure.

Final rept.,
K. G. Dyall, and R. E. LaVilla. 1986, 3p
Pub. in Physical Review A 34, n6 p5123-5125 Dec 86.

Keywords: *Argon, Emission spectra, Absorption spectra, Reprints.

The argon K absorption suprastructure features are assigned, using ab initio calculations and tabulated experimental final state energies. The assignments are supported by estimates of relative intensities. It is suggested, on the basis of the analysis, that the origin of the argon K beta double prime satellite is due to initial states with triple vacancy 1s 3p(2) core configurations.

700,523

PB88-147707 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

Resonant Structure in 3P Subshell Absorption of Excited and Ionized Manganese.

Final rept.,
J. W. Cooper, C. W. Clark, C. R. Cromer, and T. B. Lucatorto. 1987, 4p
Pub. in Physical Review A 35, n9 p3970-3973, 1 May 87.

Keywords: *Manganese, Absorption cross sections, Far ultraviolet radiation, Atomic energy levels, Reprints, *Manganese ions, *Resonance absorption, Excited states.

Spectra representing the relative cross sections for resonant absorption from the 3p subshell of laser-excited and ionized manganese have been obtained in the 47-52-eV range. The results show a marked change in the resonant structure and the appearance of new resonances which are attributed to 3p-4s transitions.

700,524

PB88-147731 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Analysis of the 5p(6)->5p(5)nl (J=1) Rydberg Series in Ba(2+).

Final rept.,
W. T. Hill, J. Sugar, T. B. Lucatorto, and K. T. Cheng. 1987, 7p
Grant NSF-PHY84-51284
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and National Science Foundation, Washington, DC.
Pub. in Physical Review A 36, n3 p1200-1206, 1 Aug 87.

Keywords: Atomic energy levels, Reprints, *Barium ions, Photoabsorption, Rydberg series, Bound state.

A detailed analysis is made for the bound 5p(6)->p(5)ns,nd levels observed in the photoabsorption of Ba(2+). A multichannel quantum-defect theory approach, with ab initio calculations for some of the parameters, is used to describe periodic enhancements in intensity associated with interchannel mixing. Qualitative agreement between experiment and theory requires the inclusion of plasma-broadening effects to account for the apparent increase in strength of the higher n levels.

700,525

PB88-151956 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Collision Kernel and Interatomic Potential.

Final rept.,
T. S. Ho, and S. I. Chu. 1986, 7p
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 33, n5 p3067-3073 May 86.

Keywords: Differential cross sections, Sodium, Argon, Reprints, *Atomic collisions, Interatomic potentials, Laser spectroscopy, Lennard-Jones potential.

The authors present a detailed study of the influence of the form and strength of the interatomic potential on the one-dimensional elastic collision kernel, a quantity of interest in the study of the effects of velocity-changing collisions on laser spectroscopic line shapes. While the analysis is confined to the Na-Ar and Ar-Ar systems, the conclusions derived from the study are general, and are expected to be also applicable to other systems where both the long- and short-range interactions play essential roles in velocity-changing collisions.

700,526

PB88-151964 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Electron Capture in Ar(1+) + H2 Collisions in the keV Energy Regime.

Final rept.,
M. Kimura, S. Chapman, and N. F. Lane. 1986, 7p
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 33, n3 p1619-1625 Mar 86.

Keywords: *Electron capture, *Hydrogen, Reprints, *Ion-molecule collisions, *Argon ions, *Charge exchange, KeV range.

Electron capture in Ar(1+)(doublet P)+H2(X singlet Sigma(g)) collisions in the keV energy regime has been studied theoretically. The molecular-orbital expansion method was used within a semiclassical formalism and an electron translation factor correction was incorporated to the first order in the magnitude of the relative velocity V. The molecular wave function and eigenenergy were obtained using the diatoms-in-molecules (DIM) method.

700,527

PB88-151998 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Laser Probing of Gallium Atom Interactions with Silicon (100) Surfaces.

Final rept.,
K. L. Carleton, and S. R. Leone. 1987, 6p
Sponsored by National Science Foundation, Washington, DC.
Pub. in Jnl. of Vacuum Science and Technology B 5, n4 p1141-1146 Jul/Aug 87.

Keywords: *Silicon, *Surfaces, *Desorption, Reprints, *Gallium atoms, Laser induced fluorescence.

The interactions of gallium atoms with silicon (100) surfaces are studied with laser probing. Laser-induced fluorescence is used to interrogate either the Ga doublet P(1/2) or doublet P(3/2) state following desorption from a 2x1 reconstructed Si(100) surface. From isothermal desorption measurements, the desorption energy of Ga on silicon is determined to be 277 plus or minus 7.5 kJ/mol (66 plus or minus 2 kcal/mol or 2.9 eV) with a frequency factor of 6×10 to the (14 + or - 1) power/s. Temperature programmed desorption heating rate studies give slightly larger values for the desorption energy and preexponential factor, but these results appear to be less reliable because of thermal lags in the temperature measurement. The strong gallium-silicon bond is consistent with the unity sticking coefficient observed here, and the fact that the scattering is dominated by a trapping desorption mechanism. The value of the preexponential factor is suggestive of a one-dimensional mobility of the Ga atoms on the 2x1 silicon (100) surface.

700,528

PB88-152004 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Observation of Three-Body Collisional Transfer between Atomic Levels.

Final rept.,
M. Harris, J. F. Kelly, and A. Gallagher. 1987, 3p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Physical Review A 36, n3 p1512-1514, 1 Aug 87.

Keywords: Atomic energy levels, Krypton, Xenon, Energy transfer, Reprints, *Strontium atoms, Atom-atom collisions.

Collisional J-mixing rates between the J=0,1,2 states of the Sr(5 triplet P(J)) multiplet have been measured in the presence of rare-gas perturbers. For Kr and Xe pressures above 100 Torr, the rates are dominated by a component which is quadratic in pressure. The authors believe the very unusual behavior is brought about by the simultaneous interaction of a Sr atom with two perturbers and not by excimer formation.

700,529

PB88-152079 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Polymers Div.

Estimation of the Amount of Nonadjacent Reentry in Polymer Crystallization. 2. Application to Once Folded N-Paraffins.

Final rept.,
E. Passaglia, and E. A. DiMarzio. 1987, 9p
Pub. in Jnl. of Chemical Physics 87, n8 p4908-4916, 15 Oct 87.

Keywords: *Polymers, *Crystallization, *Crystal defects, *Alkanes, Reprints, *Paraffines.

The methods described in the preceding paper have been used to calculate the composition of a strip of once folded molecules of n-c(sup 294)H(sup 590). The fraction of cilia and of stems participating in adjacent and nonadjacent reentry were calculated as a function of undercooling in regime I. Two cases corresponding to crystallization from the melt and one corresponding to dilute solution were considered. The results are strongly dependent on the relative rates of deposition of a stem from the liquid phase and the folding and reentry of the dangling half of an already attached molecule. The rate constants for adjacent and nonadjacent reentry were taken to be the same except that nonadjacent reentry leaves a hole in the strip. The undercooling below the melting point of the extended chain crystal at which the growing strip is in equilibrium with its environment is shown to be determined by all the imperfections in the strip, and particularly by the free energy of mixing. In all cases, the fractions of adjacent and nonadjacent reentry at this equilibrium undercooling are approximately equal and the fraction of cilia is a maximum. At higher undercoolings, the fraction of adjacent reentry rises, while the fractions of cilia and nonadjacent reentry fall, the exact behavior depending on the solution concentration and hence the relative rates of stem deposition from the liquid phase and of folding. The behavior is correlated with the free energy of mixing.

700,530

PB88-152111 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Ab Initio Study of the Hydrogen Bonding Interactions of Formamide with Water and Methanol.

Final rept.,
P. G. Jasien, and W. J. Stevens. 1986, 7p
Pub. in Jnl. of Chemical Physics 84, n6 p3271-3277, 15 Mar 86.

Keywords: *Hydrogen bonds, Methanol, Water, Chemical reactions, Reprints, *Formamide.

Ab initio calculations of hydrogen bond energies for a number of water-formamide and methanol-formamide complexes are reported at both the SCF and correlated levels. Full gradient optimizations of these structures have been performed for basis sets of double zeta and double zeta plus polarization quality. For both water and methanol, the most stable 1:1 complex is found to be a cyclic double hydrogen bonded structure. Basis set effects on the calculated hydrogen bond energies were investigated as was the magnitude of the basis set superposition error.

700,531

PB88-152145 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

Kinetics of One-Electron Transfer Reactions Involving ClO2 and NO2.

Final rept.,
R. E. Huie, and P. Neta. 1986, 6p
Pub. in Jnl. of Physical Chemistry 90, n6 p1193-1198, 13 Mar 86.

Keywords: *Electron transfer, Reaction kinetics, Nitrogen dioxide, Oxygen chlorides, Oxygen bromide, Electrode potentials, Reprints.

Rate constants for the one-electron oxidation of ClO2 and NO2 by several organic and inorganic free radicals have been measured along with rate constants for several reactions of ClO2, NO2, and BrO2. The kinetics of the reactions of ClO2 and NO2 are consistent with simple electron-transfer theory, except for the reaction of NO2 with SO3, which appears to be oxygen atom transfer. Equilibrium constants have been determined for the reactions of ClO2 with aniline at pH 6.9 and N,N-dimethylaniline at pH 9.6. This leads to one-electron redox potentials of 1.03 V and 0.86 V for these aromatic amines, respectively, at the corresponding pH.

700,532

PB88-152152 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.

**Measurements of the Pressure Dependence of the
HO₂ Radical Self Disproportionation Reaction at
298K.**

Final rept.,
M. J. Kurylo, P. A. Ouellette, and A. H. Laufer. 1986,
4p
Pub. in Jnl. of Physical Chemistry 90, n3 p437-440
1986.

Keywords: *Hydroperoxides, Water, Pressure, Photo-
chemical reactions, Reaction kinetics, Constants,
Measurement, Stratosphere, Reprints, *Atmospheric
chemistry, Radicals, Absorption spectroscopy, Data
bases, Rates.

Flash Photolysis kinetic absorption spectroscopy was
used to investigate the gas disproportionation reaction
of hydroperoxy radicals at 298K. Measurements of k/o
(where k is the rate constant and o is the HO₂ absorp-
tion cross section) were made as a function of N₂ and
O₂ pressures between 25 and 600 Torr. The authors
observations of the linear dependence of k on total
pressure as well as the existence of a finite bimolecu-
lar (zero-pressure) reaction component are in good
agreement with other recent investigations. Together
with these earlier studies, the present work provides a
detailed data base upon which to make rate constant
recommendations for atmospheric modeling.

700,533

PB88-152160 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.

**Multiphoton Ionization Detection of Gas Phase
Benzyl Radicals.**

Final rept.,
M. A. Hoffbauer, and J. W. Hudgens. 1985, 3p
Pub. in Jnl. of Physical Chemistry 89, n24 p5152-5154
1985.

Keywords: Photochemical reactions, Reaction kinet-
ics, Ionized gases, Spectroscopy, Toluene, Reprints,
*Benzyl radical.

Benzyl and benzyl-d (sub 7) radicals generated in a
flow reactor were detected using mass-resolved, reso-
nance enhanced multiphoton ionization spectroscopy.
The strongest features of the spectra were observed
between 500-510 nanometer. In both isotopic species,
an electronic band origin was assigned at 502.5 nano-
meter.

700,534

PB88-152178 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.

**One-Electron Redox Reactions in Aqueous Solu-
tions of Sulfite with Hydroquinone and Other Hy-
droxyphenols.**

Final rept.,
R. E. Huie, and P. Neta. 1985, 4p
Pub. in Jnl. of Physical Chemistry 89, n18 p3918-3921
1985.

Keywords: *Sulfites, Oxidation, Reprints, *Electrode
potentials, Aqueous solutions, Hydroxyphenols, Hy-
droxyquinone, Peroxysulfite, Radicals.

The one-electron oxidation of hydroquinone and other
hydroxyphenols by the sulfite radical SO₃(1-), and the
peroxysulfite radical, SO₅(1-), have been investigated
along with the oxidation of sulfite by several phenoxyl
radicals. Rate constants for the oxidation of hydroxy-
phenols by SO₃(1-) are small in neutral solution but
increase dramatically in basic solution, in correspond-
ence to the deprotonation of the hydroxyphenol.
SO₅(1-) reacts with most hydroxyphenols at moderate
rates ($K=1$ million to 5 million/M/s) in neutral solution.
The phenoxyl radicals with higher redox potentials,
from phenol, resorcinol, and phloroglucinol, were
found to oxidize sulfite in neutral solutions.

700,535

PB88-152194 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.

**Proton Affinity and Gas Phase Ion Chemistry of
Methyl Isocyanate, Methyl Isothiocyanate and
Methyl Thiocyanate.**

Final rept.,
Z. Karpas, W. J. Stevens, T. J. Buckley, and R. Metz.
1985, 5p
Pub. in Jnl. of Physical Chemistry 89, n24 p5274-5278,
21 Nov 1985.

Keywords: *Cyanates, Ionized gases, Isocyanates,
Protons, Reprints, *Methyl thiocyanates, *Methyl
isothiocyanates, Affinity.

The gas-phase ion chemistry of CH₃NCO, CH₃NCS
and CH₃SCN was investigated by pulsed ICR tech-
niques and their proton affinities were determined.

700,536

PB88-152202 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Kinetics Div.

**Pressure Dependence of the Rate Constant for the
Reaction HO₂ + NO₂ + M + HO₂NO₂ + M
(M=N₂,O₂) at 298K.**

Final rept.,
M. J. Kurylo, and P. A. Ouellette. 1986, 4p
Pub. in Jnl. of Physical Chemistry 90, n3 p441-444
1986.

Keywords: *Nitrogen dioxide, *Water, *Photochemical
reactions, *Reaction kinetics, *Pressure, Constants,
Measurement, Reprints, *Atmospheric chemistry, Ab-
sorption spectroscopy, Rates.

The pressure dependence at 298K of the rate con-
stant for the combination reaction between HO₂ and
NO₂ was investigated by flash photolysis kinetic ab-
sorption spectroscopy. Measurements were made at
N₂ and O₂ pressures ranging from 25-600 Torr and
the data were fit to an expression suitable for describ-
ing the pressure dependence of reactions in the fall-off
region. Potential sources of error in these measure-
ments are discussed. The present results are com-
pared to earlier measurements of the reaction system
and their importance with respect to atmospheric
chemistry is detailed.

700,537

PB88-152236 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Chemical Process Metrology Div.

IrO₂ RF Sputtered Thin Film Properties.

Final rept.,
K. G. Kreider. 1986, 2p
Pub. in Jnl. of Vacuum Science and Technology A-4,
n3 p606-607 May/Jun 86.

Keywords: pH, Thin films, Sputtering, Radio frequen-
cies, Crystal structure, Microstructure, Aluminum
oxide, Substrates, Reprints, *Iridium oxides, Electrical
conductivity, Sensors.

Iridium oxide is being considered as a pH sensing ma-
terial that would enable the fabrication of pH sensors
which would be considerably smaller than the glass
electrode type and would have higher temperature ca-
pabilities. The electrochemical behavior of sputtered
IrO₂ appears to contrast with that of IrO₂ produced by
anodization. The study has been used to investigate
the effect of varying the fabrication conditions on the
films structure and electrical properties. Radio fre-
quency planar magnetron sputter deposited thin films
of IrO₂ were fabricated and evaluated. The Al₂O₃ sub-
strate temperature, sputtering composition and pres-
sure, power levels, and deposition rates were system-
atically varied to affect the physical, chemical, me-
chanical, and electrical properties of the films. X-ray
diffraction was used to determine the Ir/IrO₂ ratio, the
crystallinity and grain size of the films. Electrical con-
ductivity measurements are correlated to processing
variables and physical properties. The one micrometer
films are also characterized using scanning electron
microscopy and for their adherence to the Al₂O₃ sub-
strates.

700,538

PB88-152467 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Reactor Radiation Div.

**Neutron Scattering Study of NH₄(1+) Dynamics
during the Deammoniation of NH₄-rho Zeolite.**

Final rept.,
T. Udovic, R. Cavanagh, J. J. Rush, M. Wax, G.
Stucky, G. A. Jones, and D. R. Corbin. 1987, 6p
Pub. in Jnl. of Physical Chemistry 91, n23 p5968-5973
1987.

Keywords: *Ion exchange resins, *Neutron scattering,
Reprints, *Zeolites, *Elastic scattering, Deammonia-
tion, Ammonia cation.

Inelastic and quasi-elastic neutron scattering mea-
surements of ammonium-rho zeolite have been used to
characterize the NH₄(1+) cation dynamics during
deep-bed deammoniation over the temperature range
473-723 K. As the deammoniation temperature is in-
creased, the assigned vibrational features of the
bound NH₄(1+) at 180 meV (bending modes), 38-45
meV (ammonium-coupled pore-opening modes of the
zeolite framework), and 10-14 meV (hindered rotation-
al modes) are found to diminish, concomitant with the
emergence of scattering features due to H-rho. Reor-
ientational dynamics of NH₄(1+) in rho are evident in
the quasi-elastic scattering data. The dependence of
the elastic incoherent structure factor on momentum
transfer suggests 120 degrees reorientations as the
dominant NH₄(1+) rotational mechanism. The tem-
perature dependence of the quasi-elastic broadening
indicates a very low (35 + or - 5 meV) reorientation
barrier.

700,539

PB88-152483 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Thermophysics Div.

Effect of Capillary Waves on Surface Tension.

Final rept.,
R. F. Kayser. 1986, 9p
Pub. in Physical Review A 33, n3 p1948-1956 Mar 86.

Keywords: *Interfacial tension, Hamiltonian functions,
Critical point, Reprints, *Surface tension, *Capillary
waves.

The capillary-wave interface Hamiltonian is general-
ized to include a wavevector-dependent surface ten-
sion, sigma(k). The model preserves the long-wave-
length consequences of the theory, but leads in addi-
tion to several provocative new predictions. In particu-
lar, a self-consistent calculation of sigma(k) implies
large positive departures of sigma(k) from the experi-
mentally-measured surface tension, sigma(o), even for
wavevectors with corresponding wavelengths that are
large compared to the intrinsic interface width, w. It
also follows that sigma(o) and the bare surface tension
cannot scale in quite the same way near a critical
point, where the bare surface tension is that of a hypo-
thetical interface constrained to be flat on horizontal
length scales somewhat larger than w. The implica-
tions of these and other predictions are discussed in
light of recent experimental and theoretical develop-
ments.

700,540

PB88-152566 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Molecular Spectroscopy Div.

Electronic Structure of FeO and RuO.

Final rept.,
M. Krauss, and W. J. Stevens. 1985, 13p
Pub. in Jnl. of Chemical Physics 82, n12 p5584-5596,
15 Jun 85.

Keywords: *Iron oxides, Spin orbit interactions, Re-
prints, *Ruthenium oxides, *Electronic structure, Excit-
ed states.

The electronic structure of FeO and RuO is examined
using multiconfiguration self-consistent-field (MC-
SCF) wave functions that go asymptotically to minimal-
ly correlated fragment atoms. The natural orbitals are
determined and evaluated in detail. The characteristics
of these orbitals are used to hypothesize an aufbau for
the ground states of most of the first and second row
transition metal oxides.

700,541

PB88-152590 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Molecular Spectroscopy Div.

Rotational Spectrum and Structure of H₂CO-HCl.

Final rept.,
G. T. Fraser, C. W. Gillies, J. Zozom, F. J. Lovas,
and R. D. Suenram. 1987, 10p
Pub. in Jnl. of Molecular Spectroscopy 126, p200-209
1987.

Keywords: *Rotational spectra, *Microwave spectros-
copy, Hydrogen chloride, Formaldehyde, Van der
Waals equation, Reprints, *Hydrogen bonds.

CHEMISTRY

Physical & Theoretical Chemistry

Rotational spectra of H₂CO-H(35)Cl, H₂CO-H(37)Cl, D₂CO-H(35)Cl, and D₂CO-H(37)Cl have been observed using a pulsed-nozzle Fourier transform microwave spectrometer. For H₂CO-H(35)Cl the spectroscopic constants have been determined.

700,542
PB88-152608 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Rotational Predissociation and Libration in the Infrared Spectrum of Ar-HCl.
Final rept.,
B. J. Howard, and A. S. Pine. 1985, 8p
Pub. in Chemical Physics Letters 122, n1-2 p1-8, 29 Nov 85.

Keywords: *Argon, *Hydrogen chloride, *Molecular spectroscopy, Van der Waals equation, Lasers, Reprints.

Fully-resolved rotational structure in the high-frequency vibrational region of the Ar-HCl van der Waals complex has been recorded under thermal equilibrium conditions at T = 127 K with a tunable difference-frequency laser. Both the fundamental H-Cl stretch and its combination with the low-frequency large-amplitude band (libration) have been observed with comparable intensities. An abrupt cutoff of the spectrum at high J due to rotational predissociation yields a measure of the binding energy of the complex. The band center shifts and rotational and distortion constants provide much information about the interaction potential surface and its vibrational dependence and about perturbations from other low-frequency modes not directly observed.

700,543
PB88-152616 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Role of Tunneling Models in Analyzing High-Resolution Spectra of Weakly Bound Molecular Complexes.
Final rept.,
J. T. Hougen. 1987, 9p
Pub. in Structure and Dynamics of Weakly Bound Molecular Complexes, p191-199 1987.

Keywords: *Molecular spectra, *Molecular structure, Chemical bonds, Reaction kinetics, Chemical analysis, Reprints, Amplitudes, Vibrational states, High resolution.

As the number of large amplitude motions in a weakly bound molecular complex increases, the size of the vibration-rotation basis set necessary for carrying out accurate calculations with model potentials (and consequently the difficulty of the calculation) increases also. In the paper the authors shall discuss one alternative to such full-scale calculations, which can be used for assigning spectra in the broad class of problems where the large amplitude motions can be described as 'tunneling' motions. The strong and weak points of the method, which uses group theory to derive phenomenological vibration-rotation-tunneling Hamiltonians, will be described together with some successful applications and some possibilities for future work.

700,544
PB88-152624 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Time-Resolved Vibrational Energy Relaxation of Surface Adsorbates.
Final rept.,
E. J. Heilweil, M. P. Casassa, R. R. Cavanagh, and J. C. Stephenson. 1985, 3p
See also PB88-230696.
Pub. in Jnl. of Vacuum Science and Technology B 3, n5 p1471-1473 1985.

Keywords: *Surface chemistry, *Adsorbates, *Silica gel, Colloids, Molecular relaxation, Reprints.

Time resolved measurements of picosecond vibrational population decay of chemisorbed species (OH, OD, BOH, NH₂, and OCH₃) on high surface area colloidal silica at room temperature have been performed. The influence of solvents on OH relaxation and the variation in observed relaxation rates are discussed in terms of the vibrational level structure and surface coordination of each adsorbate.

700,545
PB88-152632 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Vibrational Energy Decay of Surface Adsorbates.
Final rept.,
E. J. Heilweil, M. P. Casassa, R. R. Cavanagh, and J. C. Stephenson. 1985, 5p
Pub. in Springer Proceedings Phys.-Time-Resolved Vib. Spectrosc. 4, p71-75 1985.

Keywords: *Silicon dioxide, *Surface chemistry, *Adsorption, Excitation, *Adsorbates, Silicon atoms, Vibrational states, Chemisorption, Picosecond pulses, Temperature dependence.

Picosecond infrared transient bleaching experiments have been performed to measure the population lifetime (T₁) of vibrationally excited (V=1) functional groups chemisorbed on high surface area colloidal silica (SiO₂). The experimental method and results for vibrational modes of -OH, -OD, -NH₂ and -OCH₃ coordinated to surface silicon atoms and for the -BOH surface species are presented. Lifetimes for these groups at both the vacuum and liquid interfaces indicate that the adsorbate degrees of freedom, chemical coordination and nearby substrate modes play an important role in damping the vibrational energy. Additional measurements of the T₁ temperature dependence for OH(v=1) in bulk silica and of relaxation times for model OH-containing molecules in dilute solution are also reviewed.

700,546
PB88-152822 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Chemical Physics.
Proton Affinity of H₂Se, SeCO and H₂CSe and Reactions of Positive Ions with H₂Se.
Final rept.,
Z. Karpas. 1985, 5p
Pub. in Chemical Physics Letters 120, n1 p53-57, 27 Sep 85.

Keywords: *Selenium inorganic compounds, Condensation reactions, Ions, Protons, Reprints.

The proton affinities of H₂Se, SeCO and H₂CSe were determined by bracketing ICR techniques, and found to be 171.3, 152 plus or minus 1.5 and 186 plus or minus 1 kcal/mol, respectively. These values are slightly higher than those of the analogous sulfur compounds.

700,547
PB88-152962 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
One-Electron Redox Potentials of Purines and Pyrimidines.
Final rept.,
S. V. Jovanovic, and M. G. Simic. 1986, 5p
Pub. in Jnl. of Physical Chemistry 90, n5 p974-978 1986.

Keywords: *Purines, *Pyrimidines, Electrode potentials, Deoxyribonucleic acids, pH, Reprints, Electron transfer, DNA.

One-electron redox potentials of some purine and pyrimidine derivatives were determined by pulse-radiolysis from electron transfer equilibria involving their and other free radicals. The redox potentials were determined at pH 13 using p-methoxyphenol, trolox C and tryptophan, as references. The lowest oxidation potential measured for DNA bases was for guanosine, and the highest for 1-methylpyrimidines. Uric acid and isobarbituric acid were found to have the lowest potentials.

700,548
PB88-152996 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Thermophysics Div.
Mutual Diffusion Constant of Binary, Isotopic Hard-Sphere Mixtures: Molecular Dynamics Calculations Using the Green-Kubo and Steady-State Methods.
Final rept.,
J. M. Kincaid, and J. J. Erpenbeck. 1986, 14p
Pub. in Jnl. of Chemical Physics 84, n6 p3418-3431, 15 Mar 86.

Keywords: *Fluid mechanics, *Equilibrium flow, *Mixtures, Velocity, Molecular flow, Steady state, Computation, Reprints, Binary mixtures, Diffusion coefficient.

The mutual diffusion constant of a binary mixture of equal diameter hard spheres is estimated using the

method of molecular dynamics. The mixture considered is equimolar, with a species mass ratio of ten to one in a volume that is three times the close-packed volume. Two molecular dynamics methods are used: the standard Green-Kubo technique based on the evaluation of equilibrium velocity correlation functions, and a nonequilibrium method that generates a steady diffusive flow along a composition gradient by imposing special boundary conditions on two opposing faces of the cubic volume. The authors find that both methods yield, within an estimated error of about three percent, the same value of the diffusion coefficient.

700,549
PB88-153002 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Thermophysics Div.
Phase Equilibrium in Nearly Monodisperse Fluids.
Final rept.,
J. M. Kincaid, G. Morrison, and E. Lindeberg. 1983, 4p
Pub. in Physics Letters A 96A, n9 p471-474, 1 Aug 83.

Keywords: *Fluids, Critical point, Mixtures, Reprints, Phase equilibrium.

The two-phase equilibrium and critical point conditions of a polydisperse fluid (a mixture with a continuous distribution of components) are solved by making power-series expansions about the properties of a single representative species.

700,550
PB88-153929 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Chemically Modified Electrode Sensors.
Final rept.,
R. A. Durst. 1985, 14p
See also PB86-230513.
Pub. in Analytical Chemistry Symposium Ser. Ion-Sel. Electrodes 22, p115-128 1985.

Keywords: *Electrodes, Fabrication, Chemical analysis, Bioinstrumentation, Electrochemical cells, Reprints.

Electroanalytical sensors based on amperometric measurements at chemically modified electrodes are in the early stages of development. The modes of modification can take many forms, but the most common approach at the present time is the immobilization of electrocatalysts in polymer films which are applied to bare metal and carbon electrodes. The review gives a brief summary of the types of chemically modified electrodes, their fabrication, and some examples of their uses. The incorporation of biochemical systems should greatly extend the usefulness of these devices for analytical purposes.

700,551
PB88-153945 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Tunable Far Infrared Laser Spectroscopy.
Final rept.,
K. M. Evenson, D. A. Jennings, K. R. Leopold, and L. R. Zink. 1985, 5p
See also PB84-223825.
Pub. in Proceedings of the Laser Spectroscopy Conference (7th), Hawaii, June 24-28, 1985, p366-370.

Keywords: *Infrared spectroscopy, *Far infrared radiation, *Laser spectroscopy, *MIM diodes, Tunable lasers.

The authors describe the generation of far infrared (FIR) radiation with the metal-insulator-metal (MIM) diode and the operation of a spectrometer employing this diode. The technique is an extension of the use of the MIM diode from its use in the measurement of frequencies to the generation of far infrared radiation between 0.3 and 6.0 THz. The MIM diode has previously been used in frequency measurements yielding a definitive value for the speed of light and in the measurement of the frequency of visible radiation.

700,552
PB88-154018 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.

Physical & Theoretical Chemistry

Electron Transfer Reactions of Tryptophan and Tyrosine Derivatives.

Final rept.,
S. V. Jovanovic, A. Harriman, and M. G. Simic. 1986,
5p.
Pub. in Jnl. of Physical Chemistry 90, n9 p1935-1939
1986.

Keywords: *Tryptophan, *Tyrosine, Oxidation, Electrode potentials, Electron transfer, Reprints.

Oxidation of tryptophan and tyrosine, and their derivatives by oxidizing radicals was studied by pulse radiolysis in aqueous solutions at 20 degrees C. Results are presented.

700,553
PB88-156435 Not available NTIS
American Chemical Society, Washington, DC.

Journal of Physical and Chemical Reference Data, Volume 16, Number 4, 1987.

Quarterly rept.
c1987, 491p
See also PB88-156443 through PB88-156500 and PB88-112685. Prepared in cooperation with American Inst. of Physics, New York. Sponsored by National Bureau of Standards, Gaithersburg, MD.
Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: *Physical properties, *Chemical properties, Measurement techniques, Reviews, Data, Evaluation, Accuracy, Reprints.

Contents: Thermophysical properties of fluids. II. Methane, ethane, propane, isobutane, and normal butane; Methanol thermodynamic properties from 176 to 673 K at pressures to 700 bar; Internal equations for the saturation properties of ordinary water substance; Rate data for inelastic collision processes in the diatomic halogen molecules. 1986 supplement; Critical survey of data on the spectroscopy and kinetics of ozone in the mesosphere and thermosphere; Critical compilation of surface structures determined by low-energy electron diffraction crystallography; Viscosity and thermal conductivity of nitrogen for a wide range of fluid states.

700,554
PB88-156443 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Thermophysical Properties of Fluids. 2. Methane, Ethane, Propane, Isobutane, and Normal Butane, B. A. Younglove, and J. F. Ely. c1987, 222p
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p577-798 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: *Density, *Thermophysical properties, Ethane, Isobutane, Methane, Normal butane, Propane, Transport properties, *Equation of state.

Tables of methane, ethane, propane, isobutane, and normal butane thermodynamic and transport properties are presented. The mathematical relations from which these thermophysical properties are obtained are discussed. The tables list pressure, density, temperature, internal energy, enthalpy, entropy, specific heat at constant pressure and at constant volume, sound speed, viscosity, thermal conductivity, and dielectric constant.

700,555
PB88-156450 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Methanol Thermodynamic Properties from 176 to 673 K at Pressures to 700 Bar, R. D. Goodwin. c1987, 94p
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p799-892 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: *Densities, *Thermodynamic properties, Enthalpies, Entropies, *Compressibility factors, Equation of state, Fugacities, Heats of vaporization.

Available data for vapor pressures and for the orthobaric densities of methanol are examined and formulated. Then PpT data are correlated by an equation of state (EOS) which is constrained to the given coexistence boundary. Via ideal gas state specific heats, the thermodynamic properties of methanol then are obtained by numerical integrations of the EOS, and are tabulated along isobars. A comparison is made with some recent calorimetric enthalpy differences data over a wide range of the EOS surface.

700,556
PB88-156468 Not available NTIS
Ruhr Univ., Bochum (Germany, F.R.). Inst. fuer Thermo- und Fluidodynamik.

International Equations for the Saturation Properties of Ordinary Water Substance, A. Saul, and W. Wagner. c1987, 7p
Sponsored by National Bureau of Standards, Gaithersburg, MD.
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p893-901 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: *Enthalpy, *Entropy, Water, IAPS, Orthobaric densities, Saturation line, Vapor pressure.

Consistent with the latest experimental data and the recent internationally recommended values for the critical parameters, the authors have developed compact and accurate representative equations for the following properties on the saturation line of ordinary (light) water substance: vapor pressure, density, enthalpy and entropy of both the saturated liquid and the saturated vapor. These equations form the basis of a 'Supplementary Release on Saturation Properties of Ordinary Water Substance' issued by the International Association for the Properties of Steam (IAPS).

700,557
PB88-156476 Not available NTIS
Joint Inst. for Lab. Astrophysics, Boulder, CO.
Rate Data for Inelastic Collision Processes in the Diatomic Halogen Molecules. 1986 Supplement, J. I. Steinfeld. c1987, 8p
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p903-910 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: *Halogens, *Energy transfer, Inelastic collisions, Quenching, Radiative lifetimes, Rotational relaxation.

The previously published compilation of rate data for inelastic collision processes involving the homonuclear and heteronuclear diatomic halogen molecules (J. Phys. Chem. Ref. Data 13, 445 (1984)) has been updated through June, 1986. Additional data on collision processes involving the interhalogens, and on processes at very low kinetic temperatures, are presented; in addition, several previously accepted rate data have been corrected.

700,558
PB88-156484 Not available NTIS
Joint Inst. for Lab. Astrophysics, Boulder, CO.
Critical Survey of Data on the Spectroscopy and Kinetics of Ozone in the Mesosphere and Thermosphere, J. I. Steinfeld, S. M. Adler-Golden, and J. W. Gallagher. c1987, 38p
Prepared in cooperation with Spectral Sciences, Inc, Burlington, MA., and Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p911-951 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: Data, Kinetics, Ozone, Reaction rate coefficients, Spectroscopy, *Cross sections, *Electron collisions, Upper atmosphere.

Spectroscopic data and reaction rate coefficients pertinent to ozone in the mesosphere and thermosphere (altitude > 50 km) are critically surveyed. These data should be of use in modeling atmospheric infrared luminescence, measuring atmospheric ozone concentrations by remote sensing, and designing and interpreting laboratory measurements. There is a clear need for additional data on metastable ozone electronic states, additional atmospheric ozone formation channels, collision processes involving electrons and ions, and vibrational state dependence of reaction rate coefficients.

700,559
PB88-156492 Not available NTIS
Oregon State Univ., Corvallis. Dept. of Chemistry.

Critical Compilation of Surface Structures Determined by Low-Energy Electron Diffraction Crystallography,

P. R. Watson. c1987, 38p
Sponsored by National Bureau of Standards, Gaithersburg, MD.
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p953-992 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: Critically reviewed data, LEED, *Low energy electron diffraction, Reliability factor, *Surface crystallography, Surface structure.

The review critically compiles all surface structures derived from low-energy electron diffraction (LEED) crystallography reported in the refereed literature prior to January 1986. Over 250 investigations have been analyzed covering all types of surfaces including clean and adsorbate-covered metal, semiconductor and other nonmetallic substrates. Particular attention is paid to developing and applying objective criteria that allow an estimation of the reliability of a particular structural determination. The important experimental and theoretical aspects of such investigations have been extracted into easily understood tabular form supplemented by many figures and ancillary tables and complete references. It is hoped that this compilation will provide a valuable resource both for the surface science specialist and for those nonspecialists in other areas who need surface crystallographic data.

700,560
PB88-156500 Not available NTIS
Stuttgart Univ. (Germany, F.R.). Inst. fuer Technische Thermodynamik und Thermische Verfahrenstechnik.
Viscosity and Thermal Conductivity of Nitrogen for a Wide Range of Fluid States, K. Stephan, R. Krauss, and A. Laesecke. c1987, 19p

Prepared in cooperation with Gesamthochschule Siegen (Germany, F.R.). Inst. fuer Fluid- und Thermodynamik. Sponsored by National Bureau of Standards, Gaithersburg, MD.
Included in Jnl. of Physical and Chemical Reference Data, v16 n4 p993-1023 1987. Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Keywords: Evaluation, Nitrogen, *Thermal conductivity, *Correlation, *Dilute gas function, Excess function, Fluid state, Recommended values.

The viscosity and the thermal conductivity of fluid nitrogen were critically evaluated and correlated on the basis of a comprehensive literature survey. Recommended values were generated in a temperature range from 70 to 1100 K and pressures up to 100 MPa using the residual concept. To retain consistency with the IUPAC Thermodynamic Tables, the same thermodynamic key data were used. Additionally, a so-called transport equation of state was established that makes it possible to achieve a unified representation of the viscosity and thermal conductivity in terms of pressure and temperature.

700,561
PB88-162508 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.

International Conference on Chemical Kinetics. Final rept.,
J. T. Herron, W. Tsang, S. E. Stein, and D. M. Golden. 1986, 2p
See also AD-A182 285. Sponsored by SRI International, Menlo Park, CA. Chemical Kinetics Dept.
Pub. in Jnl. of Physical Chemistry 90, n3 p343-344 1986.

Keywords: *Reaction kinetics, *Chemical reactions, Meetings, Abstracts, Reprints.

This is a report on the International Conference on Chemical Kinetics, held at the National Bureau of Standards, June 17-19, 1985. The purpose and organization of the conference are described, and a list of invited speakers and their topics provided. Some general observations are made on the status of chemical kinetics.

CHEMISTRY

Polymer Chemistry

Polymer Chemistry

700,562

PB87-150827

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Physical Aging of PMMA in the Non-Linear Range: Torque and Normal Force Measurements.

Final rept.,

G. B. McKenna, and A. J. Kovacs. 1984, 4p

Sponsored by Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Recherches sur les Macromolécules.

Pub. in Polymer Engineering and Science 24, n14 p1138-1141 1984.

Keywords: *Aging tests(Materials), *Polymethyl methacrylate, Polymers, Polyacrylates, Deformation, Reprints.

Cylindrical specimens of PMMA were quenched from above the glass transition and subsequently tested in torsion. Torque and normal force relaxation responses were recorded. The experiments were performed at 40 deg, 60 deg and 80 deg C, at increasing ageing times and at deformations of from 0.0027 to 0.074. It was found, at 40 deg and 60 C deg that, contrary to the classical picture of ageing, the small deformation torque relaxation curves could not be superposed by any combination of vertical and horizontal shifts. In the non-linear range of deformations the aging responses of the torque and normal forces are different. The double logarithmic shift rates for the normal force are significantly higher than are those for the torque at the same deformation over most of the range of deformations studied.

700,563

PB87-150835

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Time Dependent Strain Energy Function for a Polymeric Glass.

Final rept.,

G. B. McKenna, and L. J. Zapas. 1985, 8p

Pub. in Polymer 26, n4 p543-550 1985.

Keywords: *Polymers, *Glass, Polymethyl methacrylate, Torsion tests, Strain tests, Reprints, Polymeric glass.

Torsion and normal force measurements were made during single step stress relaxation experiments on a polymeric glass (PMMA). Isochronal data were analyzed using an approach adapted from that developed by Penn and Kearsley (for incompressible elastic materials) to determine the derivatives $\delta W/\delta t$ (sub 1) of the time dependent strain energy function. $\delta W/\delta t$ (sub 1) $\delta W/\delta t$ (sub 2) are determined from the existing solution to the torsion of an incompressible cylinder. A special solution to the torsion of a compressible cylinder is presented and it is shown that the values of $\delta W/\delta t$ (sub 2) and $\delta W/\delta t$ (sub 1) obtained from the solution do not differ greatly from those obtained using the incompressible solution. It is found from both solutions that $\delta W/\delta t$ (sub 1) is negative and increasing towards zero with increasing time and deformation while $\delta W/\delta t$ (sub 2) is positive, greater in magnitude than $\delta W/\delta t$ (sub 1) and decreases towards zero with increasing time and deformation.

700,564

PB87-152906

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Models of Chain Folding in Semicrystalline, Lamellar Polymers.

Final rept.,

M. L. Mansfield, C. M. Guttman, and E. A. DiMarzio.

1986, 8p

Pub. in Jnl. of Polymer Science, Polymer Letters Edition 24, p565-572 1986.

Keywords: *Polymers, Mathematical models, Reprints, Chain folding.

One possible theoretical treatment of the amorphous domains between crystalline lamellae in semicrystalline polymers is provided by the statistics of random walks between two absorbing parallel plane barriers. This so-called gambler's ruin model on the simple cubic lattice leads to a prediction of the amounts of random and adjacent reentry possible in semicrystalline polymer systems. Vonk has recently argued that

when such walks are performed off-lattice, e.g., the freely jointed chain, they have average length 2L, rather than 3L, as predicted by the gambler's ruin model on a cubic lattice. This would seem to imply that the conclusions dictated by the lattice treatment are incorrect, and that only about one half of the stems are required to fold back abruptly. In this letter the authors explain the discrepancy between these two seemingly contradictory results. The authors show that both models lead to the same picture of the amorphous-crystalline interface, with over 2/3 of the stems turning back abruptly in both cases.

700,565

PB87-153276

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Random-Walk Model of Chain Polymer Adsorption Behavior at Critical Energy and Relation to a Reflecting Boundary Condition.

Final rept.,

R. J. Rubin. 1984, 11p

Pub. in AIP Conference Proceedings, n109 p73-83 1984.

Keywords: *Polymers, *Random walk model.

It is found that there is a subtle difference between the set of energy-weighted random walks generated in the discrete random-walk model of polymer chain adsorption at the critical energy and the corresponding set of random walks generated in the presence of a reflecting boundary. This difference is lost in the continuous random flight model of adsorption of de Gennes.

700,566

PB87-153284

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Application of a Photodimerizable Probe to the Forced Rayleigh Scattering Technique for Measurement of Self-Diffusion of Polymer Chains.

Final rept.,

Q. Tran-Cong, T. Chang, C. C. Han, and Y. Nishijima.

Nov 86, 4p

Pub. in Polymer 27, n1705-1708 Nov 86.

Keywords: *Polymers, Optical materials, Reprints, *Ether/bis(anthrylmethyl), Rayleigh scattering, Photodimerizable probe.

A new type of photochromic compound, a bis-(9-anthrylmethyl) ether (BAME), is introduced as a potential probe for the forced Rayleigh scattering (FRS) technique. Upon irradiation with ultra-violet (u.v.) light (approx. 360nm), BAME undergoes intramolecular dimerization which involves a large refractive index change in the visible region. The dimerization is known to be essentially irreversible in the absence of short u.v. light (approx. 250nm) at room and moderately high temperatures. A derivative of BAME is synthesized and chemically attached to polystyrene chains. Some photochemical properties of the BAME-labelled polystyrene are reported together with the results of a preliminary diffusion measurement of polystyrene by the FRS technique.

700,567

PB87-161667

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Novel Fluorescence Technique for Measurements of Additive Migration from Polymers.

Final rept.,

F. W. Wang, and B. F. Howell. 1984, 3p

Pub. in Polymer 25, n11 p1626-1628 1984.

Keywords: *Polymers, Antioxidants, Reprints, Diffusion coefficients, Phenylene diamine/N-N'(diphenyl), Thiophene/(benzoxazolyl)-butyl)-di.

Diffusion coefficients for two antioxidants N,N'-diphenyl-p-phenylenediamine (DPPD) and 2,5-di-(5-tert-butyl-2-benzoxazolyl)thiophene (Uvitex OB) have been measured by extraction from a low density polyethylene film into 1-propanol at 22 degrees C. Extraction was done in a special cuvet-equipped vessel which excludes oxygen during extraction and permits direct fluorescence monitoring of the extraction solvent. Oxygen exclusion eliminates errors due to fluorescence quenching and anti-oxidant oxidation and allows precise measurement of the diffusion coefficient.

700,568

PB87-161675

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Synthesis and Self-Diffusion of Nitrobenzoxadiazole-Labeled Polystyrene.

Final rept.,

F. W. Wang, R. E. Lowry, and E. S. Wu. 1985, 5p

Pub. in Polymer Material Science and Engineering 52, p355-359 1985.

Keywords: *Synthesis(Chemistry), Polystyrene, Polymers, Diffusion, Reprints, *Benzofurazan/nitro.

A polystyrene polymer of narrow molecular weight distribution was carboxylated, then reduced, and finally esterified with NBD-amino hexanoic acid (6-(7-nitro-benz-2-oxa-1,3-diazol-4-yl)-aminohexanoic acid). The self-diffusion of the NBD-labeled polystyrene polymer in concentrated solutions of the unlabeled polystyrene polymer was measured by the method of fluorescence recovery after photobleaching over a concentration range from 0.017 g/ml to 0.41 g/ml at room temperature. In the semidilute region, the concentration dependence of diffusion coefficient was found to be in agreement with the predictions of scaling concepts.

700,569

PB87-167680

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Superposition of Small Shear Deformations on Large Uniaxial Extensions for Viscoelastic Materials.

Final rept.,

L. J. Zapas, and A. Wineman. 1985, 5p

Pub. in Polymer 26, n7 p1105-1109 1985.

Keywords: *Polymers, *Viscoelasticity, Deformation.

The equation for small amplitude torsional response superposed on a finite axial stretch history is derived for a material modeled by the BKZ constitutive equation. For the case of a uniaxial stretch history, this equation contains a term generalizing the well known Rivlin result for nonlinear elasticity plus two additional terms. The equation is used to analyze a recent experiment which studies the relation between the period of free torsional oscillations, axial stretch and axial force in a material undergoing stress relaxation. It is shown that a 10% discrepancy which arises when the data is related by Rivlin's formula can be accounted for by the two additional terms associated with the BKZ formulation. Finally, an expression for the complex modulus for forced torsional oscillations is derived.

700,570

PB87-190146

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Natural-Abundance ¹³C-(¹³C) Spin Exchange in Rigid Crystalline Organic Solids.

Final rept.,

D. L. VanderHart. 1987, 35p

Pub. in Jnl. of Magnetic Resonance 72, p13-47 1987.

Keywords: *Magnetic resonance, *Spin lattice relaxation, *Polymers, Polyethylene, Cellulose, Crystal structure, Mathematical models, Solids, Diffusion, Lattice vibrations, Reprints, Spin exchange.

Natural-abundance ¹³C-¹³C spin exchange, in the presence of proton dipolar couplings, has been investigated for the crystalline regions of two semicrystalline polymers, linear polyethylene (LPE), and cellulose. Because of very long longitudinal relaxation times, spin exchange could be followed to times exceeding 100 s. The paper focuses on the behavior of spin exchange at the longer times. The incentive for investigating LPE was that other published work on this system suggested that spin exchange proceeded more rapidly than theory would predict. The results on an oriented sample were similar to those reported. In addition, however, the spin-exchange behavior had an unexpected temperature dependence which, in turn, was attributed to temperature-dependent chain transport through the crystalline lattice. In the low-temperature limit, spin exchange was consistent with theory. In cellulose whose monomer contains six different carbons and whose crystal structure imposes magnetic inequivalence on certain carbons there also exist questions about crystalline polymorphism. Spin exchange was studied following a selective population perturbation of only one multiplet component within the CI resonance pattern. Results reinforced the hypothesis of polymorphism. Mathematical modeling of spin exchange in

LPE and cellulose was carried out using an isolated-pair approximation.

700,571
PB87-190245 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Longitudinal Acoustic Mode Frequencies of Polyethylene Chains Containing Defects.
Final rept.,
J. Mazur, D. H. Reneker, and B. M. Fanconi. Mar 87, 4p
Pub. in Polymer Communications 28, p78-81 Mar 87.

Keywords: *Raman spectra, *Polyethylene, Crystal lattices, Defects, Crystal dislocations, Molecular vibration, Reprints, Longitudinal acoustic mode, LAM vibration.

The relation between the longitudinal acoustic mode (LAM) frequencies of crystalline polyethylene and detailed morphological models was investigated. The morphological arrangement of conformational defects which fit into the lattice and which contain gauche dihedral angles was shown to determine the LAM frequencies. The internal structural details of the defect and the conformation of adjacent chains are relatively unimportant. The LAM frequencies are inversely proportional to the sum of the length of the all-trans segment and to a quantity 2λ which represents the masslike effect of the defect region on the LAM vibration. Delta was found to have a value of 3.75 ± 0.25 Å, which is independent of the exact conformation of the defect.

700,572
PB87-190260 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Solubilities of BHT in Various Solvents.
Final rept.,
S. S. Chang, and J. R. Maurey. 1985, 4p
Pub. in Jnl. of Chemical Engineering Data 30, n4 p384-387 1985.

Keywords: *Solubility, *Toluene, Antioxidants, Polymers, Solvents, Ethanol, Water, Corn oil, Alcohols, Heat measurement, Heptanes, Phase diagrams, Polyethylene, Glycerides, Reprints, BHT.

BHT (3,5-di-tert-butyl-4-hydroxytoluene) is a widely used antioxidant in polymers as well as in many other applications. The solubilities of BHT in various solvents, such as n-heptane, ethanol, water, ethanol/water mixtures, n-octanol and corn oil, have been determined. The solubility of BHT in n-heptane is found to be slightly less than the ideal solubility predicable from calorimetric constants of BHT. Application of the solubility data from this research and from the literature are used to derive partition coefficients for BHT between solvents and polymers.

700,573
PB87-190997 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Phase Diagram and Morphology of Blends of Poly(vinylidene fluoride) and Poly(ethyl acrylate).
Final rept.,
R. Briber, and F. A. Khoury. 1987, 9p
Pub. in Polymer 28, p38-46 Jan 87.

Keywords: *Phase diagrams, *Crystallization, *Polymers, Blends, Morphology, Spherulites, Crystal structure, Reprints, Polyethylacrylate, Polyvinylidene fluoride, Polymer blends.

The phase diagram and crystallization behavior of the polymer blend system consisting of poly(vinylidene fluoride) (PVF2) and poly(ethyl acrylate) (PEA) have been examined. The melt exhibits phase separation upon heating to 10 C-50 C above the melting point of the PVF2, depending on the composition. The cloud point and equilibrium melting point curve intersect at about 180 C and a composition of 50% (by weight) PVF2. Spherulite growth rate data have been measured as a function of composition and temperature. In blends crystallized from the one phase melt the texture of spherulites becomes more open and the spherulite extinction ring spacing (due to lamellar twist) becomes larger with increasing crystallization temperature. In addition the ring spacing increases with PEA content at constant crystallization temperature.

700,574
PB87-196903 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Novel Fluorescence Method for Cure Monitoring of Epoxy Resins.
Final rept.,
F. W. Wang, R. E. Lowry, and B. M. Fanconi. 1986, 4p
Sponsored by Army Research Office, Research Triangle Park, NC.
Pub. in Polymer 27, p1529-1532 Oct 86.

Keywords: *Cure monitoring, Polymerization, Excimer, Fluorescence, Local viscosity, Process control, Spectroscopy, Reprints, *Epoxy resins.

The fluorescence spectra of organic dyes dissolved in epoxy resins are sensitive to local viscosity. The excimer forming dyes are particularly useful as probes since the monomer emission can be used as an internal standard in the measurement. In this case, the probability of excimer formation is related to molecular mobility and hence to the microviscosity. The approach has been demonstrated on epoxy resins. In another approach, trace amounts of 1-(4-dimethylamino-phenyl)-6-phenyl-1,3,5-hexatriene (DMA-DPH) and 9,10-diphenylanthracene (DPA) are added to an epoxy resin. The fluorescence intensity of DMA-DPH increases with the increase in local viscosity while the fluorescence intensity of DPA is insensitive to local viscosity and can be used as an internal standard. The ratio of the fluorescence intensities of DMA-DPH and of DPA has been measured to monitor the cure of epoxy resins.

700,575
PB87-196911 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Cure Monitoring of Epoxy Resins by Fluorescence Recovery After Photobleaching.
Final rept.,
F. W. Wang, and E. S. Wu. 1987, 3p
Sponsored by Army Research Office, Research Triangle Park, NC.
Pub. in Polymer Communications 28, p73-75 Mar 87.

Keywords: *Fluorescence recovery, *Epoxy resins, Reprints, *Cure monitoring, Photobleaching.

The diffusion coefficients of organic dyes dissolved in epoxy resins are sensitive to the local viscosity. The diffusion coefficient of a fluorescent probe dissolved in epoxy resins has been measured by fluorescence recovery after photobleaching to monitor the cure of epoxy resins.

700,576
PB87-197687 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Polymer Diffusion in an Interacting System.
Final rept.,
C. C. Han, T. Sato, M. Okada, and C. Wu. 1987, 3p
Pub. in Polymer Preprints, ACS 28, n1 p358-360 1987.

Keywords: *Interaction parameters, *Polymer diffusion, Neutron scattering, Light scattering, Reprints, PS/PVME, Sinodal decomposition.

The apparent diffusion coefficient, D_{app} , has been measured for a binary polymer system of deuterated polystyrene/poly(vinyl methyl ether). This has been measured by time resolved light scattering technique of observing the demixing (temperature jump) or re-mixing (reverse quench) of the system. Together with the temperature and composition dependence of the effective interaction parameter, χ , obtained from small angle neutron scattering experiment, the mobility, M , can also be extracted. It is shown that D_{app} decreases as the temperature of the system increases and changes sign at the critical point. Also, the mobility, M , has an Arrhenius type of temperature dependence in the temperature range of the authors study, (approx. 130 degs C to 160 degs C) with an activation energy of 37 Kcal/mole.

700,577
PB87-197695 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Thermodynamic and Hydrodynamic Properties of Dilute Solutions of Cyclic and Linear Polystyrenes.
Final rept.,
G. Hadziioannou, P. Cotts, G. ten Brinke, C. Han, P. Lutz, C. Strazielle, P. Rempp, and A. Kovacs. 1987, 5p
Pub. in Macromolecules 20, n3 p493-497 1987.

Keywords: *Polymers, *Light scattering, Radius of gyration, Neutron scattering, Reprints.

The thermodynamic and hydrodynamic properties of cyclic and linear polystyrenes, ranging from 10,000 to 180,000 molecular weight, in dilute solutions of cyclohexane have been measured by small-angle neutron scattering (SANS) and dynamic light scattering. The diffusion coefficient $D(c) = D(0)/(1 + kDc)$, was found to be negative and was, within experimental error, independent of molecular architecture. The molecular weight dependence of the radius of gyration, the hydrodynamic radius, and kD is discussed.

700,578
PB87-198156 Not available NTIS
National Bureau of Standards (NCL), Gaithersburg, MD. Fire Measurement and Research Div.
Flammability.
Final rept.,
R. G. Gann, R. A. Dipert, and M. J. Drews. 1986, 57p
Pub. in Encyclopedia of Polymer Science and Engineering, v6 p154-210 1986.

Keywords: Fire tests, Flame retardants, Flammability, Plastics, Polymers, Pyrolysis, *Fire retardants.

The combustible materials in most fatal fires is polymeric in nature. Whether natural or synthetic, these solid fuels account for 94% of lives lost, 80% of reported injuries, and 94% of property lost in residential fires in the United States (1). As a result, numerous tests have been devised for flammability and many codes and regulations cite them. Not coincidentally, significant effort has been devoted to improve the fire resistance of polymers. Such progress relies on understanding the nature of fire, fuel properties and how to measure them, and the mechanisms of polymer degradation.

700,579
PB87-203865 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Analysis of Damage Profiles in Poly(methyl methacrylate) in Terms of Oxygen Diffusion and Consumption.
Final rept.,
B. Dickens, J. W. Martin, and D. Waksman. 1986, 15p
Pub. in Polymer Degradation and Stability 15, p265-279 1986.

Keywords: *Methacrylates, Oxygen, Diffusion, Oxidation, Solubility, Polymers, Degradation, Stability, Reprints, *Chain scission, *Activation energy, *Photolysis, Polymethyl methacrylate.

Profiles of photolytically induced chain scissions in poly(methyl methacrylate) (PMMA) and oxygen diffusion and solubility parameters have been used to estimate the activation energy of the chain scission process. The resulting activation energy of 19 kcal/mol, which does not include contributions from the activation energies of oxygen diffusion and solubility, suggests that the temperature-sensitive changes in photolytic scission in PMMA arise from changes in the efficiency of the cage effect.

700,580
PB87-224499 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Simulation of Polymer Chain Dynamics by Lattice Models with Excluded Volume: Lattice Dependence.
Final rept.,
P. H. Verdier, and D. E. Kranbuehl. 1987, 7p
Pub. in Macromolecules 20, n6 p1362-1368 1987.

Keywords: Diffusion, Dilute solutions, Monte Carlo, Simulation, Solution properties, Reprints, *Polymer chain dynamics, Bread stick models, *Lattice model polymer chains, Relaxation times.

The effects of varying the lattice and the elementary move rules upon the dynamical behavior of bead-stick models of polymer chains with excluded volume have been studied by computer simulation. Long relaxation times and translational diffusion constants are reported for chains on body-centered cubic, face-centered cubic, and simple cubic lattices, for chains not constrained to lie on a lattice, for one-bead and two-bead elementary moves, and for random mixtures of one- and two-bead moves. The chain-length dependence of

the effects of excluded volume upon long relaxation times is similar for all three lattices: When only one kind of elementary move (one-bead or two-bead) is employed, the chain-length dependence of the long relaxation times is increased by somewhat more than the first power of chain length for all three lattices. When a mixture of two kinds of elementary moves is employed, the increase in chain-length dependence drops to somewhat more than the 0.5 power. However, when the requirement of lying on a lattice is removed altogether from chains using both kinds of elementary move, the chain-length dependence increases to roughly the common value found for lattice chain simulations using only one kind of elementary move. The behavior of the translational diffusion constants parallels that of the long relaxation times.

700,581
PB87-231338 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Polyesters: A Review of the Literature on Products of Combustion and Toxicity.
Final rept.,
E. Braun, and B. C. Levin. 1986, 17p
Sponsored by Consumer Product Safety Commission, Bethesda, MD.
Pub. in Fire and Materials 10, p107-123 1986.

Keywords: *Polyesters, *Toxicity, Reviews, Thermal decomposition, Reprints, *Combustion products, Flame retardants, Pyrolysis.

The available literature was reviewed to determine the nature and extent of information available on the thermal decomposition products and the toxicity of the combustion products of polyester materials used in consumer applications such as textiles and building construction. The literature review is limited to those publications printed in English through June 1984. The thermal decomposition products of polyesters are a function of temperature and oxygen content of the atmosphere. In general, as the temperature increases, the quantity of heavier hydrocarbons decreases and the production of CO and CO₂ increases. The presence of flame retardant additives, such as bromine and chlorine-containing compounds, produce halogenated combustion products. The use of phosphorus and bromine together in the same flame retardant finish increases the concentration of low molecular weight compounds. Thirteen different test protocols have been used to evaluate the toxicity of various types of polyester. Non-flame retarded polyesters give measured LC50 values ranging from 30.5m to 95.7 mg/l, while flame retarded polyesters, have LC50 values ranging from 24.0 mg/l to 38.0 mg/l. Several exceptions, however, are noted. Toxicologists consider these differences to be not significant. In general, the results from large-scale tests are ambiguous because of the presence of other materials in addition to the polyesters.

700,582
PB87-231353 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Acrylonitrile-Butadiene-Styrene Copolymers (ABS): Pyrolysis and Combustion Products and Their Toxicity--A Review of the Literature.
Final rept.,
J. V. Rutkowski, and B. C. Levin. 1986, 13p
See also PB86-153772. Sponsored by Consumer Product Safety Commission, Bethesda, MD.
Pub. in Fire and Materials 10, p93-105 1986.

Keywords: *Carbon monoxide, *Combustion products, *Toxicity, Reviews, Hydrogen cyanide, Thermal decomposition, Reprints, ABS plastics.

A review of the literature was undertaken to ascertain the current knowledge of the nature of the thermal decomposition products generated from ABS and the toxicity of these evolved products in toto. The literature review encompasses English language publications available through June 1984. The literature surveyed showed that the principal ABS thermoxidative degradation products of toxicologic importance are carbon monoxide and hydrogen cyanide. The experimental generation of these and other volatile products is principally dependent upon the combustion conditions and the formulation of the plastic. The toxicity of ABS thermal degradation products has been evaluated by five methods. The LC50 (30 min exposure + 14 day post-exposure period) values for flaming combustion ranged from 15.0 mg to 28.5 mg. In the non-flaming mode of combustion, the LC50 values ranged from

19.3 mg to 64.0. Therefore, no apparent toxicological difference exists between the flaming mode and the non-flaming mode. The toxicity of ABS degradation products was found to be comparable with the toxicity of the thermal decomposition products of other common polymeric materials.

700,583
PB87-231486 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Intramolecular Photodimerizable Probe (BAME) for Mass Diffusion Measurements by the Forced Rayleigh Scattering.
Final rept.,
C. C. Han, Q. Tran-Cong, and T. Chang. 1987, 2p
Pub. in Polymer Preprints 28, n1 p371-372 1987.

Keywords: Polymers, Reprints, *Forced Rayleigh scattering, *Intramolecular photodimerizable probe, Mass diffusion, Probe molecule, Polystyrene, BAME.

A new photochromic probe, 9-bis anthryl methyl ether (BAME) derivative, was synthesized and introduced as an effective probe for the Forced Rayleigh Scattering (FRS) technique. It is shown that BAME and polystyrene labeled with BAME exhibit a large change in refractive index under irradiation with UV light (363.8 nm). The self-diffusion of BAME and polystyrene labeled with BAME (PSA) were measured in various solvents. Self-diffusion coefficients of PSA in good, marginal and poor solvents are consistent with those obtained from quasi-elastic light scattering (QELS). Some exceptions of using BAME as a probe are shown in fluorescence quenching solvents. Results indicate that BAME can be used as an effective probe, which overcome some problems other photochromic probes are having in certain systems for mass diffusion measurements by FRS.

700,584
PB87-233425 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Small Angle Neutron Scattering of Partially Segregated Polymer Blends.
Final rept.,
W. Wu. Jan 83, 4p
Pub. in Polymer 24, p43-46 Jan 83.

Keywords: *Polymers, Macromolecules, Reprints, *Long chain conformations, *Neutron scattering, Gyration radius, Segregations, Small angle scattering.

Small angle neutron scattering (SANS) has been used extensively to investigate the conformation of macromolecules. However, the scattered intensity has been found to be extremely sensitive to the segregation of the isotopic labelled species. The segregation has resulted in enormous increases in both the radius of gyration and the molecular weight. A theoretical treatment based on the Zernicke-Prins equation with a modified pair correlation function has been developed in this work; the size and the degree of segregation can be calculated from the scattering data using the equations obtained herein.

700,585
PB87-233805 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Degradation and Pyrolysis Mechanisms.
Final rept.,
J. H. Flynn, and R. E. Florin. 1985, 60p
Pub. in Pyrolysis and Gas Chromatography in Polymer Analysis, Chapter 4, p149-208 1985.

Keywords: *Polymers, Gas chromatography, Kinetics, Mass spectrometry, Pyrolysis, Reprints, *Carbonization, Ceiling temperature, Depolymerization, Flash pyrolysis, Thermal degradation.

Thermal degradation mechanisms for organic homopolymers, copolymers and blends are discussed with emphasis on their relationship to mass spectrometry and gas chromatography. The pyrolysis mechanisms have been fitted into four types: random scission, depolymerization, carbonization and side group reactions. Applications of programmed temperature to the analysis of these systems and the effects of higher temperatures on the mechanism and product distribution are discussed. It contains 112 references and a bibliography for further reading.

700,586
PB88-100722 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Comparisons among Process Monitoring Techniques.

Final rept.,
B. M. Fanconi, F. W. Wang, and D. L. Hunston. 1987, 3p
Pub. in Proceedings of SPE Annual Technical Conference and Exhibit (45th), p1100-1102 1987.

Keywords: *Polymer composites, *Process monitoring, Viscosity, Ultrasonics, Fluorescence probes, Dielectric measurements, Differential scanning calorimetry.

Comparisons are made among six different techniques used to monitor the processing of polymer matrix composites. Three techniques, two using fluorescence probes and the third based on ultrasonics, that have potential for on-line processing are discussed in detail. Results from these techniques are compared to laboratory measurements of viscosity, conductance, and heat evaluation.

700,587
PB88-100730 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Electron Microscopy of Polymer Blends.
Final rept.,
R. M. Briber. 1987, 4p
Pub. in Proceedings of Annual Meeting of the Electron Microscopy Society of America (45th), Baltimore, MD., August 3-7, 1987, p506-509.

Keywords: *Electron microscopy, Morphology, Phase separation, Polybenzimidazole, *Polymer blends, Polyvinylidene.

Polymer blends have come to play an increasingly important role in materials science as the need for polymeric materials with wider ranging properties has developed. Data will be presented in the paper on two polymer blend systems that have benefited from the use of electron microscopy in understanding the complex morphologies than can occur in polymer systems.

700,588
PB88-100748 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Microanalysis and Electron Energy Loss Spectroscopy of Polymers.
Final rept.,
R. Briber. 1987, 4p
Pub. in Proceedings of Annual Meeting of the Electron Microscopy Society of America (45th), Baltimore, MD., August 3-7, 1987, p430-433.

Keywords: *Compositional analysis, *Electron microscopy, Electron energy loss spectroscopy, Microanalysis, Microscopy.

Analytical electron microscopy has progressed in recent years such that quantitative chemical information can be obtained from very small volumes of sample. In principle, the composition of regions on the order of a few nanometers in both diameter and thickness can be determined using energy dispersive x-ray analysis (EDS) and electron energy loss spectroscopy (EELS) (1,2). In the case of organic polymers the limitations to quantitative microanalysis are generally due to the sample and not to the instrument. Radiation damage induced mass loss often proves to be the constraining factor in obtaining quantitative information from small volumes of sample (3). The principles and processes of radiation damage in organic materials and polymers can be found in various review articles (4,5).

700,589
PB88-140934 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
SANS (Small Angle Neutron Scattering) and SAXS (Small Angle X-ray Scattering) Studies on Molecular Conformation of a Block Polymer in Microdomain Space. 2. Contrast Matching Technique.
Final rept.,
H. Hasegawa, H. Tanaka, T. Hashimoto, and C. C. Han. 1987, 8p
Pub. in Macromolecules 20, n9 p2120-2127 1987.

Keywords: Reprints, *Block copolymer, *Contrast matching, *Microdomain space, Molecular conformation, Small angle neutron scattering.

The authors critically tested the contrast matching technique in the small-angle neutron scattering from block polymers to study the molecular conformation of a block polymer chain in microdomain space. It was found that the blending of deuterated and undeuterated block polymers with a composition to produce zero contrast ('contrast matching') does not always result in true contrast matching even in the case of the two block polymers mixed at a molecular level in the microdomain space. The true matching is expected to occur only in the case when the deuterated block polymers overlap each other in the domain space to produce uniform segmental density of their own at the given composition, giving rise to the zero contrast between each microdomain. However, even in the event of incomplete contrast matching, the suppression of the domain scattering by 2 orders of magnitude was attained, which enabled us to measure the component of the radius of gyration of the block polymer chain parallel to the interface with much better accuracy than the previous work without the contrast matching. The component was again found to be 70% of the component for the unperturbed chain.

700,590
PB88-140942 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Relationship of Intrinsic Viscosity of Polymer Solutions to Molecular Weight.
Final rept.,
F. L. McCrackin. 1987, 4p
Pub. in Polymer 28, p1847-1850 Oct 87.

Keywords: Reprints, *Intrinsic velocity, Mark-Houwink equation, *Polymer solutions, Polystyrene, Theta solvent.

An equation derived by Han relating intrinsic viscosity to molecular weight of a polymer has been fitted to experimental data over a large range of molecular weight. Excellent fits were obtained although the Mark-Houwink equation did not fit the data over the complete molecular weight range. Han's equation may be fit to intrinsic viscosity data over a moderate range of molecular weight, and is shown to then accurately predict the intrinsic viscosities for molecular weights outside the range. A method is given to compute the two parameters of Han's equation from the Mark-Houwink parameters of a polymer in a solvent.

700,591
PB88-140967 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Motion of Polymers Near Surfaces.
Final rept.,
E. A. Di Marzio. 1985, 14p
Pub. in AIP (American Institute of Physics) Conference Proceedings, n137 p271-284 1985.

Keywords: *Polymers, Surface(Chemistry), Fluid flow, Reptation.

Three separate polymer problems that involve motion near surfaces are considered. The first is Separation by Flow (SBF) according to which large polymer molecules flow through a capillary faster than small polymers. The large molecules favor the central region of the tube where the fluid velocity is highest. The second problem is to determine the effect of a linear shear field on isolated polymers that are covalently attached to a surface immersed in flowing fluid. It is found that the power dissipation is 4 times higher than for a polymer freely flowing in the fluid. The third problem is to calculate reptation times in the presence of applied force fields. This last problem has applications to: (1) diffusion at an interface; (2) reptation in a shear field; (3) electrophoresis; (4) diffusion in a random force field. If the force field is large enough the reptation times get so large that the reptation concept itself fails.

700,592
PB88-152640 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Vibrational Predissociation Dynamics of Weakly Bonded Dimers: A Summary.
Final rept.,
D. S. King. 1987, 5p
Pub. in Structure and Dynamics of Weakly Bound Molecular Complexes, p593-597 1987.

Keywords: *Dimerization, Ethylene, Nitrogen oxide(NO), Tetrazines, Chemical bonds, Reaction kinetics, Reprints, *Dimers, Predissociation.

Summary of molecular dynamics section of NATO ARW on Clusters held in Maratea, Italy, September 1986.

General

700,593
PATENT-4 681 855 Not available NTIS
Department of Commerce, Washington, DC.
Humidity Sensing and Measurement Employing Halogenated Organic Polymer Membranes.
Patent,
P. H. Huang. Filed 5 Aug 85, patented 21 Jul 87, 7p
PB87-218400, PAT-APPL-6-762 740
Supersedes PB85-246866.
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, *Humidity, *Moisture content, *Polymers, Membranes, Sensors, Laboratory equipment, High temperature tests, Acids, Halogen organic compounds.

The invention is thin films of hygroscopic, halogenated organic polymer having pendant groups of a relatively strong acidic type (e.g., sulfonic groups) and pendant groups of a relatively weak acidic type (e.g., carboxylic groups) employed for humidity sensing by electronic, acoustic, and optical techniques.

700,594
PB87-209953 PC A11/MF A01
National Bureau of Standards (NML), Gaithersburg, MD.
Summary of Gas Cylinder and Permeation Tube Standard Reference Materials Issued by the National Bureau of Standards.
Final rept.,
R. Mavrodineanu, and T. E. Gills. May 87, 235p
NBS/SP-260/108
See also PB86-227592. Also available from Supt. of Docs as SN003-003-02799-5. Library of Congress catalog card no. 87-619817.

Keywords: *Catalogs(Publications), Standards, Air, Benzene, Carbon dioxide, Carbon monoxide, Gas, Methane, Nitrogen oxide, Oxygen, Propane, Sulfur dioxide, *Standard reference materials.

The publication is a summary of the gas cylinders and permeation tubes issued by NBS as Standard Reference Materials (SRM's). The material, composition, certification, use, and remarks concerning each of the SRM's described are presented in tabular form. Copies of the certificates of these SRM's are contained in the appendices for more detailed information.

700,595
PB87-218327 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Overview of Membrane Separations.
Final rept.,
R. D. Noble. 1987, 13p
Pub. in Separation Science and Technology 22, n2-3 p731-743 1987.

Keywords: *Membranes, *Separation, Applications, Reviews, Reprints.

The field of membrane separations is discussed. The major membrane types and applications are outlined. The outlook with respect to research activities and commercial applications is surveyed. The advantages and disadvantages of this separation process are discussed. Certain applications where membranes may save energy and improve productivity are also discussed.

700,596
PB87-230801 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Comparison of Isotope Dilution Mass Spectrometric Methods for the Assay of Copper in Copper Ore Reference Materials.

Final rept.,
E. S. Beary, K. A. Brletic, P. J. Paulsen, and J. R. Moody. 1987, 4p
Pub. in Analyst 112, p441-444 Apr 87.

Keywords: *Mass spectrometry, *Copper, Assays, Reprints, Isotope dilution, Reference materials.

The trend toward lower assays in the repeated determination of copper in copper ore, Standard Reference Material 332, have resulted in the withdrawal of this reference material due to material instability. Recent analyses by both isotope dilution thermal ionization mass spectrometry (TIMS) and isotope dilution inductively coupled plasma mass spectrometry (ICP-MS) have confirmed this change in copper assay. In this study ICP-MS was shown to be an excellent method for the determination of the concentration of copper in copper ore and therefore may be capable of relatively high precision for a number of elements in inorganic matrices. Two experiments were designed to study the relationship between the high loss of volatile components on drying and the corresponding low copper assay. The slow oxidation of CuS to CuSO₄ was confirmed. The accelerated moisture study indicated that exposure to changes in temperature and relative humidity did not cause this oxidation. Microwave drying provided additional information about moisture associated with the samples that had been oxidized.

700,597
PB88-156708 PC A23/MF A01
National Bureau of Standards, Gaithersburg, MD.
Compilation of Elemental Concentration Data for NBS (National Bureau of Standards) Clinical, Biological, Geological, and Environmental Standard Reference Materials.
Special pub. 1982-86,
E. S. Gladney, B. T. O'Malley, I. Roelandts, and T. E. Gills. Nov 87, 536p NBS/SP-260/111
Also available from Supt. of Docs. as SN003-003-02836-3. See also PB86-227592. Library of Congress catalog card no. 87-619888. Prepared in cooperation with Los Alamos National Lab., NM., and Liege Univ. (Belgium).

Keywords: *Catalogs(Publications), Standards, *Standard reference materials.

Concentration data on as many as 92 constituents in 166 NBS Standard Reference Materials have been collected from over 1500 journal articles and technical reports. These data are summarized in consensus (mean) values with uncertainties expressed as plus or minus one standard deviation and compared with all available certification data from NBS. Data are presented on the analytical procedures employed and all raw data are given in the tables. The compilation is a successor to NBS Special Publication 260-88.

CIVIL ENGINEERING

Civil Engineering

700,598
PB87-171427 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Fenestration Design for Office and Residential Buildings.
S. J. Treado, and D. B. Holland. Jan 87, 80p NBSIR-86/3489
Sponsored by Civil Engineering Lab. (Navy), Port Huemene, CA.

Keywords: *Civil engineering, *Windows, Office buildings, Residential buildings, Design, Comparison, *Foreign technology.

The influence of fenestration design on energy performance and illumination conditions in office and residential buildings is examined, and recommendations are given for effective design of fenestration systems to meet occupant requirements. Particular emphasis is

CIVIL ENGINEERING

Civil Engineering

given to various shading strategies, such as blinds, shades, light shelves and fins, and their impacts on interior daylight levels and distribution, illumination quality, and energy requirements. A comparison is made between the total daylight gain into the building and the useful daylight gain, where useful daylight is defined as daylight which can be used to offset electric lighting requirements. Significant improvements in daylighting, lighting and thermal performance are shown to be possible with various fenestration designs.

Construction Equipment, Materials, & Supplies

700,599
PB87-153086 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Application of CCRL Data in the Formulation of Precision Estimates for Selected Cement Standards.
Final rept.,
J. H. Pielert, J. W. Haverfield, and P. A. Spellerberg. 1985, 6p
Sponsored by American Society for Testing and Materials, Philadelphia, PA., and American Association of State Highway and Transportation Officials, Washington, DC.
Pub. in Cement and Concrete Aggregates 7, n1 p37-42 1985.

Keywords: *Cements, *Concretes, *Construction materials, *Bitumens, *Standards, Precision, Reprints, National Bureau of Standards.

Increased emphasis is being placed on the quality control of materials used by the construction industry. The needs for uniformity and accuracy of testing conducted in materials laboratories is receiving considerable attention. Precision statements included in many standard test methods provide a basis for evaluating the quality of testing. The paper provides an overview of the Materials Testing Laboratories located at the National Bureau of Standards and demonstrates how data from the reference sample programs may be used to formulate precision estimates which can be used in developing statements of precision.

700,600
PB87-161071 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Effect of Geometry and Aggregate on the Reliability of the Pullout Test.
Final rept.,
W. C. Stone, and B. J. Giza. Feb 85, 10p
Pub. in Concrete International: Design and Construction 7, n2 p27-36 Feb 85.

Keywords: *Concrete, *Aggregates, *Nondestructive tests, Reliability, Strength, Mechanical properties, Reprints.

A series of tests was performed to investigate the effect of aggregate size, and type, and the geometry of the pullout test apparatus on the reliability of the pullout test. Reliability was assessed by the standard deviation of the experimental ultimate load in replicated tests. Key geometric variables included the apex angle and the depth of embedment of the 1-inch (25mm) insert. Apex angles were varied from 30 degrees to 86 degrees, and embedment depths were varied from 0.4 in to 1.67 in (10mm to 42mm). Also investigated were the effects of nominal maximum aggregate size and the type of aggregate on reliability. Mortar specimens were used for comparison. Four aggregate types were investigated: an expanded shale lightweight aggregate, crushed soft limestone, crushed hard limestone, and river gravel.

700,601
PB87-219010 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Finite-Element Analysis of the Pullout Test Using a Nonlinear Discrete Cracking Approach.
Final rept.,
A. K. Hellier, M. Sansalone, N. J. Carino, W. Stone, and A. R. Ingraffea. 1987, 10p
Pub. in Cement, Concrete, and Aggregates 9, n1 p20-29 1987.

Keywords: *Concretes, *Strength, Crack propagation, Mathematical models, Finite element analysis, Stresses, Failure, Shear stress, Model tests, Reprints, *Pullout tests, Fracture mechanics, Aggregate interlock.

An axisymmetric finite-element model, in which fracture was simulated by means of a nonlinear discrete cracking approach, was used to study the pullout test. The pullout test involves measuring the force required to extract a conical frustum of concrete by pulling on an embedded steel disk in opposition to a concentric steel reaction ring at the concrete surface. The precise mechanism of failure and therefore the strength property of concrete, which is actually being measured by the pullout test, has been the subject of several recent studies. The present analysis indicates that failure initiates with the formation of a stable, primary crack system extending from the outer edge of the insert to a point beneath the reaction ring where it is arrested. A stress redistribution resulting from this cracking leads to the development of a secondary crack system which initiates below the concrete surface at the inner edge of the reaction ring and propagates towards the outer edge of the insert. This secondary crack system becomes the eventual failure surface defining the conical frustum. The failure surface appears to be completed by shear fracture of the remaining uncracked ligament. The ultimate load-carrying mechanisms is aggregate interlock across the completed failure surface.

700,602
PB88-110804 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.
Evaluation and Accreditation of Construction Materials Laboratories.
Final rept.,
J. W. Locke, and J. H. Pielert. 1983, 19p
Pub. in Proceedings of Conference on Quality Assurance of Highways and Bridges, Gaithersburg, MD., August 30-31, 1983, 19p.

Keywords: *Construction materials, *Laboratories, *Test facilities, Highways, Quality assurance, Manpower, Requirements, *Road materials, Accreditation, State of the art, National organizations.

The Surface Transportation Assistance Act of 1982 directs the Secretary of Transportation to coordinate a study with NBS, ASTM and others to determine the manpower needs and costs of developing a national system for the evaluation and accreditation of testing and inspection agencies. The paper provides a description of the current state-of-the-art in the areas of laboratory evaluation and accreditation, provides available data on the level and quality of construction materials laboratory testing, and specifies additional information required to predict manpower needs and costs of a national system.

700,603
PB88-111851 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Measurement of the Setting Time and Strength of Concrete by the Impact-Echo Method,
S. P. Pessiki, and N. J. Carino. Jul 87, 122p NBSIR-87/3575

Keywords: *Concretes, *Setting time, *Mechanical properties, Measurement, Impact tests, Echoes, Non-destructive tests.

Tests were performed to evaluate the feasibility of using the impact-echo method to determine setting time and monitor strength development of concrete. In the impact-echo method, the test object is subjected to point impact and the surface displacement adjacent to the impact point is monitored. From the measured displacement waveform and the thickness of the object, the P-wave velocity is determined. Changes in the P-wave velocity with time reveal information about the development of mechanical properties. Setting time tests were made on concrete mixtures of two water-cement ratios and with and without set-controlling admixtures. A strong correlation was found between the time of initial setting of mortars sieved from the concrete, as determined by penetration resistance (ASTM C 403), and the time when the P-wave velocity began to increase. It is concluded that the impact-echo method is a promising technique for nondestructively monitoring the development of mechanical properties in concrete from initial setting to ages of several days.

700,604

PB88-129705 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Effect of Inorganic Salts on Tricalcium Silicate Hydration.
Final rept.,
P. W. Brown, C. L. Harner, and E. J. Prosen. 1986, 6p
Pub. in Cement and Concrete Research 16, n1 p17-22 Jan 86.

Keywords: *Calcium silicates, *Hydration, Inorganic salts, Admixtures, Concretes, Cements, Reprints.

Hydration of C3S in salt solutions having ions in common with its products was investigated by calorimetry and aqueous phase analyses. Soluble calcium salts, which depress hydroxyl ion concentrations in solution by promoting Ca(OH)₂ precipitation, were observed to accelerate hydration. Acceleration did not occur prior to Ca(OH)₂ precipitation. A saturated CaSO₄ solution, which delayed Ca(OH)₂ precipitation, was initially retarding but subsequently accelerated hydration as the hydroxyl ion concentration in solution decreased. Of the solutions investigated, a 0.2M CaCl₂ solution was the most effective in depressing the hydroxyl ion concentration and caused the greatest acceleration.

Highway Engineering

700,605
PB87-152245 PC A13/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Behavior of 1/6-Scale Model Bridge Columns Subjected to Cyclic Inelastic Loading,
G. S. Cheok, and W. C. Stone. Nov 86, 292p NBSIR-86/3494
Sponsored by National Science Foundation, Washington, DC., Federal Highway Administration, Washington, DC., and California State Dept. of Transportation, Sacramento.

Keywords: *Columns(Support), *Bridges(Structures), Cyclic loads, Elastic properties, Model tests, Reinforced concrete, Ready mixed concrete, Gravel, Aspect ratio, Axial stress, Computer programs, Energy absorption, Displacement, Strains, Graphs(Charts), Microconcrete, Computer graphics.

Circular, spirally reinforced concrete bridge columns were subjected to cyclic inelastic loading in the laboratory. The bridge columns were one-sixth scale models of prototype columns designed in accordance with current California Department of Transportation specifications. A total of six models were tested; three were constructed with microconcrete, and three with ready-mix concrete using pea gravel. Variables included the aspect ratio, magnitude of axial load, and the use of microconcrete versus ready-mix. The models were subjected to slow reversed cyclic loading with the axial load held constant. Results from the tests are presented in the form of energy absorption, load-displacement curves, longitudinal steel strains, and displacement profiles. Comparisons of the ultimate moment capacities, measured displacement ductilities, plastic hinge lengths, and the failure mode for the six models are discussed. Comparisons with previous studies are presented. A series of graphics-based computer programs are discussed. Source code is provided.

Soil & Rock Mechanics

700,606
PB87-161055 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.
Energy Transfer in the Standard Penetration Test,
F. Y. Yekel. Sep 82, 6p
Pub. in American Society of Civil Engineers Jnl. of Geotechnical Engineering Division 108, nGT-9 p1197-1202 1982.

Keywords: *Penetration tests, Energy transfer, Accuracy, Soil tests, Standards, Rods, Hammers, Reprints.

It has been shown that the results of the Standard Penetration Test are influenced by many test variables. There is little doubt that the accuracy of the test can be greatly improved if the effect of these variables is eliminated or reduced by either accounting for the variables when the test results are interpreted or reducing their effect by modifications in the test itself. One of the test variables is the effect of the drill rod length on the energy transfer from the hammer to the sampler. The problem of energy transfer has been studied theoretically and experimentally. Schmertmann and Palacios concluded that the hammer ceases to transfer energy to the drill rod at time $t(s) = 2l/c$, in which $t(s)$ = the time at which the hammer separates from the drill rod; l = the length of the drill rod from the point of impact to the bottom of the sampler; and c = the velocity of the stress wave propagation in steel (5,100 m/s). This conclusion is predicated on the assumption that a tensile-stress wave, reflected back from the lower end of the rod, will cause the hammer to separate from the anvil, and is considered valid if the resistance force at the lower end of the rod is significantly smaller than the force imparted by the hammer at impact.

COMBUSTION, ENGINES, & PROPELLANTS

Combustion & Ignition

700,607

AD-P004 524/5

PC A02/MF A01

Colorado Univ. at Boulder.

Ignition Phenomena of Bulk Aluminum Alloy as a Function of Oxygen Pressure.

K. Nguyen. Oct 84, 9p

This article is from JANNAF (Joint Army-NASA-Air Force) Combustion Meeting (21st) Held at Laurel, Maryland on 1-4 October 1984. Volume 1, AD-A150 981, p53-61.

Availability: Chemical Propulsion Information Agency, Laurel, MD 20707 (No copies furnished by DTIC).

Keywords: *Ignition, *Aluminum alloys, Oxygen, Pressure, Carbon dioxide lasers, Laser beams, Irradiation, Surface temperature, Aluminum oxides, Cooling, Aluminum alloy 6061, Component Reports.

An experimental study was undertaken to investigate the ignition phenomena of 6061 aluminum alloy as a function of oxygen pressure. Cylindrical aluminum alloy specimens were ignited in a pure oxygen environment by a focused cw CO₂ laser beam. To study the effect of oxygen pressure on the surface temperature at ignition of 6061 aluminum alloy, the experiments were conducted at oxygen pressures ranging from 0.084 to 2.413 MPa. The temperature of history of the entire upper surface of the specimen and of a 0.5 mm diameter spot located initially at the center of the specimen top surface was recorded by using a commercial two-color ratio pyrometer and a fast-response, narrow-band, two-color pyrometer. Mass, brightness, and interior temperatures, for certain experiments were also recorded throughout the experiment. The results show that the surface temperatures at ignition of the alloy obtained from the temperature curves are below the melting temperature of the aluminum oxide and are slightly dependent on oxygen pressure. The data indicate that the ignition mechanism is complex and probably composed of several phenomena acting both separately and in conjunction with each other.

700,608

PB87-150710

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

New Concepts for Measuring Flame Spread Properties,

J. G. Quintiere, and M. Harkleroad. 1985, 29p

See also report dated Nov 84, PB85-133973. Sponsored by Federal Aviation Administration Technical Center, Atlantic City, NJ.

Pub. in American Society for Testing and Materials, Special Technical Publication 882, p239-267 1985.

Keywords: *Flame propagation, *Ignition, *Materials tests, *Fire tests, Experimental design, Composite materials, Plastics, Wood, Carpets, Reprints.

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 uniform 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. Further analyses of the data yield effective values for the thermal inertia of the material ($k\rho c$), 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.

700,609

PB87-156519

PC A03/MF A01

Brown Univ., Providence, RI. Div. of Engineering.

Study of the Effects of Oxygen Transport and Temperature History of the Chemistry of PMMA Pyrolysis.

Annual rept. 1985-86,

E. M. Suuberg, V. Dalai, and T. Kelly. Dec 86, 47p

NBS/GCR-87/523

Grant NANO-400036

Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Pyrolysis, *Polymethyl methacrylate, *Thermal degradation, Thermoplastic resins, Oxygen, Combustion.

Thermal degradation and thermal oxidative degradation of commercially available poly(methyl methacrylate) were studied at heating rates of 5, 100, and 1000 K/min. Sample residue weights and molecular weights were measured during the degradation. Results indicate that previously obtained kinetic parameters from low heating rates (0.5-5 K/min.) in inert gas agree with the results obtained from the high heating rate experiments. The effects of oxygen on degradation diminishes with higher heating rate.

700,610

PB87-161808

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.

Direct Measurement of Char-Particle Temperatures in Fluidized-Bed Combustors.

Final rept.,

A. Macek, and C. Bulik. 1984, 8p

Pub. in Proceedings of International Symposium on Combustion (20th), Ann Arbor, MI, August 12-17, 1984, p1223-1230.

Keywords: *Combustion, *Fluidized bed processors, Combustion chambers, Coal.

A new technique is described, allowing direct in situ measurement of temperatures of burning coal-char particles in the interior of fluidized-bed combustors. A prerequisite of the technique was the development of uncooled optic guides capable of withstanding the harsh environment of fluidized combustors, and the demonstration of their capability to transmit continuous, time-resolved quantitatively measurable optical information to the outside for analysis by a two-channel recording systems. Radiometric records, obtained from the interior of a fluidized-bed reactor containing a low concentration of coal particles, consist of d.c. signals, corresponding to temperatures of inert bed particles, with transient excursions due to burning particles. The records not tractable by simple ratio pyrometry, were analyzed by a method based on the assumption of two temperature levels.

700,611

PB87-162269

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.

Soot Formation in Diffusion Flames: Flow Rate, Fuel Species and Temperature Effects.

Final rept.,

R. J. Santoro, and H. G. Semerjian. 1984, 10p

Pub. in Proceedings of the International Symposium on Combustion (20th), Ann Arbor, MI., August 12-17, 1984, p997-1006.

Keywords: *Combustion, *Soot, Combustion products, Aerosols, Methane, Ethane, Ethylene, Flow rate, Diffusion flames.

A detailed study of soot particle formation in diffusion flames has been made for a series of laminar diffusion flames using a laser scattering/extinction technique. The effects of flow rate, fuel species and temperature on the evolution of the soot particle field have been investigated for methane, ethane and ethene diffusion flames. Temperature effects have been examined through nitrogen dilution of the fuel. In the studies of flow rate, fuel species and temperature variations, it has been observed that effects in the annular region of the flame, where particles first appear, control the general features of the particle field in these flames. For flow rate variations, the maximum particle size observed in the flame remains nearly constant while the soot volume fraction increases slightly with increased flow rate. Thus, particle number concentration appears to be the quantity sensitive to the flow rate variation.

700,612

PB87-165577

PC A02/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Some Observations on the Shape of Impinging Diffusion Flames,

M. A. Kakkala, and W. J. Rinkinen. Jan 87, 25p

NBSIR-87/3505

Prepared in cooperation with Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

Keywords: *Diffusion flames, shape, Propane, Natural gas, Flammable gases.

The structure of impinging diffusion flames of propane and natural gas is described. In these experiments, a burner with a diameter of 64 mm was used. The spacing between the burner surface and the horizontal ceiling was varied in the range of 15 mm - 100 mm and the nominal heat release rate in the range of 2.9 kW - 11 kW. New kinds of regular flame shapes were observed: complete rings, broken rings, laminar disc, daisy flower, cellular daisy flower. Color photographs of the various flame shapes are presented. Combustion processes causing the instabilities are discussed qualitatively, and the differences between propane and natural gas flames are identified.

700,613

PB87-179222

PC A07/MF A01

California Univ., Berkeley. Dept. of Mechanical Engineering.

Perturbed Boundary Layer Diffusion Flames,

J. A. Ang. Mar 87, 138p NBS/GCR-87/526

Grant NANO5-D0552

Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Diffusion flames, *Combustion, Boundary layers.

Thermal cracking is shown to have a significant effect on the temperature profiles in a boundary layer diffusion flame. In the study, measurements of temperature profiles in a sooting free flow flame are compared with classic flame sheet model results. This comparison reveals a large over prediction of temperatures in the region between the fuel surface and the flame. The principle cause of this overprediction is the neglect of thermal cracking in the flame sheet model. A second possible cause for the temperature overprediction is the sink effect of radiative heat transfer from soot in the boundary layer. This effect and the effects of wall emission and normal buoyancy on a horizontal boundary layer diffusion flame are studied by perturbing the cracking sheet solution. The principle effect of soot radiation is an increased blowing rate at the wall. This blowing is offset by the radiation wall emission. The postulated sink effect of soot emission is negligible.

COMBUSTION, ENGINES, & PROPELLANTS

Combustion & Ignition

The major buoyancy effect is primarily the inducement of a velocity overshoot.

700,614
PB87-191060 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Fire Measurement and Research Div.
Structural Analysis of Soot Agglomerates.

Final rept.,
R. J. Samson, G. W. Mulholland, and J. W. Gentry.
1987, 10p
Pub. in Langmuir 3, n2 p272-281 1987.

Keywords: *Structural analysis, *Soot, *Agglomerates,
Combustion, Acetylene, Reprints.

The structure of soot agglomerates formed by the combustion of acetylene in a coannular diffusion burner is studied. Structural data from electron micrographs were obtained by two methods, particle counting with the aid of stereopairs for small clusters and electronic digitization with high-resolution image processing, used for the larger agglomerates. Langevin dynamics computer simulations based on free molecular motion were performed as an aid to interpreting the experimental results. Small agglomerates (with overall size <1.0 micrometer) were found to have a fractal dimension of 1.5-1.6 compared to about 1.9 obtained by computer simulations. The power law exponent for the pair correlation function obtained over a limited range in r was found to be consistent with the value obtained by computer simulations for agglomerates in the 5-12 micrometers range but somewhat greater for the agglomerates larger than 12 micrometers. From the simulations it appears that the range of power law behavior for the pair correlation function based on the projected images is less than the range for the pair correlation function based on three-dimensional (3-D) structure.

700,615
PB87-197943 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Fire Safety Technology Div.
ASET-B: A Room Fire Program for Personal Computers.
Final rept.,
W. D. Walton. 1985, 17p
See also PB85-198935, and PB85-153913.
Pub. in Fire Technology 21, n4 p293-309 Nov 85.

Keywords: *Fires, Flame propagation, Manuals, Evacuating(Transportation), BASIC(Programming language), Computer programs, Smoke, Reprints, ASET-B computer program, Room fires, Compartment fires.

ASET-B, a personal computer program for predicting the fire environment in a single room, is presented. ASET-B solves the same differential equations as the previously developed computer program, ASET (Available Safe Egress Time), using a simpler numerical technique. ASET-B requires as input the height and area of the room, the elevation of the fire above the floor, a heat loss factor, and a fire specified in terms of heat release rate. The program predicts the thickness and the temperature of the hot smoke layer as a function of time. ASET-B is written in BASIC and is not subject to copyright. The paper describes the program and its use. Included are a listing of the program, program variable name listing and a sample run. A discussion of user modifications also is given.

700,616
PB87-201802 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Fire Research.
Cooling Effect of a Single Evaporating Droplet on a Hot Semi-Infinite Metal Body.
M. di Marzo, D. D. Evans, and A. K. Trehan. Apr 87,
30p NBSIR-87/3517
Sponsored by Maryland Univ., College Park. Computer Science Center.

Keywords: Evaporation, Fire fighting, Fuels, Mathematical models, Temperature distribution, Cooling, Thermal measurements, Surfaces, Solids, Aluminum, Thermal conductivity, *Spray cooling, *Droplets, *Solid fuels.

Transient cooling of solid surfaces by water droplet evaporation has been investigated through controlled experiments using a large heated aluminum cylinder. Quantitative prediction of droplet evaporation time and in-depth transient temperature distribution in the solid have been made. All data, regardless of the droplet volume or of the initial body surface temperature, lie

within a narrow band about a straight line. This finding is the first important step to obtain a simple model for spray cooling based on local accurate description of the droplet-solid interactions. Modelling of spray cooling phenomena is the foundation for the construction of a thermal model for solid fuel fire extinguishment.

700,617
PB87-210266 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD.
Diffusion-Controlled Reaction in a Vortex Field.
Rept. for Sep 86-Sep 87,
R. G. Rehm, H. R. Baum, and D. W. Lozier. Jun 87,
40p NBSIR-87/3572
Contract AFOSR-155A-87-0018
Sponsored by Air Force Office of Scientific Research,
Bolling AFB, DC.

Keywords: *Turbulent flow, Chemical reactions, Fuels, Oxidizers, Graphs(Charts), Navier-Stokes equations, Models, *Fuel combustion, Turbulent mixing.

A two-dimensional model of a constant-density diffusion controlled reaction between unmixed species initially occupying adjacent half-spaces is formulated and analyzed. An axisymmetric viscous vortex field satisfying the Navier-Stokes equations winds up the interface between the species as they diffuse together and react. A flame-sheet approximation of the rapid reaction is made using Shvab-Zeldovich dependent variables. The model was originally proposed by F. Marble, who performed a local analysis and determined the total consumption rate along the flame sheet. The present paper describes a global similarity solution to the problem which is Fourier analyzed in a Lagrangian coordinate system. An asymptotic analysis of the Fourier amplitudes, valid for large Schmidt numbers is presented. The solution is evaluated numerically in Lagrangian and Eulerian coordinate systems. This problem has been studied as part of a more general model which has application to the description of turbulent combustion.

700,618
PB87-231320 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Fire Measurement and Research Div.
Simplified Characterization of Upholstered Furniture Heat Release Rates.
Final rept.,
V. Babrauskas, and W. D. Walton. 1986, 12p
Pub. in Fire Safety Jnl. 11, p181-192 1986.

Keywords: Chairs, Models, Reprints, *Fire engineering design, *Furniture calorimeters, Heat release, Sofas, Upholstered furniture.

The technology for measuring upholstered furniture heat release rates was established with the development of the furniture calorimeter. Analysis of a large number of tests in the furniture calorimeter has now demonstrated that for most specimens a good approximation to the rate of heat release as a function of time may take the form of a triangle. Methods of generating such curves, suitable for fire protection engineering hazard assessment purposes, have been developed.

700,619
PB87-233672 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Fire Measurement and Research Div.
Effects of External Radiant Flux and Ambient Oxygen Concentration on Nonflaming Gasification Rates and Evolved Products of White Pine.
Final rept.,
T. Kashiwagi, T. J. Ohlemiller, and K. Werner. 1987,
15p
Contract DE-A101-76PR06010
Sponsored by Department of Energy, Washington, DC.
Pub. in Combustion and Flame 69, p331-345 1987.

Keywords: *Pine wood, *Thermal degradation, Carbon dioxide, Carbon monoxide, Gasification, Reprints, *Foreign technology.

Time-dependent gasification mass flux, sample temperatures, and evolved products (CO, CO₂, H₂O, and total hydrocarbons) of thermally thick white pine (approximately 3.8 cm cubes) were measured under the nonflaming condition at thermal radiant fluxes of 2.5-6.9 W/cm squared in three different atmospheres of N₂, 10.5% O₂/89.5% N₂ and air. Results indicate that ambient oxygen significantly increases the gasification mass flux (for example, at 2.5 W/cm squared, the

mass flux in air increases about three times over the mass flux in nitrogen), sample temperatures (surface temperature in air increases as much as 200 deg. C over that in nitrogen), and char depth, and changes the evolved products distribution (carbon dioxide yields in air are about 6-8 times larger than that in nitrogen and CO yields in air are about twice as large as that in nitrogen). Therefore, extreme care is needed to apply results obtained in an inert atmosphere to cases, such as ignition, flame spread, and smoldering, in which a wood sample is exposed to oxygen containing atmospheres.

700,620
PB87-233706 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Fire Safety Technology Div.
Example Illustrating Slide Rule Estimates of Fire Growth.
Final rept.,
J. R. Lawson, and J. G. Quintiere. 1986, 9p
Pub. in Fire Technology 22, n1 p45-53 Feb 86.

Keywords: *Fire growth, Visibility, Smoke, Reprints, *Mass loss rate, *Heat release, *Radiant flux ventilation.

The exercise is designed to provide an example of the use of the predictive methods presented in the November 1985 issue of Fire Technology. It is intended as a hypothetical illustration and should not be construed as representative of the hazard associated with the particular items, materials and occupancy configuration selected. The first step in analyzing a fire scenario is to define the problem in terms of information required by the relevant predictive formula.

700,621
PB88-109889 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Fire Research.
Fire Research Publications, 1986.
N. H. Jason. Apr 87, 48p NBSIR-87/3555
See also report for 1985, PB86-203817.

Keywords: *Fires, *Bibliographies, Combustion, Smoke, Toxicity, Fire safety, Fire protection, Meetings, Soot, *Fire research.

'Fire Research Publications, 1986' is a supplement to previous editions; the last five editions are referenced below. Earlier edition information is available upon request: 1981 NBSIR 82-2499 PB82-220104; 1982 NBSIR 83-2706 PB83-238915; 1983 NBSIR 84-2871 PB84-217066; 1984 NBSIR 85-3153 PB85-208502; 1985 NBSIR 86-3372 PB86-208317. Only publications prepared by members of the Center for Fire Research (CFRO, by other National Bureau of Standards (NBS) personnel for CFR, or by external laboratories under contract or grant from the CFR are cited.

700,622
PB88-110044 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Fire Research.
Mixing in Variable Density, Isothermal Turbulent Flows and Implications for Chemically Reacting Turbulent Flows.
W. M. Pitts, and T. Kashiwagi. May 87, 74p NBSIR-87/3550
Sponsored by Air Force Office of Scientific Research,
Bolling AFB, DC.

Keywords: *Turbulent flow, *Flames, *Jet mixing flow, Reynolds number, Flow visualization, Velocity measurement, Chemical reactivity.

The goal of the research was to improve the fundamental understanding of chemically reacting turbulent flow. The approach which was taken was to investigate mixing in variable density flows in order to better understand the role of local density fluctuations (which result from chemical heat release) on the turbulent mixing behavior. The development of new experimental diagnostics having excellent spatial and temporal resolution is described. These techniques have been utilized to investigate a wide range of mixing properties in variable density flows.

700,623
PB88-110317 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Fire Research.

FIREDOC Users Manual,
N. H. Jason. Sep 87, 40p NBSIR-87/3562

Keywords: *Fires, *Research management, *Data bases, Manuals, FIREDOC, FRIS (Fire Research Information Services), Bibliographic data base, On line systems.

FIREDOC is the on-line bibliographic database which reflects the holdings (published reports, articles, books, and audiovisual items) of the Fire Research Information Services (FRIS), at the Center for Fire Research, National Bureau of Standards. This manual provides a step-by-step technique for entering and exiting the database via telecommunication lines, as well as a number of techniques for searching the database and processing the results of the searches.

700,624
PB88-111810 PC A07/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Users' Guide to FIRST (Fire Simulation Technique), a Comprehensive Single-Room Fire Model,
H. E. Mitler, and J. A. Rockett. Sep 87, 141p NBSIR-87/3595

Keywords: *Enclosures, *Fires, Computerized simulation, Mathematical models, Bench marks, User manuals (Computer programs), Computer programs, Compartment fire models.

The document is an instructional manual which will facilitate use of the computer program FIRST. (The name 'FIRST' is an acronym; it stands for FIRE Simulation Technique). This is a prototype of a 'benchmark' computer model of how a fire develops in a single compartment. Given a fire (or fires) ignited on one or more fuel sources, FIRST describes the principal phenomena which occur, such as the movement of gases in and out of the compartment, the growth of the fire(s), the development of a hot layer, etc. This guide is not meant to be documentation for the model, and so detailed descriptions of the physics or of the program structure have been kept to a minimum.

700,625
PB88-113709 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Some Performance Comparisons for a Fluid Dynamics Code,
D. W. Lozier, and R. G. Rehm. Sep 87, 20p NBSIR-87/3638

Keywords: *Computational fluid dynamics, *Fires, *Combustion, Data processing, Computer programs, Fortran, Minicomputers, *Supercomputers, Scientific data, Computer performance evaluation.

The 3D transient motion of a buoyancy-driven perfect gas in an enclosure is computed by a Fortran program (BF3D). A combustion model for eventual inclusion in the program is under development. BF3D changes slowly, has a long lifetime, and is run fairly infrequently. Typical runs have large storage and moderate CPU requirements. BF3D runs on large supercomputers but the newer mini-supercomputers appear to be suitable also and may be advantageous for ease of access and usage. Scientific workstations are convenient for development. Comparisons of BF3D on selected supercomputers, mini-supercomputers, scientific workstations and conventional mainframes are presented for the purpose of making partial benchmark data available to the computing public.

700,626
PB88-115761 PC A99/MF E04
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Compilation of Chemical Kinetic Data for Combustion Chemistry. Part 1. Non-Aromatic C, H, O, N, and S Containing Compounds (1971-1982),
F. Westley, J. T. Herron, and R. J. Cvetanovic. Aug 87, 685p NBS/NSRDS-73/1
Also available from Supt. of Docs. as SN003-003-02804-5. See also PB81-205429.

Keywords: *Combustion, *Reaction kinetics, Chemical reactions, Tables (Data), Oxidation, Decomposition, Arrhenius parameters.

Chemical kinetics data for reactions of importance in combustion chemistry are compiled. Experimental, theoretical, evaluated, or estimated rate constants are given for reactions of O, O₂, O₃, H, H₂, OH, HO₂,

H₂O, H₂O₂, N, N₂, N₃, NO, NO₂, NO₃, N₂O, N₂O₅, NH, NH₂, NH₃, NH=NH, NH₂=NH, NH₂=NH₂, HN₃, HNO, HONO, HONO₂, HO₂NO₂, NH₂O, NH₂O₂, S, S₂, SO, SO₂, SH, H₂S, and the aliphatic, alicyclic, and heterocyclic saturated and unsaturated C₁ to C₁₅ hydrocarbons, alcohols, aldehydes, ketones, thiols, ethers, peroxides, amines, amides, and their free radicals. The data were taken from the literature published between 1971 and 1982. Data previously issued in 1981 as NBSIR-81-2254, which covered the literature published from 1971 through 1977, are included. The data are reported as rate constants or in terms of the parameters A, n, and B of the extended Arrhenius expression $k = A(T/298)^n \exp(-B/T)$, where $B = E/R$. Data are given for 1931 reactions.

700,627
PB88-141254 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Fire Chemistry of Polymeric Materials.
Final rept.,
R. G. Gann. 1985, 7p
Pub. in Chemical and Physical Processes in Combustion 1985, pC.1-C.7.

Keywords: *Flammability, *Polymers, Fire tests, Combustion, Reprints.

Solid (polymeric) materials are the fuels for nearly all fires. The paper reviews the elements of fire science pertinent to polymer combustion, their generic degradation mechanisms, and the activity of fire retardant additives.

700,628
PB88-141262 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Effects of Exposure to Single or Multiple Combinations of the Predominant Toxic Gases and Low Oxygen Atmospheres Produced in Fires.
Final rept.,
B. C. Levin, M. Paabo, J. L. Gurman, and S. E. Harris. 1987, 15p
Pub. in Fundamental and Applied Toxicology 9, p236-250 1987.

Keywords: *Exposure, *Fires, *Combustion products, Carbon monoxide, Hydrogen cyanide, Gases, Toxicity, Hypoxia, Carbon dioxide, Reprints.

The toxicity of single and multiple fire gases is studied to determine whether the toxic effects of the combustion products from materials can be explained by the toxicological interactions (as indicated by lethality) of the primary fire gases or if minor, more obscure gases need to be considered. LC50 values for Fischer-344 rats have been calculated for the individual gases, carbon monoxide (CO), hydrogen cyanide (HCN), or decreased oxygen (O₂), for 30-min exposures plus relevant postexposure periods using the NBS Toxicity Test Method.

700,629
PB88-147772 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Smoke Measurements on Upholstered Furniture Using the Cone Calorimeter.
Final rept.,
V. Babrauskas. 1985, 5p
Pub. in Proceedings of International Conference on Fire Safety 10, p39-43 1985.

Keywords: *Smoke, *Upholstery, Furniture, Smoke measurement, Calorimeters, Reprints.

No abstract available.

700,630
PB88-155833 PC A03/MF A01
Maryland Univ., College Park. Dept. of Mechanical Engineering.
Measurement of Velocity and Temperature Profiles in Low-Speed, Turbulent Non-Isothermal Flows,
V. Motevali, C. H. Marks, and B. J. McCaffrey. Nov 87, 27p NBS/GCR-87/535
Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville. Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Fire tests, *Turbulent flow, *Thermocouple pyrometers, Velocity measurement, Temperature

measurement, Ceilings (Architecture), Plumes, Room fires.

A probe has been developed utilizing thermocouples as the sensors which, together with associated data-reduction and processing equipment, makes it possible to measure velocity and temperature profiles in low-speed, turbulent, non-isothermal flows. The technique presented here might be well suited for transient processes where simultaneous measurements are required in multiple locations. This probe was devised in order to measure the velocity and temperature profiles in the jet formed under a ceiling when a buoyant plume from a fire impinges on the ceiling.

700,631
PB88-156690 PC A07/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Compilation of Chemical Kinetic Data for Combustion Chemistry. Part 2. Non-Aromatic C, H, O, N, and S Containing Compounds (1983),
F. Westley, J. T. Herron, and R. J. Cvetanovic. Dec 87, 143p NBS/NSRDS-73/2
Also available from Supt. of Docs. as SN003-003-02830-4. See also PB88-115761. Library of Congress catalog card no. 87-20244.

Keywords: *Combustion, *Fossil fuels, Hydrocarbons, Reaction kinetics, Carbon, Nitrogen, Chemical reactions, Sulfur, Oxidation, Hydrogen, Fossil fuels, Arrhenius parameters.

Chemical kinetic data for reactions of importance in combustion chemistry are compiled. Experimental, theoretical, evaluated, or estimated rate constants are given for reactions of O, O₃, H, H₂, OH, HO₂, H₂O, N, N₃, NO, NO₂, N₂O, NH, NH₂, SH, H₂S, SO, SO₂, and the aliphatic, alicyclic, and heterocyclic saturated and unsaturated C₁ to C₁₅ hydrocarbons, alcohols, aldehydes, ketones, thiols, ethers, peroxides, amines, amides, and their free radicals. The data were taken from the literature published in 1983. Data omitted from Part 1 of the series, covering the period 1971 to 1982, are also included.

Rocket Propellants

700,632
AD-A183 010/8 PC A04/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
High Temperature Chemistry of Stored Chemical Energy Reactions for Propulsion.
Annual rept. 25 May 85-31 Dec 86,
L. P. Cook, E. R. Plante, D. W. Bonnell, and J. W. Hastie. Jul 87, 57p NBSIR-87-3601
Contract N00014-85-F-0144

Keywords: *Liquid propellants, *Liquid metals, *Reaction kinetics, Energy storage, Aluminum oxides, Coalescence, Islands, Kinetics, High temperature, Magnesium oxides, Edges, Growth (General), Fuels, Lithium fluorides, Aluminum, Drops, Melts, Lithium compounds, Oxides, Phase studies, Equilibrium (General), Thermochemistry, Perchloryl compounds, Fluorides, Ceramic materials, Containment (General), Oxidation, Thermogravimetric analysis, Transport, Vapor phases, Nucleation, Thermodynamics.

This report summarizes the results of a continuing study of the high temperature chemistry of stored chemical energy reaction systems. Thermogravimetric studies have been completed on the behavior of Aluminum oxide and Magnesium oxide in the presence of ClO₃F. Based on these data a new ceramic containment system comprised of alumina and magnesia parts has allowed extension of kinetic experiments from the 650 C limit previously encountered to a temperature in excess of 800 C. Using the new apparatus, we have observed the relative inertness of the Al component of the fuel to oxidation by ClO₃F even at 800 C. We have also noted the extensive vapor phase transport of Lithium fluoride and Magnesium fluoride not expected on the basis of known thermodynamic data. Thermogravimetric experiments have been completed on the oxidation of molten aluminum droplets by ClO₃F. Rate data for this reaction indicate multiple mechanisms, possibly including the following steps: (1) nucleation and growth of AlF₃ precipitation sites; (2) edge growth of AlF₃ islands followed by coalescence

COMBUSTION, ENGINES, & PROPELLANTS

Rocket Propellants

of islands; (3) diffusion limited thickening of the AlF₃ layer. Observations on the early stages of the Al/CuO₃F reaction have also been made using high pressure sampling transpiration mass spectrometry.

700,633

PC A03/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

In situ Fluorescence Monitoring of the Viscosities of Particle-Filled Polymers in Flow.

Annual rept. 1 Oct 86-30 Sep 87,

A. J. Bur, F. W. Wang, and R. E. Dehl. Jan 88, 30p

NBSIR-88/3694

Sponsored by Office of Naval Research, Arlington, VA.

Keywords: *Propellants, *Binders, *Polymers, *Fluorimeters, *Fluorescence, Spectroscopy, Mixing, Rheology, Viscosity, Polybutadiene, Aluminum oxide, Measuring instruments.

During FY87, the authors activity has focused on the development of measurement equipment, laboratory experiments using fluorescence monitoring, and the synthesis of a polymeric fluorescent chromophore. Laboratory equipment development has consisted of the design and construction of a capillary flow apparatus and a laboratory mixer. The capillary apparatus has been incorporated into a commercial fluorometer and is being used for the simultaneous measurement of fluorescence anisotropy and rheological parameters of concentrated polymer solutions and low molecular weight polymers. The authors have demonstrated the feasibility of the capillary measurement system by observing the anisotropy of a toluene solution of a polymer binder as a function of capillary head pressure from 0 to 40 psi. A mixer, which incorporates co-rotating and counter-rotating shearing elements and glass walls for viewing fluorescence, has been constructed and used to monitor the mixing of a low molecular weight polybutadiene based polymer and aluminum oxide.

General

700,634

PC B88-110671

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Zone Modeling of Forced Ventilation Fires.

Final rept.,

H. E. Mittler. 1984, 24p

Pub. in Combustion Science and Technology 39, p83-106 1984.

Keywords: *Fire safety, Algorithms, Ventilation, Computerized simulation, Layers, Zones, Carbon dioxide, Oxygen, Reprints, *Foreign technology, *Fire scale models.

In 1982, the Nuclear Regulatory Commission posed a forced-ventilation problem which is described. The algorithm developed for its solution is discussed. This was embedded in the Harvard Mark 5.3 computer code, and predictions then made for the outcome of a series of experiments carried out at Lawrence Livermore Laboratory (see previous paper). Comparisons are made between the predicted and the actual results. Predictions are generally in good agreement with experiment, especially for the volumetric input rate and the CO₂ and oxygen concentrations. One inadequate feature, however, is the model's consistent underprediction of the peak temperatures reached in the upper layer.

Pressure and Temperature Insensitive Glass and Optical Coatings and Fibers Therefrom.

Patent,

D. Blackburn, A. Feldman, and N. Lagakos. Filed 10 Dec 85, patented 1 Dec 87, 9p PB88-147939, PAT-APPL-6-807 150

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Optical coatings, *Fiber optics, *Patents, Tantalum oxides, Glass fibers, Heat resistant coatings, PAT-CL-350-96.34.

Pressure and temperature insensitive optical fibers are produced using a Ta₂O₅ based glass composition which has a high bulk modulus and a low thermal expansion coefficient. The glass composition can function as the cladding in the optical fiber or as a protective coating which surrounds the cladding thereby protecting the fiber from fluctuations in temperature and pressure.

700,636

PC A05/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Parametric Cost-Revenue Model ('PAREC') for Electronic Message Service Systems,

Technical note,

C. Witzgall, P. B. Saunders, and R. E. Schofer. Nov 86, 93p NBS/TN-1225

Also available from Supt. of Docs as SN003-003-02785-5.

Keywords: *Cost engineering, *Cost benefit analysis, Mail, Mathematical models, Profits, Optimization, Return on investment, Network flows, Systems engineering, Investments, Services, Methodology, Combinatorial analysis, *Electronic message systems, *PAREC model, Costs, Revenue.

The report describes a methodology for analyzing costs and benefits of a national electronic message service system and of similar systems involving alternative configurations of unspecified size. At the core of this methodology is a mathematical model, called PAREC, which provides information on sizes and configurations which optimize profit or return on investment. It is based on a technique for optimal selection of subconfigurations due to J.M.W. Rhys. A parametric minimum cost network flow algorithm was developed for the purpose of solving the resulting optimization problems.

700,637

PC A06/MF A01

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Assessment of Error Bounds for Some Typical MIL-STD-461/462 Types of Measurements.

Technical note,

J. E. Cruz, and E. B. Larsen. Oct 86, 111p NBS/TN-1300

Also available from Supt. of Docs as SN003-003-02782-1. Sponsored by Army Aviation Systems Command, St. Louis, MO.

Keywords: *Electromagnetic compatibility, *Standards, Field strength, Military communication, Calibrating, Transmission lines, Electromagnetic fields, Error analysis, Measurement, Antenna factors, Test methods.

The report deals with the instrumentation and equations for several systems used by the U.S. Army for electromagnetic compatibility (EMC) testing and calibrations. Most testing for MIL-STD-461/462 is performed in a shielded enclosure (screenroom) rather than at an open field site, which leads to uncertainty in the measurement of emissions from electronic equipment, or the susceptibility of equipment to radiation. Assessment of error bounds by the National Bureau of Standards (NBS) is covered in the report, and suggestions are given for improving the measurements. Four areas of concern were studied as follows: (a) electromagnetic (EM) fields generated in a parallel-plate transmission line (stripline), (b) EM fields beneath a single-wire transmission line in a screenroom (long-wire line), (c) determination of antenna factors for electromagnetic interference (EMI) antennas located in a screenroom, and (d) calibration of EMI receivers to measure broadband impulsive signals.

National Bureau of Standards, Boulder, CO.

Achievement in Radio: Seventy Years of Radio Science, Technology, Standards, and Measurement at the National Bureau of Standards,

W. F. Snyder, and C. L. Bragaw. Oct 86, 887p NBS/SP-555

Also available from Supt. of Docs as SN003-003-02762-6. Library of Congress catalog card no. 85-600619.

Keywords: *Radio communication, *Telecommunication, Radio equipment, Frequency standards, Time standards, Ionospheric propagation, Radio waves, Electrical measurement, Antennas, Standards, History, Reviews, *National Bureau of Standards, *US NBS.

Topics discussed include the following (partial listing): The early years of radio at NBS; Fighting a war with Hertzian waves; Radio standards and measurements; Antennas, instruments, and systems in development; Probing the ionosphere; Time and frequency standards; Radio waves in the lower atmosphere; Engineering for radio propagation; Beyond the ionosphere; Quantum and plasma physics; On the international scene; The precursor roles.

700,639

CP T03

National Bureau of Standards, Gaithersburg, MD.

Transport Class 4 and Internet Protocol.

Software,

J. Mulvenna. 2 Apr 87, mag tape NBS/SW/MT-87/007

See also PB86-146537.

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.

Keywords: *Software, *Telecommunication, *Data transmission, Operating systems(Computers), Standards, Magnetic tapes, *Transport class 4, C programming language, DEC VAX 11-780 computers.

The tape contains the NBS implementation of the Operating Systems Interconnections (OSI) Transport Class 4 and Internet Protocol. The protocols operate in the user space of Berkeley UNIX 4.3. The Internet Protocol is capable of accessing IEEE 802.3, IEEE 802.4 and X.25 subnetworks. The transport protocol is automatically derived in part from a formal description based on an extended finite state automata model. The formal specifications and the finite state automata tools are included on the tape. Also included is a sample protocol user...Software Description: The program is written in the C programming language for implementation on a DEC VAX 11/780 computer using the UNIX operating system.

700,640

PC B87-202941

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

Calibration of Optical Fiber Power Meters: The Effect of Connectors.

Final rept.,

R. L. Gallawa, and X. Li. 1987, 5p

Pub. in Applied Optics 26, n7 p1170-1174, 1 Apr 87.

Keywords: *Optical communication, *Power meters, *Calibrating, Fiber optics, Optical measurement, Reprints, *Optical connectors, *Optical fibers.

The paper addresses the question of accurate measurement of optical power at the wavelengths and power levels of interest to the telecommunication community. In particular, the authors examine the calibration of power meters that are destined for use in a field environment. Connectors and adapters are shown to skew the measurements, leading to errors attributable to reflections from the connector or to angular dependence of detector response. Calibration data are taken using two popular connector types: a biconic and an SMA type. The data are sufficient to illustrate the problem but definitive conclusions cannot be drawn regarding variability of performance with connector or connector type, because of the limited data.

700,641

PC B87-223756

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

COMMUNICATION

Common Carrier & Satellite

700,635

PATENT-4 709 987

Not available NTIS

Department of Commerce, Washington, DC.

700,638

PC B87-172045

PC A99/MF E04

Use of Power Transfer Matrices in Predicting System Loss: Theory and Experiment.

Final rept.,

J. M. Maisonneuve, and R. L. Gallawa. 1985, 16p
See also PB85-197770. Sponsored by Direction des Recherches, Etudes et Techniques, Paris (France).
Pub. in Fiber and Integrated Optics 6, n1 p11-26 1985.

Keywords: Attenuation, Reprints, *Local area networks, *Fiber optics transmission lines, Ray theory, Multimode, Matrices.

The phase space diagram for parabolic and step index fibers leads to a graphic representation of the bound, leaky, and refracted rays of ray theory. This concept is used to predict the attenuation of typical components of local area networks. The technique uses power transfer matrices to track the evolution of power distribution in ray packets. In particular, the authors predict and then measure the power transfer of two ray packets for a step index fiber. The comparison is encouraging.

700,642

PB88-153994

Not available NTIS

National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Network Architecture Div.

Performance Improvements for ISO Transport.

Final rept.,

R. Colella, R. Aronoff, and K. Mills. 1985, 8p
See also PB88-154000. Sponsored by Institute of Electrical and Electronics Engineers, Inc., New York, and Association of Computing Machinery, New York.
Pub. in Proceedings of the Data Communications Symposium (9th), Whistler Mountain, British Columbia, Canada, September 10-13, 1985, p9-16.

Keywords: *Computer networks, *Data transmission, Protocols, Standards, Efficiency, Performance, *Channels(Data transmission), *Open systems interconnections, *Transport protocol, *Throughput, ISO, Computer performance evaluation.

The NBS Protocol Performance Laboratory is developing enhanced protocol mechanisms for OSI class 4 transport that will improve the throughput efficiency achieved on a satellite channel. A selective acknowledgement mechanism has been shown to improve throughput efficiency by as much as 34%. Several alternative expedited data mechanisms have demonstrated throughput efficiency improvements as great as 38%. Most of the protocol mechanism enhancements considered require only minor changes to the international standard OSI transport protocol.

700,643

PB88-154000

Not available NTIS

National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Network Architecture Div.

Performance Improvements for ISO Transport.

Final rept.,

R. Colella, R. Aronoff, and K. Mills. 1985, 7p
Sponsored by Institute of Electrical and Electronics Engineers, Inc., New York, and Association of Computing Machinery, New York.
Pub. in Proceedings of the International Conference on the Management and Performance Evaluation of Computer Systems (CMG '85), Dallas, TX., December 9-13, 1985, p379-385.

Keywords: *Computer networks, *Data transmission, Protocols, Standards, Efficiency, Performance, *Channels(Data transmission), *Open systems interconnections, *Transport protocol, *Throughput, ISO, Computer performance evaluation.

The NBS Protocol Performance Laboratory is developing enhanced protocol mechanisms for OSI class 4 transport that will improve the throughput efficiency achieved on a satellite channel. A selective acknowledgement mechanism has been shown to improve throughput efficiency by as much as 34%. Several alternative expedited data mechanisms have demonstrated throughput efficiency improvements as great as 38%. Most of the protocol mechanism enhancements considered require only minor changes to the international standard OSI transport protocol.

Policies, Regulations, & Studies

700,644

PB87-173720

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering. **NBS-Industry (National Bureau of Standards-Industry) Cooperation to Advance Microwave Standards.**

Final rept.,

B. C. Belanger. 1987, 12p
Pub. in Proceedings of 1987 Measurement Science Conference, Irvine, CA., January 29-30, 1987, p1-12.

Keywords: *Millimeter waves, *Microwaves, Standards, US NBS.

A comprehensive status report on NBS' microwave measurement services was presented at the last Measurement Science Conference. The paper provides an update on developments over the past year. The most significant advance is a recent decision by the MILSTAR Program to support NBS to develop national measurement standards for the frequencies and measurements of interest to the MILSTAR contractors. In the present climate of concern over budget deficits, it is very unlikely that major new programs can be initiated to expand NBS' level of effort on microwave measurements through direct Congressional appropriations to NBS. Accordingly, the paper explores possible ways that NBS and industry can work together to ensure that critical microwave standards needs are met, in particular, those identified by the IEEE Committee to Promote National Microwave Standards and the NCSL National Measurement Requirements Committee.

700,645

PB88-109186

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Millimeter-Wave Standards: An Emerging Need.

Final rept.,

R. T. Adair, G. R. Reeve, and L. E. Gatterer. 1986, 7p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-35, n4 p376-382 Dec 86.

Keywords: *Millimeter waves, *Standards, Surveys, Reprints, Calibration, US NBS.

Several technology surveys concerning millimeter-wave (MMW) measurement needs and capabilities have been conducted by the National Bureau of Standards (NBS), Boulder Laboratories, and others. The results of some of these studies are summarized. Current MMW standards and calibration capabilities at NBS are reviewed. The lack of national standards in certain frequency bands may lead to problems with the specification, acceptance testing, and calibration of some components and systems.

700,646

PB88-134606

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Relaxation of an Unattached Chain in a Cross-Linked Network: A Span Analysis of Reptation.

Final rept.,

R. Gaylord, E. DiMarzio, A. Lee, and G. H. Weiss. Nov 85, 2p
Pub. in Polymer Communications 26, n11 p337-338 Nov 85.

Keywords: Reprints, *Reptation, *Span, *Random walk, Viscoelasticity, Tube model.

The reptation model is analyzed in terms of the properties of the span of an ordinary random walk. Expressions are obtained for the fraction of occupied tube, the tube escape time and the complex dynamic viscosity. The continuous-time random walk modification of the reptational model is also discussed.

700,647

PB88-138813

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Stability Measurements of Ku-Band Spread Spectrum Equipment Used for Two-Way Time Transfer.

Final rept.,

D. A. Howe. 1987, 15p
Contract F30602-85-0055
Sponsored by Rome Air Development Center, Griffiss AFB, NY.

Pub. in Proceedings of Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting (18th), Washington, DC., December 2-4, 1986, p437-451.

Keywords: Frequency stability, Synchronous satellites, *Time transfer, Ku band, Spread spectrum transmission.

The NBS Boulder Laboratory is in the process of assembling a very high accuracy time transfer system. The system includes a 6.1 meter Ku-band satellite earth station, two transportable earth stations each with a 1.8 meter dish, and commercial modems designed for two-way timing. Elements of the facilities are described in the paper. High-accuracy timing with this equipment using the two-way time transfer technique via a geostationary satellite is discussed. Phase stability measurements of ground facilities in various loop-around schemes using a satellite simulator have been performed in order to determine ultimate stability limits. Allan-variance stability plots are generated for sample times of 1 s to several days at various carrier-to-noise density (C/N₀) ratios. These plots are compared to theoretical limits obtained from the model of phase jitter given for the spread spectrum modem.

700,648

PB88-147384

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

NBS (National Bureau of Standards) Calibration Procedure for Providing Time and Frequency at a Remote Site by Weighting and Smoothing of GPS (Global Positioning System) Common View Data.

Final rept.,

M. A. Weiss, and D. W. Allan. 1987, 7p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p572-578 Jun 87.

Keywords: *Frequency stability, Frequency standards, Data smoothing, Reprints, Time transfer, Global positioning system, Calibration.

The National Bureau of Standards (NBS) Time and Frequency Division now performs precision time and frequency transfer using common view measurements of Global Positioning System (GPS) satellites as a calibration service. Using the service, the authors have been able to transfer time with time stabilities of a few nanoseconds, time accuracies of the order of 10 ns, and frequency stabilities of one part in 10 to the 14th power, or better, for measurement times of about four days and longer. The full accuracy of the NBS primary frequency standard is now available at a remote site. The paper describes the technique used for weighting and smoothing the data to produce these levels of stability and accuracy. All of the primary frequency standards used in the generation of International Atomic Time (TAI) now use the technique.

700,649

PB88-152756

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

GPS (Global Positioning System) Time Steering.

Final rept.,

W. J. Klepczynski, H. F. Fliegel, and D. W. Allen. 1986, 13p

Pub. in Proceedings of Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting (18th), Washington, DC., December 2-4, 1986, p237-249.

Keywords: *Time transfer, Global positioning system.

The importance of the Global Positioning System (GPS) for global time transfer makes it desirable to steer GPS time as closely as possible to the UTC rate. Currently, GPS time is maintained to satisfy two system requirements. First, GPS time is steered to within one microsecond of UTC(USNO) when the leap seconds imposed on UTC since 1980 have been removed. Second, the GPS Navigation Message gives the offset UTC(USNO) - GPS time to users with an error not to exceed 100 nanoseconds. User performance would be improved, however, if changes in the GPS time rate were smaller and more gradually imposed than at present. Three current developments are expected to improve GPS time steering performance: the installation of a stable clock ensemble at the GPS Master Control Station; improvement of supporting hardware; and application of control theory to steering procedures.

COMPUTERS, CONTROL & INFORMATION THEORY

Radio & Television Equipment

Radio & Television Equipment

700,650

PB87-197786 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Personal/Mobile FM (Frequency-Modulated) Transceivers.
Final rept.,
R. L. Jesch, and M. J. Treado. 1986, 17p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in NIJ (National Institute of Justice) Standard-0224.00, p1-17 May 86.

Keywords: *Transmitter receivers, Law enforcement, Frequency modulation, Mobile equipment, Performance standards, Reprints.

The document establishes minimum performance requirements and methods of test for frequency-modulated personal/mobile transceivers. It is intended for use by law enforcement agencies and other interested parties in the selection and procurement of mobile transceivers. The standard covers mobile equipment operating in the 150-174 MHz and 400-512 MHz frequency bands, and addresses performance characteristics such as receiver sensitivity, audio power, distortion and response, carrier power, insertion loss, and electromagnetic compatibility. Tests are conducted both at ambient conditions and at environmental extremes. The document includes the principal terms and definitions required to use the standard and lists the primary items of test equipment needed to make the measurements. References and a bibliography are included.

700,651

PB87-233888 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Mobile FM Transceivers.
Final rept.,
W. D. Bensema, and M. J. Treado. May 86, 32p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in National Institute of Justice Standard-0210.00, 32p May 86.

Keywords: *Transmitter-receivers, *Law enforcement, Mobile equipment, Frequency modulation, Very high frequencies, Ultrahigh frequencies, High frequencies.

The document establishes minimum performance requirements and methods of test for frequency-modulated mobile transceivers. It is intended for use by law enforcement agencies and other interested parties in the selection and procurement of mobile transceivers. The standard covers mobile equipment operating in the 25-50 MHz, 150-174 MHz, 400-512 MHz and 806-866 MHz frequency bands, and addresses performance characteristics such as receiver sensitivity and selectivity, audio distortion and response, carrier power, frequency stability, and electromagnetic compatibility. Tests are conducted both at ambient conditions and at environmental extremes. The document includes the principal terms and definitions required to use the standard and lists the primary items of test equipment needed to make the measurements. References and a bibliography are included.

Hybrid Computer-Optical Processing with Inexpensive Liquid Crystal Television.

Final rept.,
M. Young, and M. Weppner. 1986, 8p
Pub. in the Proceedings of the International Optical Computing Conference, Jerusalem, Israel, July 6-11, 1986, p146-153.

Keywords: *Pattern recognition, Holography, Fourier transformation, Real time operations, Matched filters, Television equipment, *Optical processing, Liquid crystal display systems, Image processing.

A computer-optical processing system is described that uses an inexpensive liquid crystal (LCD) television monitor and a selective holographic filter for coherent pattern recognition. A digital computer is used to generate an edge enhanced image of an object, to expose a Fourier transform hologram of the image, and to use the hologram as a sort of matched filter for recognizing the original object in real time.

700,653

PB87-180857 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems Components Div.
Programming the Parallel Processor.
Final rept.,
G. Lyon. 1987, 13p
Pub. in The Role of Language in Problem Solving 2, p321-333 1987.

Keywords: *Parallel processors, *Serial processors, Computer programming, Reprints, *Parallel programming.

Language pragmatics for efficient parallel programming encompass many things, of which some are familiar from serial machines and others are not. Proceeding discursively, numerous examples illustrate language-level facets selected from parallel performance areas of load balance, granularity, and memory domains. A concluding sketch of a construct for 'self-service' shows how an understanding of execution implications might eventually yield a portable language construct.

700,654

PB87-195327 PC A03/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.
Methodology for Broadband Token Passing Bus Interoperability Testing.
R. Rosenthal, and D. P. Stokesberry. Apr 87, 48p
NBSIR-87/3536

Keywords: *Data transmission, *Modems, Broadband, Protocols, Tests, *Byte functional modules, *Token bus networks, *Modules(Electronics), *Local area networks.

A method for testing broadband token passing bus interoperability is described. The method was tested in a controlled laboratory environment at the National Bureau of Standards with four modern manufacturers' and three headend remodulator manufacturers' equipment. The tested equipment implemented specific token passing bus options found in commercially available products. The methodology specifies seven environmental and electrical parameters; for the first set of tests, nominal parameter settings were selected. The methodology uses specific test frames developed for their unique bit patterns. These frames were transmitted, received, and counted to exercise the broadband modems and headend remodulators. The methodology organizes the frame transmissions into five test definitions. Each test definition is repeated for each headend remodulator.

700,655

PB87-208328 PC A03/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.
Measurement of Fault-Tolerant Parallel Processors.
J. W. Roberts, A. Mink, and R. J. Carpenter. May 87, 50p
NBSIR-87/3568
Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.

Keywords: *Computer systems hardware, Performance, Control equipment, Reliability, Measurement, *Fault detection, *Parallel processors.

Computer systems that continue to operate correctly in the presence of faults are vital for many important

applications. A number of measurement techniques can be used to determine how well computers detect and recover from faults. Both time to recover and degree of recovery can be measured.

700,656

PB87-225363 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems Components Div.
Fast, Message-Based Tagless Marking.
Final rept.,
G. Lyon. 1987, 5p
Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in Proceedings of Conference on Hypercube Multiprocessors (1987), Knoxville, TN., September 29-October 1, 1986, p78-82 1987.

Keywords: Addressing, Algorithms, *Memory devices, *Marking, *Parallel processing, Domains.

The parallel implementation of a marking algorithm provides an object lesson on the importance of memory domains for some classes of parallel application, especially searchings. A new tagless marking algorithm for list-structures has an underlying linear mode that initiates an independent O(n) cycle test (and sometimes, cycle cut) only when a reentrancy arises. The maximum cost of cycle testing is established by the size of the address space. The method is ideal for parallel implementation across private memory domains linked via message-passing, since segmenting the address space abbreviates cycle tests. In particular, while both domains and processors equally shorten worst case execution times, the disposition of domains is a static determination independent of dependencies within a list-structure. Domain balance is thus easier to satisfy than processor load balance.

700,657

PB87-226908 PC A02/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD. Advanced Systems Div.
Hardware-Assisted Multiprocessor Performance Measurements.
J. W. Roberts, A. Mink, J. M. Draper, and R. J. Carpenter. Jun 87, 16p
NBSIR-87/3585
Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.

Keywords: Computer systems hardware, Performance, Measurement, Tests, *Multiprocessors, *Parallel processors, Computer performance evaluation, Events.

The report describes the implementation and use of a hardware-assisted trace measurement system (TRAMS) used to obtain performance measurements of parallel cooperating processes executing on a multiprocessor computer. The benefit of TRAMS is that the overhead required to obtain timing information is approximately two orders of magnitude better than the standard system call, thus providing more accurate results with minimum perturbation to the measured processes. The level of accuracy allows measurement of fine-grain portions of these parallel processes which cannot be reasonably measured using standard techniques, and are therefore usually presented as negligible. Some measurements that have been obtained using TRAMS on a tightly-coupled, shared-memory parallel processor are reported here and include basic programming constructs, process creation, process synchronization, and shared memory allocation.

700,658

PB88-100714 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
On-Chip Propagation Delay Measurement.
Final rept.,
D. J. Radack, and L. W. Linholm. 1987, 3p
Pub. in Proceedings of Institute of Electrical and Electronics Engineers Custom Integrated Circuits Conference (1987), Portland, OR., May 4-7, 1987, p579-581.

Keywords: *Integrated circuits, *Delayed Johnson counter, *Inverter chain, Propagation delay, Ring oscillator, Test pattern, Test structure.

The accurate measurement of gate propagation delay is needed for increasing the accuracy of simulators and for comparing device designs and evaluating fabrication technologies. A digital circuit is presented which can be used to determine propagation delay of any unclocked circuit elements. The circuit contains on-chip

COMPUTERS, CONTROL & INFORMATION THEORY

Computer Hardware

700,652

PB87-180832 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

logic which allows propagation delay measurement using a low-frequency parametric test system.

700,659
PB88-112313 PC A03/MF A01
 National Bureau of Standards (ICST), Gaithersburg, MD. Advanced Systems Div.
Performance Measurement Instrumentation for Multiprocessor Computers.
 R. J. Carpenter. Aug 87, 32p NBSIR-87/3627
 ARPA Order-5520
 Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.

Keywords: *Computer systems hardware, *Performance tests, Measurement, Instruments, *Parallel computers, *Multiprocessors, Computer performance evaluation.

The complexity of achieving near-optimum performance from multiprocessor parallel computers demonstrates a need for performance measurement. However, when multiple processors are acting in concert on a single problem, perturbations caused by measurement can be unacceptable. Additional hardware can reduce the perturbation caused by measurement, and can be offered in several stages of refinement and cost. The hardware can often be offered as an option; it is necessary to provide access to the required signals in the system's original design.

Computer Software

700,660
PB87-150595 Not available NTIS
 National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.
Framework for Improving Software Maintenance Throughout the Software Life Cycle.
 Final rept.,
 W. M. Osborne. 1984, 2p
 Pub. in Proceedings of Software Engineering Standards Application Workshop (3rd), San Francisco, California, October 2-4, 1984, p137-138.

Keywords: Quality assurance, Maintenance, *Computer software maintenance, *Computer software, *Life cycle costs, *Software tools, Computer software management, Software engineering.

The paper discusses the need to adopt a software maintenance framework which addresses each phase of the software life cycle and influences the decisions made during that phase. The framework should identify software maintenance policies, procedures, and activities. When developing a software maintenance framework, consideration should be given to such life-cycle requirements: the ease of understanding and using the software; the ease of making and controlling changes; the adoption and use of improved techniques and tools and a quality assurance plan.

700,661
PB87-152005 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.
Why Can't We Access More Numeric Data Via Computers.
 Final rept.,
 J. R. Rumble. 1984, 6p
 Pub. in Proceedings of National Online Meeting, New York, NY., April 10-12, 1984, p325-330.

Keywords: *Data processing, Materials, Telecommunication, Handbooks, Economic factors, *Access methods, *Data bases, *Scientific data, *Technical data, *Data compilation, On line systems, Costs, Benefits.

It appears obvious that at some future time, say 25 to 50 years from now, scientists and engineers will be able to access by computer any numeric data they need. Even now, the computer and communications technology to provide this access is available and has been implemented in several small systems. If, however, one compares the number of individual machine-readable databases available (less than 150) to the large number of printed handbooks and data compilations (over 2500 in the NSRDS collection alone), it is evident that only a minute fraction of the everyday working data can in fact be reached by computer today. Why is this so. In the paper, several reasons will

be identified and discussed. These include the high cost of data entry, the difficulty of database building, the lack of obvious economic benefits, the small number of well-articulated demands, and the lack of encouragement from major on-line vendors. In addition, some recent attempts to make engineering properties of materials available by computer will be presented.

700,662
PB87-153052 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Forth Profile Management System.

Final rept.,
 J. L. Michaloski. 1984, 1p
 Sponsored by Journal of Forth Application and Research, Rochester, NY.
 Pub. in Proceedings of Rochester Forth Conference on Real Time Systems, Rochester, NY., June 6-9, 1984, p193.

Keywords: *Loader routines, *Source programs, Program management, *Computer files, *File management systems, Off line systems, On line systems, Computer codes, FORTH programming language.

A new approach to program management is presented called Profile Management (PM). Differing from conventional file systems, PM not only handles those problems of offline source code management, but extends this concept to deal with the on-line status of the machine. The basis of this new approach is the 'profile', i.e. a partition of source code on the disk. Each profile names a section of code that can be used throughout the loading process, plus allowing various forms of status information to be accessed via commands within the Profile Management system. Further, each profile can be subdivided into smaller partitions that themselves act as an individual profile or as a part of the parent profile. These subdivisions offer a flexible mechanism for loading entire programs or just individual components.

700,663
PB87-157137 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
K* (Kay-Star): A FORTRAN-Based Code for Programming and Evaluating Interactive Software.
 Final rept.,
 D. F. Redmiles. 1984, 9p
 Pub. in Proceedings of Conference on Engineering Databases: Software for On-Line Applications, San Antonio, TX., June 17-21, 1984, p61-69.

Keywords: *Software engineering, *Data structure, Computer programs, Evaluation, Interfaces, Programmers, *Computer codes, *Fortran-based codes, Interactive systems, Fortran 77 subroutines, Command languages, Operating systems(Computers).

K* (read kay-star) is an experimental library of FORTRAN 77 subroutines that simplifies the design and implementation of command-driven interactive programs. K* gives program designers a way to evaluate and modify easily the user interface. Also, it relieves programmers of coding many tasks associated with user interaction. The K* library and the programming methodology it uses are designed with 'mid' to 'large' sized applications in mind. The paper first describes K* and under which circumstances K* is most useful; second, it presents an example implementation of an interactive program.

700,664
PB87-157228 PC A05/MF A01
 National Bureau of Standards, Gaithersburg, MD. Center for Programming Science and Technology.
Programming Languages for Knowledge-Based Systems.
 Special pub.,
 J. V. Cugini. Feb 87, 82p NBS/SP-500/145
 Also available from Supt. of Docs as SN003-003-02783-9. Library of Congress catalog card no. 86-600602.

Keywords: *Programming languages, *Symbolic programming, Procedure oriented languages, Terminology, Evaluation, *Knowledge based systems, *Expert systems, *LISP programming language, Prolog programming language, OPS 5 programming language, Computer software.

Knowledge-Based Systems (KBS) represent a new software methodology which can broaden the scope

of computer applications. When developing such software at the programming level, symbolic languages offer features to the programmer not provided by traditional procedural languages. The three most widespread symbolic languages are Lisp, Prolog, and OPS5. An abstract model for a basic KBS and associated terminology is described. This provides a framework for evaluation of the languages. There are several criteria by which one may assess the relative merits of these languages for a given knowledge-based application. Some are related to the languages' expressiveness for typical KBS techniques, others to the user's requirements. An extensive set of these criteria is discussed, and the languages are evaluated in light of them.

700,665
PB87-160990 CP T19
 National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
DATAPLOT: An Interactive High-Level Language for Graphics, Non-Linear Fitting, Data Analysis, and Mathematics. Version 87.1.
 Software,
 J. J. Filliben. Jan 87, mag tape NBS/SW/MT-87/005
 Supersedes PB82-181454, PB83-215574, and PB84-211796.

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, PB87-161006, PB87-161014, PB82-181462, PB82-181470, PB82-181488, PB82-181496, and PB82-181504.

Keywords: *Software, *Computer graphics, *Plotting, Programming languages, Mathematics, *DATAPLOT programming language, *High level languages, *Interactive graphics, Menus, Computer program portability, Data analysis, H=Univac; IBM; Cyber; DEC VAX, L=Fortran.

DATAPLOT is a portable, high-level interactive language/system for graphics, fitting, data analysis, and mathematics. It has wide applicability--especially in a research/scientific/engineering environment. Recent enhancements allow DATAPLOT to be run as a menu system. Such menus are completely user-definable thereby allowing them to be fully tailored to one's local needs and environment...Software Description: The program is written in FORTRAN for implementation on a number of host computers, such as, UNIVAC, IBM, CYBER, DEC VAX, and others. Approximately 600K bytes of main memory are required.

700,666
PB87-161006 PC A04/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
DATAPLOT: New Features. Version 87.1.
 J. J. Filliben. Jan 87, 62p NBS/SW/MT-87/005A
 For system on magnetic tape, see PB87-160990. Supersedes PB84-214055. See also PB87-161014.

Keywords: *Computer graphics, Programming languages, Documentation, *DATAPLOT programming language, *High level languages.

The document is an overview of new features which have been implemented into DATAPLOT from July 1985 to December 1986. These features enhance not only the analysis power of DATAPLOT, but also the ease-of-use of DATAPLOT. All enhancements featured in the document have been incorporated into the DATAPLOT 87.1 release.

700,667
PB87-161014 PC A05/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
DATAPLOT: Implementation Manual. Version 87.1.
 J. J. Filliben. Jan 87, 83p NBS/SW/MT-87/005B
 For system on magnetic tape, see PB87-160990. Supersedes PB84-214063. See also PB87-161006.

Keywords: *Computer graphics, *Programming languages, Minicomputers, Manuals, *DATAPLOT programming language, User manuals(Computer programs), Computer program portability, Mainframe computers.

DATAPLOT is a portable, high-level interactive language/system for graphics, fitting, data analysis, and mathematics. It has wide applicability--especially in a research/scientific/engineering environment. The

Computer Software

Manual outlines the step-by-step procedure for implementing DATAPLOT 87.1. Inasmuch as the underlying DATAPLOT code is portable (FORTRAN 77), and inasmuch as transportability considerations are an integral part of the design, then this described implementation procedure is valid and appropriate for a wide variety of mainframes and minis.

700,668

PB87-171880

CP T11

National Bureau of Standards (ICST), Gaithersburg, MD.

NBS (National Bureau of Standards) Prototype Compiler for Estelle.

Software,

M. Hobbs, and R. J. Linn. Nov 86, mag tape NBS/SW/MT-87/002

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, PB87-171898.

Keywords: *Software, Hierarchies, Protocols, Prototypes, Specifications, *Estelle system, *Open systems interconnections, *Compilers, *Computer communications, Software libraries, National Bureau of Standards, Software tools, Byte functional modules, L=C; YACC; LEX, H=VAX-11/780.

Estelle is a formal description technique for computer communication protocols being developed in the International Standards Organization (ISO) for specifying Open Systems Interconnection (OSI) protocols. It models protocols as extended finite state machines, called modules, arranged in a dynamic hierarchy. Modules communicate by exchanging interactions at named interaction points. The prototype compiler translates an Estelle formal description into declarations in the C language of data structures and procedures. The code must be augmented with a library of run-time functions (supplied with the compiler) and certain implementation-dependent functions (written by the user based on supplied examples). From these elements, an executable program can be produced to realize the behavior of the formal description. Because the compiler is an early prototype, it may not be appropriate for some situations. However, it should be a useful tool for suitable users with detailed knowledge of Estelle and a willingness to deal with compiler internals when necessary. The compiler was implemented using the Unix 4.2bsd operating system, including the YACC and LEX tools for compiler construction. The full compiler source is provided. The compiler code and the code that it generates are both in the C language, mostly avoiding non-portable constructs. **Software Description:** The program is written in the YACC, LEX, and C programming languages for implementation on a VAX 11/780 computer using the Unix 4.2bsd operating system. 200K bytes of core storage are required.

700,669

PB87-171898

PC A05/MF A01

National Bureau of Standards (ICST), Gaithersburg, MD.

User Guide for the NBS (National Bureau of Standards) Prototype Compiler for Estelle.

Draft rept.,

R. J. Linn. Nov 86, 76p ICST/APM-87-1, NBS/SW/MT-87/002A

For system on magnetic tape, see PB87-171880.

Keywords: Simulation, Protocols, Prototypes, Documentation, *Estelle system, *Compilers, *Subroutine libraries(Computers), Software libraries, National Bureau of Standards, User manuals(Computer programs).

The document accompanies a software product, the NBS Prototype Compiler for Estelle. It describes an implementation model for Estelle, the output of the compiler, the run-time library of support routines, and the syntax of Estelle used by the compiler. Instructions are provided for installing the compiler, executing it, and providing the necessary implementation environment. Complete source is provided for a practical example of a simple protocol simulation, and the report describes this example in some detail.

700,670

PB87-172235

PC A16/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.

OMNITAB 80: An Interpretive System for Statistical and Numerical Data Analysis.

Final rept.,

S. T. Peavy, S. G. Bremer, R. N. Varner, and D.

Hogben. Nov 86, 357p NBS/SP-701

Supersedes PB82-136474. Also available from Supt. of Docs as SN003-003-02775-8. Library of Congress catalog card no. 86-600589.

Keywords: *Computer programming, *Statistical analysis, *Numerical analysis, *Probability theory, Programming languages, Bessel functions, Matrices(Mathematics), Least squares method, Plotting, *OMNITAB 80 system, Computer software, Portability.

OMNITAB 80 is a highly integrated general purpose programming language and statistical software computing system. The system enables the user to use a digital computer to perform statistical and numerical data analysis without having any prior knowledge of computers or programming languages. The system responds to simple instructions to obtain accurate results since reliable, varied and sophisticated algorithms for data analysis and manipulation are referenced. It may be used either interactively or in batch mode. OMNITAB 80 has been installed nationally and internationally. OMNITAB has been completely written to make it as machine independent as possible. The document describes Version 6.0. Details are presented so that the user can easily find the specific information needed in any particular instance. Part A is a simple compact introduction to OMNITAB. Part B describes the general and special features of the OMNITAB system. Part C gives explanations, with short examples, for the use of specific instructions. Part D is a complete alphabetical list of the instructions which are in the system.

700,671

PB87-173910

PC A02/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.

OED: Object-Oriented Editor,

J. C. Boudreaux. Mar 87, 19p NBSIR-87/3530

Keywords: *Editing, *Object programs, *Editing routines, *FranzLISP programming language, *LISP programming language.

In the paper an object-oriented editor, called OED, is defined in the FranzLISP programming language. Though editors are usually associated with sets of functions to manipulate textfiles, in the work the term is being used to characterize a family of LISP functions which create and modify formal representations of objects in AMPL/Core.

700,672

PB87-193603

Not available NTIS

National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Achieving Hash Table Searchers in One or Two Bucket Probes.

Final rept.,

G. Lyon. 1985, 6p

Pub. in Computer Jnl. 28, n3 p313-318 1985.

Keywords: Addressing, Tables(Data), Searching, Reprints, *Sorting, *Computer files, *File maintenance, *File management systems.

No abstract available.

700,673

PB87-195277

PC A13/MF A01

National Bureau of Standards (ICST), Gaithersburg, MD.

Workshop on Factory Communications, March 17-18, 1987,

R. Rosenthal. Mar 87, 282p NBSIR-87/3516

Sponsored by Institute of Electrical and Electronics Engineers, Inc., Washington, DC.

Keywords: *Computer systems programs, *Industrial engineering, *Information systems, *Networks, Automation, Computerized simulation, Design, Manufacturing, Factories, Computer networks, Communication networks, Computer aided manufacturing, Computerized control systems.

The workshop proceedings report recent efforts of government, industrial, and academic researchers in factory communication networks. Four major research areas are addressed: the application of manufacturing automation protocols (MAP) in factory networks, the

application of non-MAP protocols, design and simulation tools and analytic and simulation modeling.

700,674

PB87-210332

PC A04/MF A01

National Bureau of Standards (ICST), Gaithersburg, MD. Center for Programming Science and Technology. **Application Software Prototyping and Fourth Generation Languages.**

Special pub. (Final),

G. E. Fisher. May 87, 69p NBS/SP-500/148

Also available from Supt. of Docs as SN003-003-02797-9. Library of Congress catalog card no. 87-619824.

Keywords: Productivity, Specifications, Prototypes, *Applications programs(Computers), *Software engineering, *Computer software, *Fourth generation programming language, *4GL programming language, Life cycle costs.

The report describes a methodology for developing software requirements and specifications using Fourth Generation Languages (4GLs) and application prototyping. Various prototyping methodologies are reviewed, and general prototyping strategies and factors are discussed. The report describes the advantages and disadvantages of application prototyping, and develops techniques for implementing a software development model that incorporates prototypes based on the capabilities of 4GLs. The phases, processes, and deliverables are described for each event in the development cycle. An appendix contains a tutorial example to illustrate the methodology proposed.

700,675

PB87-218269

Not available NTIS

National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Editor for Program Design.

Final rept.,

M. V. Zelkowitz. 1987, 5p

Contracts F49620-85-K-0008, N000014-85-K-0633

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and Office of Naval Research, Arlington, VA.

Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) Compcon Spring 87, San Francisco, CA., February 23-27, 1987, p242-246.

Keywords: *Editing, Design, Environments, *Artificial intelligence, Program generation, Syntax.

An integrated environment for creating program designs is being built at the University of Maryland. The editor is based on a six-level hierarchy that describes the process of program editing. Three levels describe the current set of available text editors that are used to build program text, while levels four through six raise the language level available to the programmer to that of a design language. Many programming tools such as macro processing, templates and some fourth generation language features are contained within this hierarchy. The role of artificial intelligence applications for program design is also being investigated. The result is a system that allows for the easy merging of design and code into one document.

700,676

PB87-225439

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.

Multiple Programs in One UNIX Process.

Final rept.,

D. E. Libes. Aug 87, 7p

Pub. in Login 12, n4 p7-13 Jul-Aug 87.

Keywords: *Operating systems(Computers), *Multi-processing, Reprints, *XINU operating system, *UNIX operating system, *Interprocessor communication, Global.

A small operating system (XINU) was ported to UNIX 4.2BSD. The entire operating system runs as a single UNIX process. The code is approximately 1000 lines of C (including comments) and 6 lines of assembler. All of the code is user-level, and thus presents a system easy to examine, understand, and experiment with further. The code has been used as a base for an application of several cooperating processes communicating through global variables. Alternatively, the system provides semaphores and messages for interprocess communication.

700,677
PB87-233581 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Robot Systems Div.
Note on Real Time Parametric Cubic Segment
Curve Generation.
 Final rept.,
 M. Roche, and W. X. Li. 1987, 7p
 Pub. in *Intelligent Instruments and Computers* 5, n7
 p168-174 Jul 87.

Keywords: *Computer graphics, Arrays,
 Curves(Geometry), Interpolation, Reprints, Real time.

As coordinate values are determined, the authors wish to add them to an array and apply an interpolation procedure to the new coordinate values of the array. That is, as the sequence is being increased, it will be interpolated by a cubic fit. The authors will exhibit two procedures which limit the cubic construction to be one segment behind the last segment of the sequence. That is the input coordinate values are not the end points for the cubic segment being constructed. Another procedure will include this last input coordinate value as end coordinate values for this last cubic segment being generated. The method of parabolic blending for the curve and surface interpolation originally conceived by A. W. Overhauser (1) is applied as well as two procedures employing three points and one vector. As will be seen, these methods lend themselves to real time curve generation.

700,678
PB88-108667 PC A03/MF A01
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Center for Applied Mathematics.
Tutorial on Programming in LEMM and MACFOR,
 D. F. Redmiles. Jul 87, 47p NBSIR-87/3622

Keywords: *Computer programming, *Programming,
 *Fortran 77 programming language, *Software libraries,
 *Data structures, Relational data bases, LISP programming language, LEMM system, MACFOR system, User manuals(Computer programs).

Two FORTRAN 77 libraries called LEMM and MACFOR are described. These libraries were implemented to enable FORTRAN programmers to use list and structure oriented data types like those available in LISP and Pascal. The LEMM library combines ideas from the LISP programming language and the relational database model to provide a structured data type for representing and storing data. The MACFOR library implements many of the functions of the LISP programming language within FORTRAN and supports the implementation of the LEMM subroutines. The two libraries are intended to be used together and their expositions here are interposed with emphasis placed on using LEMM. However, the MACFOR library can be used independently, especially by programmers familiar with LISP. The LEMM and MACFOR libraries codify popular and proven concepts in data representation. Many programming examples are provided to make the use of these libraries understandable and applicable in the field.

700,679
PB88-109848 PC A06/MF A01
 National Bureau of Standards, Gaithersburg, MD. Inst. for Computer Sciences and Technology.
Annotated Bibliography on Reliable System Design,
 W. McCoy, K. Roessing, and M. Ruhl. May 87, 116p
 NBSIR-87/3559

Keywords: *Reliability(Electronics), Systems design,
 *Distributed computer systems, *Fault tolerant computing, *Bibliography, Software tools.

The difficulty in assuring some level of fault-tolerance, reliability, safety availability or survivability in large, complex distributed system has long been recognized. Techniques are now emerging that try to address the issue in system design, including formal description, design tools, automatic implementation and system simulation. The bibliography contains brief summaries of 350 papers from various computer science and engineering journals, books, dissertations and technical report in the years 1972-1987, on these and related topics.

700,680
PB88-109855 PC A08/MF A01
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Center for Applied Mathematics.

Interactive Nonlinear Least Squares Program.
 Technical note (Final),
 C. M. Wolfe, B. W. Rust, J. H. Dunn, and I. E. Brown.
 Jul 87, 163p NBS/TN-1238
 Also available from Supt. of Docs. as SN003-003-02815-1.

Keywords: *Computer programming, *Diagnostic routines, Mathematical models, Nonlinear programming, Least squares method, Linear programming, Fortran, *Software engineering, *INVAR computer program, *Interactive systems, On line systems, Real time systems, NBS Cyber 855 computer, Computer codes.

INVAR is an interactive computer code which uses the Stanford variable-separable nonlinear regression program. VARPRO to solve nonlinear (and linear) least squares problems. The variable-separable feature of VARPRO makes it attractive to users with real-world fitting problems because it iterates only on the parameters which appear nonlinearly in the model. Not only does this simplify the iteration, but it also means that the user is not required to supply initial estimates for the parameters which appear linearly. INVAR implements VARPRO within an environment providing the user with on-line feedback and the opportunity to make changes, transformations, and corrections in real-time. It provides extensive statistical diagnostics and plots of the results. The report is both a tutorial guide for beginners and a reference manual for experienced users who wish to make changes in the code. It contains three completely solved example problems. Three appendices contain information necessary for making changes in the programs.

700,681
PB88-110036 PC A04/MF A01
 National Bureau of Standards, Gaithersburg, MD. Inst. for Computer Sciences and Technology.
Survey of OSI (Open Systems Interconnection) Network Management Standards Activities.
 Final rept.,
 C. M. Chernick, K. Mills, R. Aronoff, and J. W. Strauch. 17 Jul 87, 58p NBSIR-87/3593
 Sponsored by Air Force Unified Local Area Network Architecture Program Office, Hanscom AFB, MA.

Keywords: *Computer networks, *Standards, Management, Protocols, Surveys, Layers, Security, *OSI computer network, *OSI systems, *Open systems interconnections, Interconnections, Configuration management, Fault tolerant computing, Commercial sector.

The paper surveys the status of OSI network management activities. The executive summary projects future availability of standards and commercial products for the management of OSI systems. Several major problems remaining to be solved by the standards community, are discussed. The paper reviews the characteristics and capabilities of the specific management areas described in the ISO management framework model. These management areas include: Configuration and Name Management; Security Management; Performance Management; Fault Management; and Accounting Management. The Common Management Information Service (CMIS) and Common Management Information Protocol (CMIP) and their capabilities are reviewed. A bibliography of relevant standards papers relating to OSI Network Management, as of March, 1987, is provided.

700,682
PB88-123799 PC A04/MF A01
 National Bureau of Standards, Gaithersburg, MD. Information Systems Engineering Div.
Guide on Data Entity Naming Conventions.
 Special pub. (Final),
 J. J. Newton. Oct 87, 61p NBS/SP-500/149
 Also available from Supt. of Docs. as SN003-003-02818-5. Library of Congress catalog card no. 87-619867.

Keywords: *Naming, *Data dictionaries, *Data base management, Data bases, Data structures, Data base administrator.

A coherent set of naming conventions for data entities is crucial to the central management of data. Name content and format must be designed to maximize the information content and relationship to the logical structure of the data. The report discusses the development and administration of naming conventions for data entities. The Information Resource Dictionary System (IRDS) meta-name schema provides a framework for name development. The report describes a methodology for deriving a relationship between an

entity's dictionary names and details a method for structuring the format and content of entity names which maximizes opportunities for analysis and sharing of data.

700,683
PB88-124177 CP T11
 National Bureau of Standards (ICST), Gaithersburg, MD.
NBS (National Bureau of Standards) Prototype Compiler for Estelle.
 Software,
 B. Strausser, and J. Linn. Oct 87, mag tape NBS/SW/MT-88/001
 Supersedes PB87-171880.

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 PB88-124185, and PB88-124193.

Keywords: *Software, Hierarchies, Protocols, Prototypes, Specifications, *Estelle system, *Open systems interconnections, *Compilers, *Computer communications, National Bureau of Standards, L=C; YACC; LEX, H=VAX-11/780.

Estelle is a formal description technique for computer communication protocols being developed in the International Standards Organization (ISO) for specifying Open Systems Interconnection (OSI) protocols. It models protocols as extended finite state machines called modules, arranged in a dynamic hierarchy. Modules communicate by exchanging interactions at named interaction points. The prototype compiler translates an Estelle formal description into declarations in the C language of data structures and procedures. The code must be augmented with a library of run-time functions (supplied with the compiler) and certain implementation-dependent functions (written by the user based on supplied examples). From these elements, an executable program can be produced to realize the behavior of the formal description. Because the compiler is an early prototype, it may not be appropriate for some situations. However, it should be a useful tool for suitable users with detailed knowledge of Estelle and a willingness to deal with compiler internals when necessary.

700,684
PB88-124193 PC A04/MF A01
 National Bureau of Standards (ICST), Gaithersburg, MD.
Internals Guide for the NBS (National Bureau of Standards) Prototype Compiler for Estelle.
 Final rept.,
 R. J. Linn. Sep 87, 55p ICST/SNA-87/4, NBS/SW/MT-88/001B
 For system on magnetic tape, see PB88-124177.

Keywords: Simulation, Protocols, Prototypes, Documentation, *Estelle system, *Compilers, *Subroutine libraries(Computers), National Bureau of Standards.

The document describes the theory of operation and some of the internal details of the compiler. It may be of interest to someone considering modifications to the compiler.

700,685
PB88-138961 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Recovering Files from a Damaged Files-11 Disk.
 Final rept.,
 J. Levine. 1985, 12p
 Pub. in *RSX Multi-Tasker*, p19-30 Jul 85.

Keywords: *Magnetic disks, Recovery, Reprints, *File maintenance, *Disk recording systems, *Computer files.

A Method for recovering files from a disk which has been damaged by a hardware malfunction is described. The method will work on any disk that is in Files-11 format, such as is written by the RSX11M operating system.

700,686
PB88-152426 Not available NTIS
 National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Computer Software

Building and Sustaining Software Maintainability.

Final rept.,
W. M. Osborne. 1987, 11p
Pub. in Proceedings of the Conference on Software Maintenance, Austin, TX., September 21-24, 1987, p13-23.

Keywords: Maintenance, Quality control, *Computer software maintenance, *Software quality control, Computer software, Life cycles.

The paper provides an overview of the current techniques used for achieving and sustaining maintainable software. Strategies for improving software quality and maintainability throughout the software lifecycle are presented.

700,687

PB88-152434 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Source Code Analyzer for Maintenance.

Final rept.,
D. R. Kuhn. 1987, 5p
Pub. in Proceedings of the Conference on Software Maintenance, Austin, TX., September 21-24, 1987, p176-180.

Keywords: Maintenance, Analyzers, Source programs, *Computer program maintenance, *Data dictionaries, *Software tools, *Software engineering, C programming language, Public domain, Computer software.

The paper describes a tool that reads all C source files in a directory and produces information useful for program maintenance. The tool generates a call tree, a call matrix, and the transitive closure of the matrix, which shows indirect relationships between routines. It computes some measures that may help estimate the complexity of the program being maintained, and also identifies subsystems (possibly nested) within the program. The paper describes the information provided and shows how it saves time in understanding the program to be modified, estimating the complexity of the change, and performing regression testing on the modified program. The tool is in the public domain and will be available through the National Technical Information Service (NTIS).

700,688

PB88-152442 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Simple Tools to Automate Documentation.

Final rept.,
D. R. Kuhn, and C. G. Hollis. 1985, 8p
Pub. in Proceedings of the Conference on Software Maintenance, Washington, DC., November 11-13, 1985, p203-210.

Keywords: Automation, *Computer program documentation, *Software tools, On line systems, Computer software maintenance, Cost.

Automated documentation normally requires complex and expensive software. The paper describes how detailed documentation can be extracted from source code using simple programs and standard utilities. The ability to extract such information is a by-product of a methodology designed to reduce the complexity of data-driven systems. Almost all documentation can be regenerated as needed, instead of storing extensive and often obsolete material. The authors experience with the method indicates that it is valuable for use in on-line system maintenance and documentation, and as an inexpensive alternative to the large-scale software development environment. The paper gives examples and describes the method in sufficient detail to allow those interested to adapt these techniques to their own environment.

700,689

PB88-152459 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Validation, Verification, and Testing of Software: An Enhancement to Software Maintainability.

Final rept.,
D. R. Wallace. 1985, 10p
See also PB81-167074.
Pub. in Proceedings of the Conference on Software Maintenance, Washington, DC., November 11-13, 1985, p69-78.

Keywords: *Computer programming, Verifying, Proving, Quality assurance, Validity, *Software engineering, Information validation.

The proliferation of software and the increasing complexity of software systems increase the need for software maintenance and the importance of software maintainability. An integrated validation, verification, and testing (VV and T) program for software is essential to achieving improved software maintenance and maintainability. The paper addresses early planning for VV and T, issues in selecting standards and analytic techniques for use throughout the software lifecycle, and finally the benefits derived from VV and T to both software maintenance and software maintainability.

700,690

PB88-152657 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Information Systems Engineering Div.

Data Element Standards: Communication Standards for End Users.

Final rept.,
R. G. Saltman. 1986, 4p
Pub. in Proceedings of the Computer Standards Conference Striking a Balance between Technology, Economics, Politics, and Reality--For Substance, Not Form, San Francisco, CA., May 13-15, 1986, p34-37.

Keywords: Computer networks, Standards, *Information management, *Data elements, *Data transfer(Computers), End use, Costs.

Data element standards are a type of communication standard, as their function is to maximize the ease of data interchange among data systems. A new way of defining the concept of data element and related terms contributes to the view of a data element as a communications channel. Data element standards reduce data collection costs, and improve the consistency of data derived from different sources. The latter is essential for effective organizational decision making. Data element standards are an essential component of information management. Important tasks in data element standardization are the specification of data types and naming conventions, the selection of organizational data elements, and the assignment of maintenance responsibilities. Decision making in data element standardization must include organizational as well as technical considerations.

700,691

PB88-153663 PC A12/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.

Draft Stable Implementation Agreements for Open Systems Interconnection Protocols. NBS (National Bureau of Standards) Workshop for Implementors of Open Systems Interconnection. Version 1, Edition 0.

R. Rosenthal. Oct 87, 253p NBSIR-87/3674

Keywords: *Computer networks, Standards, Tests, Protocols, Agreements, Meetings, *Open systems interconnections, OSI, Local area networks, Draft.

The document records current Draft Stable Agreements for Open System Interconnection Protocols among the organizations participating in the NBS/OSI Workshop Series for Implementors of OSI Protocols. This document is updated after each workshop (every 4 months).

700,692

PB88-153713 PC A08/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.

Ongoing Implementation Agreements for Open Systems Interconnection Protocols. NBS (National Bureau of Standards) Workshop for Implementors of Open Systems Interconnection.

R. Rosenthal. Oct 87, 162p NBSIR-86/3385/7

Keywords: *Computer networks, Tests, Protocols, Implementation, Standards, Meetings, Agreements, *Foreign technology, *Open systems interconnections, *Local area networks, OSI.

The document records current agreements on implementation details of Open System Interconnection Protocols among the organizations participating in the NBS/OSI Workshop Series for Implementors of OSI Protocols. These decisions are documented to facilitate organizations in their understanding of the status of agreements. This is a standing document that is updated after each workshop (every four months).

Information Processing Standards

700,693

FIPS PUB 119 PC E08
National Bureau of Standards (ICST), Gaithersburg, MD.

Ada. Category: Software Standard. Subcategory: Programming Language.

Federal information processing standards.
M. V. Vickers. 8 Nov 85, 345p
Errata sheet inserted. Prepared in cooperation with American National Standards Inst., New York.
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Standards, *Programming languages, Programming manuals, Compilers, Interpreters, *ADA programming languages, *Federal information processing standards, *Computer program portability, High level programming languages.

The publication announces the adoption of American National Standard Reference Manual for the Ada* Programming Language, ANSI/MIL-1815A-1983, as a Federal Information Processing Standard (FIPS). The American National Standard Ada, ANSI/MIL-STD-1815A-1983, specifies the form and meaning of program units written in Ada. The purpose of the standard is to promote portability of Ada programs for use on a variety of data processing systems. The standard is for use by implementors as the reference authority in developing compilers, interpreters, or other forms of high level language processors; and by other computer professionals who need to know the precise syntactic and semantic rules of the standard.

700,694

FIPS PUB 124 PC A03/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.

Guideline on Functional Specifications for Database Management Systems. Category: Software. Subcategory: Data Management Applications.

Federal information processing standards (Final),
C. L. Sheppard. 30 Sep 86, 35p
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: Specifications, Computer systems hardware, Guidelines, *Data base management systems, *Federal information processing standards, Global, Computer software, Data structures.

The Guideline assists the data processing manager in the specifications of database management functions. In the Guideline is a framework for gathering and incorporating an appropriate set of data management functions into a request for proposals document. The emphasis is on the logical separation of the database management functional specifications, the relationship among the logical categories, and the recommended set of sources.

700,695

FIPS PUB 125 PC E11
National Bureau of Standards (ICST), Gaithersburg, MD.

MUMPS. Category: Software Standard. Subcategory: Programming Language.

Federal information processing standards (Final),
M. V. Vickers. c1984, 161p
Prepared in cooperation with American National Standards Inst., New York.
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Standards, *Information systems, *Programming languages, *MUMPS programming language, *Federal information processing standards, Computer software.

The publication announces the adoption of American National Standard for Information Processing Systems Programming Language MUMPS, ANSI/MDC X11.1-1984, as a Federal Information Processing Standard (FIPS). The American National Standard specifies the form and meaning of program units written in MUMPS. The purpose of the standard is to promote portability of MUMPS programs for use on a variety of data processing systems. The standard is used by implementors as the reference authority in developing language processors; and by other computer professionals who need to know the precise syntactic and semantic rules of the

language. (Copyright (c) 1984 by American National Standards Institute, Inc.)

700,696
FIPS PUB 126 PC E11
National Bureau of Standards (ICST), Gaithersburg, MD.
Database Language NDL (Network Database Language). Category: Software Standard. Subcategory: Database.
Federal information processing standards (Final), J. Sullivan. c1986, 148p
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Programming languages, *Standards, Data processing, Information systems, Programming manuals, *Federal information processing standards, Computer software, NDL.

The publication announces adoption of American National Standard Database Language NDL, ANSI X3.133-1986, as a Federal Information Processing Standard (FIPS). ANSI X3.133-1986, specifies three languages that make up a network model database management system. They are: (a) A schema definition language, for declaring the structures and integrity constraints of a network structured database; (b) A subschema definition language, for declaring a user view of that database; (c) A module language, including NDL statements, for declaring the database procedures and executable statements of a specific database application. The purpose of the standard is to promote portability of database definitions and database application programs between different installations. The standard is used by implementors as the reference authority in developing a network model database management system and standard language interfaces to that database management system; and by other computer professionals who need to know the precise syntactic and semantic rules of the standard.

700,697
FIPS PUB 127 PC E10
National Bureau of Standards (ICST), Gaithersburg, MD.
Database Language SQL (Structured Query Language). Category: Software Standard. Subcategory: Database.
Federal information processing standards (Final), J. Sullivan. c1986, 121p
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Programming languages, *Standards, Data processing, Information systems, Programming manuals, *Federal information processing standards, Computer software, SQL.

The publication announces adoption of American National Standard Database Language SQL, ANSI X3.135-1986, as a Federal Information Processing Standard (FIPS). ANSI X3.135-1986 specifies two languages that make up a relational model database management system. They are: (a) A schema definition language, for declaring the structures and integrity constraints of a database; (b) A module language, including SQL statements, for declaring the database procedures and executable statements of a specific database application. The purpose of the standard is to promote portability of database definitions and database application programs between different installations. The standard is used by implementors as the reference authority in developing a relational model database management system and standard language interfaces to that database management system; and by other computer professionals who need to know the precise syntactic and semantic rules of the standard.

700,698
FIPS PUB 128 PC E13
National Bureau of Standards (ICST), Gaithersburg, MD.
Computer Graphics Metafile (CGM). Category: Software Standard. Subcategory: Graphics.
Federal information processing standards (Final), D. Benigni. 1986, 343p
Prepared in cooperation with American National Standards Inst., New York.
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Computer graphics, *Federal information processing standards, Metafile, *Software tools, *Computer program portability.

The publication announces the adoption of the American National Standard for Computer Graphics Metafile, ANSI X3.122-1986, as a Federal Information Processing Standard (FIPS). ANSI X3.122-1986 is a graphics data interface standard which specifies a file format suitable for the description, storage, and communication of graphical (pictorial) information in a device independent manner. The purpose of the standard is to facilitate the transfer of graphical information between different graphical software systems, different graphical devices, and different computer graphics installations.

700,699
FIPS PUB 129 PC E04
National Bureau of Standards (ICST), Gaithersburg, MD.
Optical Character Recognition (OCR) - Dot Matrix Character Sets for OCR-MA. Category: Hardware Standard. Subcategory: Character Recognition.
Federal information processing standards (Final), T. C. Bagg. c1987, 41p
Prepared in cooperation with American National Standards Committee, New York.
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: Standards, Data processing, Cost engineering, *Optical character recognition, *Federal information processing standards.

The FIPS announces the adoption of the American National Standard X3.111-1986, Optical Character Recognition (OCR) -- Matrix Character Sets for OCR-MA, as a Federal Information Processing Standard. The standard provides the description, scope, and application rules for character sets that are generated by low resolution dot matrix printers and designed to match, as close as practical, the design of the OCR-A character set. A major purpose of this OCR standard is to reduce the cost of data input into ADP systems which use Optical Character Recognition (OCR) equipment.

700,700
FIPS PUB 21-2 PC E15
National Bureau of Standards, Gaithersburg, MD.
COBOL. Category: Software Standard. Subcategory: Programming Language.
Final rept., M. V. Vickers. 18 Mar 86, 822p
Supersedes FIPS-PUB-21-1.
Three ring vinyl FIPS binder also available, \$6.25 N.A.C. Others write for quote.

Keywords: *Cobol, *Programming languages, *Standards, Data processing, Information systems, Programming manuals, *Federal information processing standards, *High level languages, Computer software.

The publication announces the adoption of American National Standard Programming Language, COBOL, ANSI X3.23-1985, as amplified herein, as a Federal Information Processing Standard (FIPS). The revision supersedes FIPS PUB 21-1 and reflects major changes and improvements in the COBOL specifications. It also contains changes to the Objectives, Applicability, and Implementation portions of FIPS PUB 21-1 to recognize advances in programming language technology and to provide consistent policy for all FIPS languages. The American National Standard defines the elements of the COBOL programming language and the rules for their use. The purpose of the standard is to promote portability of COBOL programs for use on a variety of data processing systems. The standard is used by implementors as the reference authority in developing processors and by users who need to know the precise syntactic and semantic rules of the standard language.

700,701
FIPS PUB 29-2 PC A02/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.
Interpretation Procedures for Federal Information Processing Standards for Software. Category: Software Standard. Subcategory: Graphics.
Federal information processing standards (Final), M. Vickers. 14 Sep 87, 8p
Supersedes FIPS PUB-29-1.

Keywords: *Computer graphics, *Programming languages, *Standards, *Federal information processing standards, *Computer software.

The purpose of the Federal Information Processing Standards Publication (FIPS PUB) is to establish the

procedures for requesting a technical interpretation of any of the Federal Information Processing Standards (FIPS) for software and for providing a solution to the request. The FIPS PUB supersedes FIPS PUB 29-1 in its entirety. The FIPS for software include, but are not limited to, FIPS programming languages, FIPS database languages, FIPS graphics languages, and FIPS operating systems languages. The standards are used as the basis for the implementation of software, validation of software, or writing of application programs.

700,702
FIPS PUB 5-2 PC A03/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.
Codes for the Identification of the States, the District of Columbia and the Outlying Areas of the United States, and Associated Areas. Category: Data Standards and Guidelines. Subcategory: Representations and Codes.
Federal information processing standards (Final), R. G. Saltman. 28 May 87, 11p
Supersedes FIPS PUB 5-1.
Three ring vinyl binder also available, North American Continent price \$9.95; all others write for quote.

Keywords: *Coding, *Information systems, Standards, States(United States), Countries, *Federal information processing standards, *Geocoding.

The standard provides a set of two-digit numeric codes and a set of two-letter alphabetic codes for representing the 50 states, the District of Columbia and the outlying areas of the United States, and associated areas. The standard covers all land areas under the sovereignty of the United States, the freely associated states of Federated States of Micronesia and Marshall Islands, and the trust territory of Palau. The revision supersedes FIPS PUB 5-1 in its entirety.

700,703
FIPS PUB 70-1 PC E05
National Bureau of Standards, Gaithersburg, MD.
Representation of Geographic Point Locations for Information Interchange. Category: Data Standards and Guidelines. Subcategory: Representations and Codes; Earth Science Series.
Federal information processing standards (Final), R. G. Saltman. 14 Nov 86, 31p
Supersedes FIPS PUB 70.
Three ring vinyl binder also available, North American Continent price \$6.25; all others write for quote.

Keywords: *Geography, *Location(Position), Standards, National government, Coordinates, Latitude, Longitude, Mapping, *Federal information processing standards, *Information transfer.

The standard specifies a uniform format for representing geographic point location data in digital form for purposes of information interchange among data systems. The standard applies only to the three coordinate systems most widely used in the United States to define the position of a point that may be on, above, or below the Earth's surface. These systems include: Latitude and Longitude, Universal Transverse Mercator (UTM), and State Plane Coordinate Systems; all three are mathematically interconvertible and are officially recognized by many mapping and surveying agencies of the Federal and State governments.

700,704
PB87-164067 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems Components Div.
Verifying Conformance to the X.25 Standard.
Final rept., G. E. Clark, and M. K. Wong. Apr 85, 5p
Pub in Data Communication 14, n4 p153-154, p157-158, p161 Apr 85.

Keywords: *Telecommunication, *Standards, Conformity, Tests, Reprints, *Federal information processing standards, *Computer program verification, *Packet switching, Compliance, Computer networks.

NBS has developed a set of verification techniques which can be applied by any organization to determine compliance with Federal Information Processing Standard 100, the government's standard for interfacing data terminals and computers to packet switched data terminals and computers to packet switched data networks. A fundamental objective of these verification tests is concerned with establishing uniform verification testing and unambiguous evaluation proce-

COMPUTERS, CONTROL & INFORMATION THEORY

Information Processing Standards

dures to aid government users in acquiring ADP and telecommunications facilities or services based on the CCITT X.25 specifications. These tests are designed for use by vendors and suppliers so as to provide government users with assurance the products they acquire are in conformance with the FIPS 100/FS 1041 specifications and can interwork.

700,705
PB87-179891 PC A04/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD. Center for Programming Science and Technology. **Report on the NBS (National Bureau of Standards) Software Acceptance Test Workshop, April 1-2, 1986.**
Final rept.,
D. R. Wallace, and J. C. Cherniavsky. Mar 87, 52p
NBS/SP-500/146
Also available from Supt. of Docs as SN003-003-02793-6. Library of Congress catalog card no. 87-619806.

Keywords: *Standards, Tests, Standardization, Automation, Meetings, *Computer software, *Software tools, *Acceptability, *National Bureau of Standards, Computer program verification, Computer program reliability.

The document is a report on the Software Acceptance Test Workshop held at the National Bureau of Standards, April 1-2, 1986. The workshop consisted of eight sessions divided over two days. The topics of the first day's sessions were acceptance testing of off-shelf software, test case selection techniques, automated support for software acceptance testing, and software acceptance criteria. The topics of the second day's sessions were the management of software acceptance testing, standardization issues in software acceptance testing, research areas for software acceptance testing, and the state of practice in software acceptance testing. The report describes the charges given to all of the sessions, highlights of discussions from each of the sessions, and the conclusions of the workshop. The report is intended for those who purchase, market, develop or maintain software and for those who are responsible for software acceptance testing.

700,706
PB88-141130 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Center for Computer Systems Engineering.
NBS (National Bureau of Standards) Assistance to OSI (Open Systems Interconnection) Product Development.
Final rept.,
R. P. Blanc. 1986, 3p
Pub. in Comput. Stand. Interfaces 5, n4 p313-315 1986.

Keywords: *Computer networks, *Standards, Product development, Tests, Specifications, Compatibility, Interfaces, Protocols, Performance tests, Conformity, Government policies, Requirements, Reprints, *Open systems interconnections, *Commercial sector, Industry, National Bureau of Standards.

A primary objective of the National Bureau of Standards (NBS) Computer Networking Program is to achieve Open Systems Interconnection (OSI), consistent with government requirements, through commercial products. The authors now have a number of OSI standards, but those standards are not really useful until they are implemented in commercial off-the-shelf systems. At NBS in the early days of OSI, most of the resources were devoted to the development of standard specifications. Now over 90% of the resources go into helping industry turn those paper specifications into products. Most of the activities are laboratory based. They are oriented toward developing testing mechanisms that industry can use in the development of compatible OSI products. They also help to organize the industry to make implementation decisions which are then reflected in user specifications such as the Manufacturing Automation Protocol (MAP), and Technical/Office Protocol (TOP), and Federal Information Processing Standards (FIPS). To assist implementors the authors are now conducting three primary activities: the OSI Implementors Workshop, performance testing, and conformance testing.

700,707
PB88-152475 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Network Architecture Div.

Implementation of OSI Protocols.
Final rept.,
J. Heafner, and R. Blanc. 1985, 5p
Pub. in Conference Record--IEEE (Institute of Electrical and Electronics Engineers) International Conference on Communications, Chicago, IL., June 23-26, 1985, p614-618.

Keywords: *Computer networks, *Standards, Tests, Specifications, Protocols, Implementation, *Open systems interconnections.

The paper describes a test methodology for testing the correctness of computer network protocols. It describes a procedure for arriving at consensus among interested parties concerning implementation details of a protocol specification. Then a formal process of testing is described. The results of this procedure are illustrated by the description of a multi-vendor demonstration of correctly operating protocols.

Pattern Recognition & Image Processing

700,708
PB87-132239 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Design and Function of the NBS (National Bureau of Standards) Pipelined Image Processing Engine.
Final rept.,
E. W. Kent, M. O. Shneier, and R. Lumia. J. M. Herriman, R. L. Luck, and G. S. Henrici. 1985, 18p
Pub. in Proceedings of Conference on Vision '85, Detroit, MI., March 25-28, 1985, p8.40-8.57.

Keywords: *Robots, Mapping, Arrays, Television cameras, Feedback, *Image processing, *Robot vision, *Parallel processing, Real time, National Bureau of Standards.

The Sensory-Interactive Robotics Group of the National Bureau of Standards is producing PIPE (Pipelined Image Processing Engine), an experimental, multi-stage, multi-pipelined image processing device for research in low-level machine vision. The device can acquire images from a variety of source, such as analog or digital television cameras, ranging devices, and conformal mapping arrays. It can process sequences of images in real time, through a series of local neighborhood and point operations, under the control of a host device. Its output can be presented to such devices as monitors, robot vision systems, iconic to symbolic mapping devices, and image processing computers.

700,709
PB87-149795 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Iterative Reconstruction Algorithms: Convergence as a Function of Spatial Frequency.
Final rept.,
S. J. Norton. 1985, 8p
Pub. in Jnl. of the Optical Society of American A-Optics and Image Science 2, n1 p6-13 1985.

Keywords: Algorithms, Reprints, *Image reconstruction, Image processing, Iterative methods.

An analysis is presented of two well-known iterative reconstruction-from-projections algorithms, ART (algebraic reconstruction technique) and SIRT (simultaneous iterative reconstruction technique), which demonstrates how individual spatial frequency components in the image converge at different rates to their respective object components. The analysis proceeds by considering the continuous versions of the ART and SIRT algorithms in the limit of continuous sampling along the projections and in angle. Explicit convergence formulas are derived which show that the continuous ART and SIRT algorithms converge to the correct solutions, that the convergence is geometric, and how the rate of convergence depends on spatial frequency.

700,710
PB87-150918 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.

Perimeter of a Fuzzy Set.
Final rept.,
A. Rosenfeld, and S. Haber. 1985, 6p
Pub. in Pattern Recognition 18, n2 p125-130 1985.

Keywords: *Pattern recognition, Generalized functions, Convex sets, Reprints, *Fuzzy sets, *Image processing.

In pattern recognition one often wants to measure the perimeters of regions in images. This is straightforward if the region is crisply defined, but if it is fuzzy, it is not obvious how its perimeter can be measured. The paper proposes a definition of perimeter for fuzzy subsets of the plane, and shows that it reduces to the standard definition if the fuzzy subset is an ordinary subset. The isoperimetric inequality does not generalize to fuzzy subsets, but certain properties of the perimeters of convex sets do generalize to fuzzy perimeters of convex fuzzy subsets.

700,711
PB87-151874 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Real-Time Iconic Image Processor.
Final rept.,
R. Lumia, M. O. Shneier, and E. W. Kent. 1985, 6p
Pub. in Proceedings of Institute of Electrical and Electronics Engineers International Conference on Robotics and Automation, St. Louis, MO., March 25-28, 1985, p873-878.

Keywords: Real time operations, Computer graphics, Data storage, *Robot vision, *Image processing, *Pipelining(Computers), Computer vision, Host computers, Input output processing, National Bureau of Standards.

The Sensory-Interactive Robotics Group at the National Bureau of Standards is producing PIPE, a pipelined image-processing engine, for research in low-level machine vision. PIPE processes sequences of images at field rates through a series of point and neighborhood operations. It is divided into a variable number of identical stages, each of which performs an independent set of operations on the image data stored in the stage. A stage control unit determines the sequence of operations performed within a stage on each image. The sequence is easily modified by a host computer during the inter-field interval when all of the stage control units can be totally reconfigured. Images flow through PIPE in several ways. In addition to the (standard pipeline) 'forward' pathway, where an output image is sent to the next stage, an output image can also be sent to the same stage via a 'recursive' pathway and to the previous stage via a 'retrograde' pathway. As a result, PIPE can support relaxation operations, temporal neighborhood operations, and other local operations.

700,712
PB87-210035 PC A06/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Image Processing for Optical Engineering Applications.
M. B. Weppner, and M. Young. Apr 87, 105p NBSIR-87/3065

Keywords: Fourier transformation, Fiber optics, Computer programs, *Image processing, Computer applications, Optical fibers, Single mode fibers.

The Internal Report describes the development and testing of image processing software designed for optical engineering applications. Image processing functions in this software include two-dimensional Fourier transforms, convolution, noise reduction, multiple image resolutions, and low-level image processing functions. The software also contains image information display tools including Gaussian beam and g-profile characterization for optical fiber measurements. The necessary image file input/output routines are presented in the software and are used to read and store images in conjunction with other image processing software, digitizing cameras, and output display devices.

700,713
PB88-147335 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems Components Div.

Digitizing Documents: Guidelines for Image Quality.

Final rept.,
T. C. Bagg. 1987, 4p
Pub. in Inform 1, n11 p6-9 Nov 87.

Keywords: Reprints, *Image quality, *Digitized images, Microimages, Quality index.

The paper relates the Quality Index method for determining microimage systems quality to the expected image quality when using raster scanners to digitize images.

700,714

PB88-152897

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Incremental Reconstruction of 3D Scenes from Multiple, Complex Images.

Final rept.,
M. Herman, and T. Kanade. 1986, 53p
Pub. in Artificial Intelligence 30, n3 p289-341 1986.

Keywords: Aerial photographs, Photointerpretation, Reprints, *Image reconstruction, *Computer vision, Stereoscopic vision, Three dimensional.

The 3-D Mosaic system is a vision system that incrementally reconstructs complex 3D scenes from a sequence of images obtained from multiple viewpoints. The system encompasses several levels of the vision process, starting with images and ending with symbolic scene descriptions. The paper describes the various components of the system, including stereo analysis, monocular analysis, and constructing and updating the scene model. In addition, the representation of the scene model is described. The model is intended for tasks such as matching, display generation, planning paths through the scene, and making other decisions about the scene environment. Examples showing how the system is used to interpret complex aerial photographs of urban scenes are presented.

General

700,715

PB87-162103

Not available NTIS

National Bureau of Standards (ICST), Gaithersburg, MD. Systems and Software Technology Div.

Security for Personal Computers: A Growing Concern.

Final rept.,
D. D. Steinauer. 1984, 8p
Pub. in Comput. Secur. Jnl. 3, n1 p33-40 1984.

Keywords: Microcomputers, Computers, Security, *Personal computers, *Computer security, *Cryptography.

The article provides an overview of the special problems associated with the security of personal computer systems. It focuses on key technical vulnerabilities and methods to mitigate their effects.

DETECTION & COUNTERMEASURES

Acoustic Detection

700,716

PATENT-4 517 665

Not available NTIS

Department of Health and Human Services, Washington, DC.

Acoustically Transparent Hydrophone Probe.

Patent,
A. S. DeReggi, and G. R. Harris. Filed 17 Nov 83, patented 14 May 85, 10p PB87-184339, PAT-APPL-6-553 387

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: *Hydrophones, *Probes, *Patents, Acoustic detection, Transparency, Electrodes, Polymeric films, Piezoelectric materials, Sensitivity, Vinylidene fluoride polymers, PAT-CI-367-163.

The invention relates to hydrophones employing piezoelectrically active elements of the polymer membrane type which possess the property of nearly complete acoustical transparency.

700,717

PATENT-4 653 036

Not available NTIS

Department of Health and Human Services, Washington, DC.

Transducer Hydrophone with Filled Reservoir.

Patent,
G. R. Harris, and A. S. DeReggi. Filed 23 Oct 84, patented 24 Mar 87, 8p PB87-184321, PAT-APPL-6-663 969
Supersedes PB85-141778.

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: *Hydrophones, *Patents, Probes, Ultrasonic radiation, Piezoelectric materials, Polymeric films, Vinylidene fluoride polymers, PAT-CI-367-170.

A hydrophone device with one or more very small active spots located on a large continuous ferroelectric sheet, such as PVDF, overcomes many of the problems in prior art constructions associated with the high dielectric constant of various media in which the device is used. Additional improvements include increased signal to noise ratio and a sensitivity independent of the medium properties. The hydrophone device includes a piezoelectrically active sheet stretched and clamped on over the top of a hoop ring. A backing is attached to the back of the hoop ring. A low-dielectric material fills the space between the backing and the sheet. This material eliminates the capacitive loading effect which would otherwise be presented by the medium being probed.

700,718

PATENT-4 672 851

Not available NTIS

Department of Commerce, Washington, DC.

Acoustic Evaluation of Thermal Insulation.

Patent,
G. V. Blessing, and D. R. Flynn. Filed 30 May 86, patented 16 Jun 87, 10p PB87-203121, PAT-APPL-6-868 483
Supersedes PB86-220324.

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: *Thermal insulation, *Patents, Acoustic measurement, Acoustic measuring instruments, Evaluation, PAT-CL-73-597.

An acoustic method for measuring the quantity and installed density of thermal insulation includes introducing a sensing apparatus comprised of one or two acoustic transducers which are so placed as to measure the attenuation and/or phase shift of acoustic waves passing through the insulation. The thermal conductivity for a given insulation material may be monitored as a function of insulation depth by relating the acoustic amplitude and/or phase to a predetermined relationship for that particular insulation material. The relationship may be simply a set of tabular guides relating the quantity of insulation to an amplitude or phase value. This method may be applied to material in an open space. In the case of an attic enclosure, the apparatus introduced through a small ceiling hole may be subsequently unfolded or manipulated to place the transducers and possibly a reflecting target in the desired location relative to each other for carrying out the desired measurements.

Optical Detection

700,719

PATENT-4 714 339

Not available NTIS

Department of Commerce, Washington, DC.

Three and Five Axis Laser Tracking Systems.

Patent,
K. C. Lau, and R. J. Hocken. Filed 28 Feb 86, patented 22 Dec 87, 15p PB88-153689, PAT-APPL-6-834 728
Supersedes PB86-199189.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Patents, *Optical tracking, Robots, Tracking, Position(Location), *Laser applications, Three degrees of freedom, Five degrees of freedom.

A tracking system for measuring at least the spatial coordinates of a target and possibly the angular orientation of the target. A collimated beam is directed to the target and a mirror attached to the target reflects this beam back to a tracking point. Photosensors attached to the tracking or target point provide error signals to a servo system which controls optics at the tracking or target points to provide the direction necessary to accomplish the coincidence of the beams. An interferometer interferes the source beam with the beam that has travelled twice between the tracking and target points in order to measure the separation. By measuring the directions of the beams relative to structure attached to the tracking and target points, the target point can be located in spatial coordinates and additionally the orientation of the target structure can be determined.

ELECTROTECHNOLOGY

Antennas

700,720

PB87-152278

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering. Far-Field Transient Response of an Antenna from Near-Field Data.

D. A. Hill. Dec 86, 28p NBSIR-86/3063
Sponsored by Defense Nuclear Agency, Washington, DC.

Keywords: *Antennas, Far field, Transient response, Near field, Singularity expansion method, Time domain, Frequency domain.

The theory for calculating the transient far-field response of an antenna from planar near-field data in either the time domain or the frequency domain has been developed. A double integral must be evaluated if the authors begin with time-domain data, but a triple integral must be evaluated if they begin with frequency-domain data. However, the frequency-domain integrals are in a form that is suitable for three-dimensional FFT. Two idealized examples are studied, and identical results are obtained starting with frequency-domain or time-domain data. The main practical difficulty in determining the transient response is the large number of near-field samples that are required. If data are taken at only a few near-field points, then the singularity expansion method (SEM) presents a possible method of determining the complex resonances of the antenna under test.

700,721

PB87-161428

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Directional Scanning of Complex Electromagnetic Environments.

Final rept.,
J. Randa, and M. Kanda. Dec 85, 4p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation AP-33, n12 p1413-1416 Dec 85.

Keywords: *Electromagnetic environments, Plane waves, Reprints, Directional scanning.

A directional scanning technique is formulated for determining characteristics of an electromagnetic (EM) environment with a relatively small number of meas-

ELECTROTECHNOLOGY

Antennas

urements, and results of a simulated application are presented. The method relies on measurements with a directional probe to obtain information about the coefficients in a planewave expansion of the field within a large volume. The simulation indicates that although the spatial variation of the field can not be accurately determined, the spatial average of the field intensity can.

700,722

PB87-161436

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Calibration of Microwave Antenna Gain Standards.

Final rept.,

A. C. Newell, C. F. Stubenrauch, and R. C. Baird. Jan 86, 4p

Pub. in Proceedings of the Institute of Electrical and Electronics Engineers 74, n1 p129-132 Jan 86.

Keywords: *Microwave antennas, *Standards, Precision, *Antenna gain, *Calibration, Near field, Uncertainty.

Techniques for precision calibration of microwave antenna gain standards are described with discussions of applicability and associated uncertainties. Included are the three-antenna, extrapolation, swept-frequency, and near-field techniques.

700,723

PB87-161444

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Results of Planar near Field Testing with Ultralow Sidelobe Antennas.

Final rept.,

A. C. Newell, M. H. Francis, D. P. Kremer, and K. R. Grimm. 1985, 6p

Contract N00014-83-C-0671

Sponsored by Office of Naval Research, Arlington, VA. Pub. in Proceedings of 1985 AP-S International Symposium on Antennas and Propagation, Vancouver, Canada, June 17-21, 1985, v2 p693-698.

Keywords: *Antenna radiation patterns, Measurement, Tests, *Antenna lobes, *Sidelobes, Near field.

An investigation to demonstrate Planar Near Field (PNF) measurement accuracy for ultralow sidelobe antennas is nearing completion at the National Bureau of Standards, Boulder, CO. The existing NBS scanner has been modified to accommodate antennas up to 10m long and 4m high. Two antennas will be measured as a part of this research effort. They are the AWACS (U.S. Airborne Warning and Control System) and the ULSA (Ultra Low Sidelobe Antenna), traveling wave antennas which are respectively 8m X 1.5m and 6m X 1m. Results of tests to introduce controlled NF measurement error confirm predicted far field (FF) sidelobe accuracies at the -60dB level. Additional results show the utility of a new 2-element probe to extend sidelobe measurement accuracy by steering a probe pattern null in the direction of the test antenna's mainbeam.

700,724

PB87-161469

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Out-of-Band Response of Reflector Antennas.

Final rept.,

D. A. Hill. May 86, 10p

See also report dated April 1985, PB85-224475.

Pub. in Institute of Electrical and Electronics Engineers Transactions on Electromagnetic Compatibility EMC-28, n2 p80-89 May 86.

Keywords: *Antennas, Responses, Parabolic antennas, Reprints, Out of band response.

The response of reflector antennas to out-of-band frequencies has been analyzed using physical optics. A simple approximate expression has been obtained for the effective aperture, and this expression yields both the receiving pattern and the frequency dependence of the on-axis gain. The theory has been compared with published out-of-band measurements, and the pattern agreement is good, but the measured gain falls below the theory. This discrepancy is caused by mismatch loss in the coax-to-waveguide adapter.

700,725

PB87-161485

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Site Attenuation.

Final rept.,

R. G. FitzGerrell. Feb 86, 3p

See also report dated November 1985, PB86-169083. Pub. in Institute of Electrical and Electronics Engineers Transactions on Electromagnetic Compatibility EMC-28, n1 p38-40 Feb 86.

Keywords: *Antennas, Attenuation, Measurement, Computation, Reprints, *Site attenuation.

Site attenuation is a measure of performance of an open test site at frequencies below about 1 GHz. These sites typically consist of a large obstruction-free ground plane and the hemisphere above it. Calculations of site attenuation are presented which provide a reference for measurements made on a 30- by 60-m wire-mesh ground screen. Measured data are compared to the calculated results.

700,726

PB87-172011

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Comparison of Measured and Calculated Mutual Coupling in the Near Field between Microwave Antennas.

Final rept.,

C. F. Stubenrauch, and M. H. Francis. Jul 86, 7p

See also report dated Jun 84, PB85-105963.

Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation AP-34, n7 p952-958 Jul 86.

Keywords: *Microwave antennas, Coupled antennas, Antenna radiation patterns, Measurement, Far field, Comparison, Reprints, Near field.

Measurements of near-field mutual coupling between two moderate sized microwave antennas were performed and compared to coupling calculated using recently developed computer programs. Required input data for the programs are the complex far-field radiation patterns of the antennas and various geometrical factors describing the relative positions and orientations of the two antennas. Measured and calculated coupling as a function of both transverse and radial displacement showed good agreement.

700,727

PB87-172714

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Near-Field Array of Yagi-Uda Antennas for Electromagnetic Susceptibility Testing.

Final rept.,

D. A. Hill, and G. H. Koepke. Nov 86, 9p

See also report dated Jul 85, PB86-102688.

Pub. in Institute of Electrical and Electronics Engineers Transactions on Electromagnetic Compatibility EMC-28, n4 p170-178 Nov 86.

Keywords: *Antenna arrays, Yagi antennas, Electromagnetic fields, Electromagnetic susceptibility, Field tests, Reprints, Near field.

In electromagnetic-susceptibility testing of electronic equipment, the ideal incident field is a plane wave. To approximate this condition, a seven-element array of Yagi-Uda antennas has been constructed and tested at a frequency of 500 MHz. The element weightings are determined by a near-field synthesis technique, which optimizes the uniformity of the field throughout a rectangular test volume in the near field of the array. The amplitude and phase of the electric field have been measured throughout the test volume with a short-dipole probe, and the agreement with the theory is excellent.

700,728

PB87-172722

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Standard Linear Antennas, 30 MHz to 1000 MHz.

Final rept.,

R. G. FitzGerrell. 1986, 7p

Pub. in Proceedings of International Conference on Electromagnetic Compatibility (5th), York, England, October 1-3, 1986, p147-153.

Keywords: *Antennas, Very high frequencies, Ultra-high frequencies, Linear systems, Monopole antennas, Dipole antennas.

Simple linear antennas are described that are designed to operate in the 30 MHz to 1000 MHz frequency range.

Commercial coaxial hybrid junctions are used as balanced-to-unbalanced transmission line transformers (baluns) for the dipole antennas. The monopoles are fed unbalanced against a large ground screen. Calculated site attenuation (insertion loss) between pairs of these antennas over an assumed perfectly conducting plane ground is compared to insertion loss data measured using the 30 m by 60 m NBS ground screen.

700,729

PB87-182895

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Time-Domain Sensors and Radiators.

Final rept.,

M. Kanda. 1986, 53p

Pub. in Time-Domain Measurements in Electromagnetics, Chapter 5, p122-174 1986.

Keywords: *Antennas, *Detectors, Conical antennas, Loop antennas, Electrical measurement, Time domain.

The purpose of the chapter is to discuss various sensors and radiators commonly used for time domain antenna measurements. The sensors and radiators discussed here are passive, 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. For their usefulness in electric field strength measurements, linear antennas loaded non-uniformly 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 improved antenna characteristics. Various types of TEM horns are considered for improved directivity, e.g., a conducting TEM horn, and a resistively loaded TEM horn. For the magnetic field strength measurements, a loop antenna with uniform resistive loading is discussed.

700,730

PB87-210233

PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

NBS (National Bureau of Standards) Calibration Procedures for Horizontal Dipole Antennas (25 to 1000 MHz).

Technical note,

D. G. Camell, E. B. Larsen, and J. E. Cruz. Apr 87, 49p NBS/TN-1309

Also available from Supt. of Docs as SN003-003-02800-2.

Keywords: *Dipole antennas, Anechoic chambers, High frequencies, Very high frequencies, Ultrahigh frequencies, *Calibration, US NBS.

The publication describes the theoretical basis and test procedures for horizontally polarized dipole calibrations at the National Bureau of Standards. Two different techniques and two different test sites are used. The standard antenna method uses the calculation of a field strength level, from the response of a simple half-wave dipole, to calibrate an antenna. This method is used at an open field site in the frequency range of 25 to 1000 MHz. The standard field method applies the theoretical gain equations of waveguides to determine the field strength level. This latter method is used in an anechoic chamber in the frequency range of 200 to 1000 MHz. Procedures for both techniques are explained and measurement setups are illustrated. Measurement uncertainties are discussed. Sample reports are included for both methods.

700,731

PB87-232567

PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Analysis of an Array of Log-Periodic Dipole Antennas for Generation Test Fields.

G. H. Koepke, D. A. Hill, and M. T. Ma. Jun 87, 40p NBSIR-87-3068

Sponsored by Naval Surface Weapons Center, Dahlgren, VA.

Keywords: *Dipole antennas, *Log periodic antennas, Electromagnetic fields, Phased arrays, Analysis.

An analysis of log-periodic dipole antennas was extended to study their use in arrays designed for electromagnetic susceptibility measurements. Parameters

of an array of five log-periodic dipole antennas were calculated and in some cases compared to a single log-periodic dipole antenna. These parameters were used to evaluate the tradeoffs that exist in the design of an optimum transmitting antenna for susceptibility measurements.

700,732
PB87-233896 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Effect of Random Errors in Planar Near-Field Measurements.

Final rept.,
A. C. Newell, and C. F. Stubenrauch. 1986, 4p
Sponsored by National Aeronautics and Space Administration, Cleveland, OH, Lewis Research Center.
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) Antenna and Propagation Society Symposium (1986), Philadelphia, PA., June 8-13, 1986H, p195-198.

Keywords: *Antennas, Random error, Phased arrays, Near field, Sidelobes.

Equations have previously been derived to predict the effect of systematic errors in planar near-field measurements. Similar expressions for random errors have not been generally available, although computer simulation has been used to study some specific cases. In the report, simple general expressions are derived to predict the effect of random errors that require only minimal information about the antenna and the error distributions.

700,733
PB88-120969 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Coupling between Two Antennas Separated by a Planar Interface.

Final rept.,
D. A. Hill, and K. H. Cavcey. 1987, 10p
Sponsored by Army Belvoir Research and Development Center, Fort Belvoir, VA.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Geoscience and Remote Sensing GE-25, n4 p422-431 Jul 87.

Keywords: *Antennas, Loop antennas, Dipole moments, Interfaces, Plane waves, Polarization, S matrix theory, Reprints, *Metal detectors, Buried objects.

The plane-wave spectrum technique is used to analyze the coupling between a pair of antennas separated by a planar interface. Multiple reflections between the antennas or between either antenna and the interface are included in the formulation. The formulation is used to model detection of buried objects, and a low-frequency metal detector example is analyzed in detail. For a transmitting loop and a buried oblate spheroid, the plane wave spectrum technique is shown to agree with well-known quasi-static approximations. Some experimental results from a 3-kHz metal detector are also shown.

700,734
PB88-121983 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Out-of-Band Response of Antenna Arrays.

Final rept.,
D. A. Hill. 1987, 4p
See also PB88-121991.
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) International Symposium on Electromagnetic Compatibility, Atlanta, GA., August 25-27, 1987, p435-438.

Keywords: *Antenna arrays, Far field, Reflector antennas, Out of band.

The response of antenna arrays to out-of-band frequencies has been analyzed, using the effective aperture approach. An average value of effective aperture can be obtained by averaging the incidence angle and the polarization of the incident field. Far-field patterns have also been calculated by treating the array element excitations as random variables. The randomness in the element excitations causes a decrease in directivity, and an increase in sidelobe level.

700,735
PB88-121991 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Out-of-Band Response of Array Antennas.

Final rept.,
M. H. Francis, and D. A. Hill. 1987, 6p
See also PB88-121983.
Pub. in Proceedings of Antenna Measurement Techniques Association Meeting, Seattle, WA., September 28-October 2, 1987, p14-19.

Keywords: *Antenna arrays, Near field, Out of band.

The out-of-band response of array antennas was analyzed from both a theoretical and experimental point of view. Theory shows that the out-of-band response of an antenna depends primarily on two factors: the antenna's input impedance, and its directivity. Experiment shows that, for most practical purposes, the out-of-band response of an antenna can be estimated from a measurement of the antenna's input reflection coefficient alone. If the reflection coefficient is low, the antenna response will be good; if the reflection coefficient is high, the antenna response will be poor.

700,736
PB88-123732 PC A05/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Extrapolation Range Measurements for Determining Antenna Gain and Polarization.

Technical note,
A. G. Reppar, A. C. Newell, and D. T. Tamura. Aug 87, 88p NBS/TN-1311
Also available from Supt. of Docs. as SN003-003-02826-6.

Keywords: *Antennas, Amplification, Polarization(Waves), Calibration, Near field.

The extrapolation range measurement technique for determining the power gain and polarization of antennas at reduced range distances is described. It is based on a generalized three-antenna approach and does not require quantitative a priori knowledge of the antennas. During the past decade, it has been extensively used by the National Bureau of Standards, Boulder, Colorado, to calibrate antenna gain standards for industry and other agencies within \pm or -0.1 dB. To help one understand how calibrations of the accuracy are achieved, the extrapolation range description includes discussions on the required theory, the measurement procedures, the range configuration and instrumentation, the errors, and some measurement examples. Recent extensions of the extrapolation method required for swept/stepped frequency gain calibrations and for corrections to reduce ground reflection effects, are also presented.

Circuits

700,737
PATENT-4 638 257 Not available NTIS
Department of Commerce, Washington, DC.
Amplification by a Phase Locked Array of Josephson Junctions.

Patent,
D. G. McDonald. Filed 26 Nov 85, patented 20 Jan 87, 9p PB87-150470, PAT-APPL-6-801 972
Supersedes PB86-166386.
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: *Phase locked systems, *Amplifiers, *Josephson junction, *Patent applications, Amplification, *Phase locked arrays, PAT-CL-330-61R.

A Josephson junction amplifier comprises an array of series connected Josephson junctions which are maintained in a finite voltage, mutually electromagnetically phase-locked state. An input signal is applied across a first group of one or more but less than all of the Josephson junctions, and the output is taken across a second group of the junctions which has a greater number of junctions than the first group. Alternatively, two arrays may be connected in parallel to provide stable electromagnetic phase locking.

700,738
PB87-153839 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Modeling a Voltage-Locked Josephson Junction Array Amplifier: Gain, Input Impedance, and Bandwidth.

Final rept.,
D. G. McDonald. 1986, 11p
Pub. in Jnl. of Applied Physics 60, n9 p3247-3257, 1 Nov 86.

Keywords: *Josephson junctions, *Amplifiers, *Equivalent circuits, Superconductivity, Reprints.

Previously published experimental results are used to deduce an equivalent circuit for this amplifier, based on the shunted junction model. It is found that the very small inductances of the junction shunt resistors play an important role in determining the shape of the current-voltage curves in the voltage-locked region. Once the circuit is determined using the shunted junction model a combination of an approximation method (the method of slowly varying amplitudes) and the shunted junction model is used to approximately maximize the power gain of the circuit. The maximum gain achieved in these simulations of the two-junction amplifier is 11.3. The gain occurred with a negative resistance input impedance of $-0.41R$ and a signal source impedance of $0.167R$, where R is the junction shunt resistance. It is estimated that the bandwidth of the amplifier is about 1 GHz.

700,739
PB87-161550 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Quench Circuit for Electronic Instruments Used with Superconducting Magnets.

Final rept.,
R. G. Benson, R. B. Goldfarb, and E. S. Pittman. Sep 86, 2p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Cryogenics 26, p482-483 Aug-Sep 86.

Keywords: *Superconducting magnets, *Electrically powered instruments, Protection, Reprints, Quenching.

A multifunction circuit is described that protects instruments connected or coupled to a superconducting magnet in the event of a quench.

700,740
PB87-179420 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Wide-Band Low Noise MM-Wave SIS Mixers with a Single Tuning Element.

Final rept.,
A. V. Raisanen, D. G. Crete, P. L. Richards, and F. L. Lloyd. 1986, 18p
Sponsored by Office of Naval Research, Arlington, VA., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in International Jnl. of Infrared and Millimeter Waves 7, n12 p1835-1852 1986.

Keywords: Extremely high frequencies, Millimeter waves, Reprints, *Mixers(Electronics), Quasi particles, Low noise.

Several SIS quasiparticle mixers have been designed and tested for the frequency range from 80 to 115 GHz. The sliding backshort is the only adjustable RF tuning element. The RF filter reactance is used as a fixed RF matching element. A mixer which uses a single 2×2 micrometer squares Pb-alloy junction in a quarter-height waveguide mount has a coupled conversion gain of $GM(DSB)$ equals $2.6 \pm$ or -0.5 dB with an associated noise temperature of $TM(DSB) = 16.4 \pm$ or -1.8 K at the best DSB operation point. The receiver noise temperature $TR(DSB)$ is $27.5 \pm$ or $-$ for the mixer test apparatus. The mixer provides a SSB receiver noise temperature below 50K over the frequency range from 91 to 96 GHz, the minimum being $TR(SSB)$ equals $44 \pm$ or -4 K. Another mixer with an array of five 5×5 micrometers squares junction in series in a full-height waveguide mount has much lower noise temperature $TM(DSB)$ equals $6.6 \pm$ or -1.6 K, but less gain $GM(DSE) = -5.1 \pm$ or $-5.1 \pm$ or -0.5 dB.

700,741
PB87-180907 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Circuits

Low Noise SIS Mixer with Gain for 80-115 GHz.

Final rept.,
A. V. Raisanen, D. G. Crete, P. L. Richards, and F. L. Lloyd. 1986, 4p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Proceedings of ESA Workshop on a Space-Borne Sub-Millimetre Astronomy Mission, Segovia, Spain, June 4-7, 1986, p255-258

Keywords: *Extremely high frequencies, Millimeter waves, *Mixers(Electronics), Quasi particles, Low noise.

Several SIS quasiparticle mixers have been designed and tested for the frequency range from 80 to 115 GHz. The sliding backshort is the only adjustable RF-tuning element. The RF-filter reactance is used as a fixed RF-matching element. A mixer which uses a single 2×2 micrometers squared Pb-alloy junction in a $1/4$ -height waveguide mount has a coupled conversion gain of $GM(DSB) = 2.6 + \text{or} - 0.5 \text{ dB}$ with an associated noise temperature of $TM(DSB) = 16.4 + \text{or} - 1.8 \text{ K}$ at the best DSB operation point. The receiver noise temperature $TR(DSB)$ is noise temperature below 50 K over the frequency range from 91 to 96 GHz, the minimum being $TR(SSB)$ equals $44 + \text{or} - 4 \text{ K}$.

700,742

PB87-191052

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Performance of Arrays of SIS Junctions in Heterodyne Mixers.

Final rept.,
D. G. Crete, W. R. McGrath, P. L. Richards, and F. L. Lloyd. 1987, 6p
Sponsored by Office of Naval Research, Washington, DC., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques MTT-35, n4 p435-440 Apr 87.

Keywords: Josephson junctions, Millimeter waves, Extremely high frequencies, Performance, Arrays, Reprints, *Mixers(Electronics).

A systematic experimental study was made of the performance of millimeter-wave quasiparticle heterodyne mixers which use arrays of SIS tunnel junctions. Sets of arrays with $N = 1, 5, 10, 25$, and 50 junctions in series were fabricated by photolithography. All of the arrays in a given set were made on a single silicon wafer so that their response time parameter (ω_{sub}) ($R_{\text{sub}} N$)C would be the same. Junction areas were scaled so that the total impedance was the same for each array in a set. Sets of arrays from four wafers with values of (ω_{sub}) ($R_{\text{sub}} N$)C ranging from 2.6 to 13 were evaluated in mixers at 33 and 36 GHz.

700,743

PB87-191136

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Phase Lock of a Long Josephson Junction to an External Microwave Source.

Final rept.,
M. Cirillo, and F. L. Lloyd. 1987, 5p
Pub. in Jnl. of Applied Physics 61, n7 p2581-2585, 1 Apr 87.

Keywords: *Josephson junctions, *Microwave oscillators, *Phased locked systems, Reprints.

A long Josephson junction dc biased on a zero-field singularity and emitting radiation at microwave frequencies was irradiated with external microwave power. This power can be supplied either by a room-temperature oscillator or by another long junction. It was found that the oscillations of the junction can coherently lock to the external signal for frequency intervals ranging from 500 MHz. The dependence of the width of these intervals of coherence on the external microwave power was measured for the case in which the power is generated by a room-temperature oscillator.

700,744

PB87-201687

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Precision Power Amplifier for Power/Energy Calibration Applications.

Final rept.,
O. B. Laug. 1987, 6p
Pub. in Proceedings of the Institute of Electrical and Electronics Engineers Instrumentation and Measurement Technology Conference, Boston, MA, April 27-29, 1987, p129-134 1987.

Keywords: *Power amplifiers, Metal oxide transistors, Field effect transistors, MOSFET.

A precision power amplifier for use in power/energy calibration applications is described. The amplifier was primarily designed to boost the output amplitude of a dual-channel digital generator to provide the nominal 120 or 240 rms voltage component of a 'phantom' calibration power source. The amplifier has a fixed gain of 40 and can provide a maximum output voltage swing of 970 volts peak-to-peak or 340 V rms at 100 + or - 5 rms. The bandwidth is from dc to 150 kHz and at 60 Hz the observed no-load, short-term amplitude and phase instabilities are + or - 5 ppm and + or - 5 microradians, respectively. The amplifier design uses high voltage N-channel MOSFETs in the output driver stage together with a unique circuit topology of opto-isolators between the low-level input stage and the high-level output stage.

700,745

PB88-109095

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
Calibrating a Dual Six-Port or Four-Port for Measuring Two-Ports with Any Connectors.

Final rept.,
C. A. Hoer, and G. F. Engen. 1986, 4p
Pub. in 1986 IEEE (Institute of Electrical and Electronics Engineers) MTT-S Digest, p665-668 1986.

Keywords: *Network analyzers, Electrical measurement, Phase shift, Reflection, Scattering, Attenuation, Reprints, *Automatic network analyzers, Calibration, Six port, Four port, Two port.

A technique is described for calibrating a dual six-port or four-port ANA so that the scattering parameters of two-port devices having any combination of connectors can be measured. The technique is a generalization of the 'thru-reflect-line' (TRL) calibration technique in which the 'thru' is replaced with a second length of precision transmission line.

700,746

PB88-109152

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Background and Theory.

Final rept.,
G. F. Engen. 1987, 6p
See also PB88-109160.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p501-506 Jun 87.

Keywords: *Network analyzers, Electrical measurement, Microwave equipment, Metrology, Accuracy, Reprints, *Automatic network analyzers, On line systems, Six port.

One of the major challenges confronting the microwave metrologist today is that of providing an accuracy assessment for the automatic network analyzer (ANA). The paper provides the background and theory for the recently developed on-line solution now in use with the six-port systems at the National Bureau of Standards.

700,747

PB88-109160

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Background and Theory.

Final rept.,
G. F. Engen. 1986, 1p
See also PB88-109152.
Pub. in Proceedings of Conference on Precision Electromagnetic Measurement, Gaithersburg, MD., June 23-27, 1986, p236.

Keywords: *Network analyzers, Electrical measurement, Microwave equipment, Metrology, Accuracy, *Automatic network analyzer, On line systems, Six port.

One of the major challenges confronting the microwave metrologist today is that of providing an accuracy assessment for the automatic network analyzer (ANA). This provides the background and theory for the recently developed on-line solution now in use with the six-port systems at the National Bureau of Standards.

700,748

PB88-109202

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Extension to Nonmating Connectors.

Final rept.,
C. A. Hoer, and G. F. Engen. 1987, 6p
See also PB88-109210.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p524-529 Jun 87.

Keywords: *Network analyzers, Electrical measurement, Electrical impedance, Electric connectors, Error analysis, Reflection, Scattering, Accuracy, Reprints, *Automatic network analyzers, On line systems, Six port.

A technique is described for calibrating a dual six-port or four-port automatic network analyzer (ANA) so that the scattering parameters of two-port devices having any combination of connectors can be measured. The technique is a generalization of the 'thru-reflect-line' (TRL) calibration technique in which the thru is replaced with a second length of precision transmission line. Expressions for errors associated with the second line are derived.

700,749

PB88-109210

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Extension to Non-Mating Connectors.

Final rept.,
C. A. Hoer, and G. F. Engen. 1986, 2p
See also PB88-109202.
Pub. in Proceedings of Conference on Precision Electromagnetic Measurements, Gaithersburg, MD., June 23-27, 1986, p241-242.

Keywords: *Network analyzers, Electrical measurement, Electrical impedance, Electric connectors, Reflection, Scattering, Attenuation, Accuracy, *Automatic network analyzers, On line systems, Six port, Calibration.

In a series of companion papers the background, theory, and experimental results have been presented for a real-time on-line accuracy assessment for the dual six-port ANA. As formulated, however, the procedures are based on the thru-reflect-line (TRL) calibration procedure which, in turn, assumes that the connector interface is of the 'sexless' variety. The paper extends the methodology to mating (e.g. Type N) connector types and also to devices with 'non-insertable' connectors.

700,750

PB88-109228

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Treatment of Systematic Errors.

Final rept.,
C. A. Hoer. 1987, 6p
See also PB88-109236.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p514-519 Jun 87.

Keywords: *Network analyzers, Electrical measurement, Electrical impedance, Microwave equipment, Reflection, Scattering, Accuracy, Error analysis, Reflectometers, Reprints, *Automatic network analyzers, On line systems, Six port, Four port.

Expressions are derived for calculating estimates of the systematic errors in dual six-port or four-port measurements of reflection coefficient and scattering parameters due to imperfections in the transmission-line standard used to calibrate the system. A new mathematical model for a four-port reflectometer makes it easier to visualize and analyze these errors. In the new

model, two of the three parameters needed to characterize a four-port can be determined without standards. All imperfections in the standard perturb only the third parameter which acts as an impedance transformer.

700,751
PB88-109236 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Treatment of Systematic Errors.
Final rept.,
C. A. Hoer. 1986, 2p
See also PB88-109228.
Pub. in Proceedings of Conference on Precision Electromagnetic Measurements, Gaithersburg, MD., June 23-27, 1986, p238-239.

Keywords: *Network analyzers, Electrical measurement, Electrical impedance, Error analysis, Reflectometers, Reflection, Scattering, Accuracy, *Automatic network analyzers, On line systems, Six port, Four port.

Expressions are derived for calculating systematic errors in dual six-port or four-port measurements of reflection coefficient and scattering parameters due to imperfections in the transmission line standard used to calibrate the system. A new mathematical model for a four-port reflectometer makes it easier to visualize and analyze these errors.

700,752
PB88-109269 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Experimental Results.
Final rept.,
J. R. Juroshek. 1987, 4p
See also PB88-109277.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p520-523 Jun 87.

Keywords: *Network analyzers, Electrical measurement, Electrical impedance, Microwave equipment, Reflection, Accuracy, Estimates, Reprints, *Automatic network analyzers, On line systems, Six port.

The accuracy of a modern automatic network analyzer (ANA) is a function of a number of variables. Connector quality, operator technique, system hardware, and system calibration are just a few of the many parameters that affect the day-to-day accuracy of an automated system. The paper describes the results of the current efforts at NBS to implement on-line accuracy estimates for its dual six-port network analyzers. Results are presented showing uncertainty estimates obtained in quasi-real time during the measurement of customers' devices.

700,753
PB88-109277 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Experimental Results.
Final rept.,
J. R. Juroshek. 1986, 1p
See also PB88-109269.
Pub. in Proceedings of Conference on Precision Electromagnetic Measurements, Gaithersburg, MD., June 23-27, 1986, p240.

Keywords: *Network analyzers, Electrical measurement, Electrical impedance, Reflection, Accuracy, Estimates, *Automatic network analyzers, On line systems, Six port.

The accuracy of a modern automatic network analyzer is a function of a number of variables. Connector quality, operator technique, system hardware, and system calibration are just a few of the many variables that can affect the day-to-day accuracy. The talk describes the results of the current efforts at NBS to implement online accuracy estimates for its Dual Six-Port network analyzers. Results are presented showing uncertainty estimates obtained in quasi-real time during the measurement of customers' devices.

700,754
PB88-109285 Not available NTIS

National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Statistical Methods for Random Errors.

Final rept.,
R. M. Judish, and G. F. Engen. Jun 87, 7p
See also PB88-109293.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p507-513 Jun 87.

Keywords: *Network analyzers, Electrical measurement, Random error, Standard deviation, Accuracy, Reprints, *Automatic network analyzers, Nonlinear estimation, Six port, Calibration, Uncertainty, On line systems.

A basic property of a measurement process is that repeated observations of the same quantity will not give identical results due to the presence of random errors. In order to assess the effects of random errors in the authors measurement process, they need to build in redundancy. The paper presents a brief summary of the statistical methods used to evaluate the random errors in dual six-port measurements of reflection coefficient and scattering parameters.

700,755
PB88-109293 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
On-Line Accuracy Assessment for the Dual Six-Port ANA (Automatic Network Analyzer): Statistical Methods for Random Errors.
Final rept.,
R. M. Judish. 1986, 1p
See also PB88-109285.
Pub. in Proceedings of Conference on Precision Electromagnetic Measurements, Gaithersburg, MD., June 23-27, 1986, p237.

Keywords: *Network analyzer, Electrical measurement, Random error, Least squares method, Accuracy, *Automatic network analyzers, On line systems, Six port.

A basic property of a measurement process is that repeated observations of the same quantity will not give identical results due to the presence of random errors. In order to access the effects of random errors in the authors measurement process, they need to build in redundancy. The paper presents the statistical methods which convert the redundancy built into the Dual Six-Port Automatic Network Analyzer (ANA) into meaningful estimates of the random errors.

700,756
PB88-111182 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Test-Point Selection and Testability Measures via QR Factorization of Linear Models.
Final rept.,
G. N. Stenbakken, and T. M. Souders. 1987, 5p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p406-410 Jun 87.

Keywords: Electrical faults, Selection, Mathematical models, Algorithms, Reprints, *Electrical networks, Test methods, Factorization, Calibration.

An efficient algorithm is presented for selecting test points for use in applications such as calibration and fault diagnosis of electronic networks. The algorithm, based on QR factorization of the circuit sensitivity matrix, minimizes the prediction or estimation errors which result from random measurement error. A definition of testability based on the concept of minimum estimation error is also introduced. Practical examples are given.

700,757
PB88-111208 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Design and Characterization of a Programmable Step Generator with Very Fast Settling Performance.
Final rept.,
H. K. Schoenwetter. 1987, 5p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p428-432 Jun 87.

Keywords: *Pulse generators, Step response, Precision, Design, Reprints, Computer applications.

A pulse generator for testing the 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 a 50-ohm termination. Voltage steps within the range settle to within plus or minus 0.2 and plus or minus 0.1 percent of full-scale range (FSR) in approximately 4 and 6 ns, respectively. The 10-90 percent transition duration (TR) is approximately 1.7 ns.

700,758
PB88-111216 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Active High-Voltage Divider and Phase Shifter.
Final rept.,
O. Petersons, and S. P. Mehta. 1987, 7p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p362-368 Jun 87.

Keywords: *Voltage dividers, *Phase shift circuits, Power measurement, Design, Reprints, Calibration.

An instrument combining the functions of an active high voltage divider and a phase shifter designed to yield small phase-angle uncertainties within 20 microrad is described. It is based on a circuit employing a feedback amplifier and a controlled source. The presence of the controlled source greatly reduces the potential for dynamic instabilities of the feedback loop and effectively eliminates the errors associated with the finite gain of the amplifier. Design and construction details and the results of the accuracy evaluation are presented.

700,759
PB88-117577 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Series-Array Josephson Voltage Standards.
Final rept.,
R. L. Kautz, C. A. Hamilton, and F. L. Lloyd. 1987, 8p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics MAG-23, n2 p883-890 Mar 87.

Keywords: *Josephson functions, *Standards, Phase locked systems, Superconductivity, Reprints, *Voltage standards, Chaos.

Series arrays typically including 1500 Josephson junctions driven at 90 GHz have been used to generate quantized reference voltages in excess of 1 V. Such standards simplify the procedure and reduce the measurement uncertainties in the calibration of electrochemical cells.

700,760
PB88-124417
(Order as PB88-124409, PC A04/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.
Automated Potentiometric System for Precision Measurement of the Quantized Hall Resistance.
G. M. Reedtz, and M. E. Cage. 1987, 8p
Prepared in cooperation with Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin (Italy).
Included in Jnl. of Research of the National Bureau of Standards, v92 n5 p303-310 Sep-Oct 87.

Keywords: *Hall effect, *Potentiometers(Instruments), Electrical measurement, Precision, *Quantum Hall effect, Resistance standards, Ohm, Automatic.

The paper describes the development of an automated potentiometric measurement system that is used to compare the quantized Hall resistance with that of wire-wound reference resistors having the same nominal value. Conceptual considerations, along with the major practical problems associated with this method, are presented. The authors then report experimental results which demonstrate that this measurement system is accurate to within a 0.0007 ppm one standard deviation uncertainty.

700,761
PB88-138540
(Order as PB88-138516, PC A04/MF A01)
National Bureau of Standards, Boulder, CO.

Circuits

Low Noise Cascode Amplifier, S. R. Jefferts, and F. L. Walls. 1987, 4p
Prepared in cooperation with Joint Inst. for Lab. Astrophysics, Boulder, CO.
Included in Jnl. of Research of the National Bureau of Standards, v92 n6 p383-386 Nov-Dec 87.

Keywords: *Amplifiers, Transistor amplifiers, Field effect transistors, Equivalent circuits, Performance, Design, *Cascode amplifiers, Low noise, Schematic diagrams, Penning traps, Ion traps.

The article discusses the design, schematics, and performance of a very low noise FET cascode input amplifier. This amplifier has noise performance of less than 1.2 nV/(Hz) to the 1/2 power) and 0.25 fA/(Hz) to the 1/2 power) over the 500 Hz to 50 kHz frequency range. The amplifier is presently being used in conjunction with a Penning ion trap but is applicable to a wide variety of uses requiring low noise gain in the 1 Hz to 30 MHz frequency range.

700,762
PB88-138755 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Electrosystems Div.
High Accuracy, 10 Hz - 1 MHz Automatic AC Voltage Calibration System.
Final rept.,
N. M. Oldham, M. E. Parker, A. Young, and A. G. Smith. 1987, 5p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n4 p883-887 Dec 87.

Keywords: *Voltmeters, Voltage measuring instruments, Alternating current, Converters, Reprints, *Calibration, High accuracy, Automatic.

An automatic system for calibrating high-accuracy ac voltmeters and calibrators is described. The system is based on traditional coaxial, thermal voltage converters to provide ac voltage measurement uncertainties of 5-20 ppm in the audiofrequency range and 5-250 ppm over the full range from 10 Hz to 1 MHz at voltages between 0.5-600 V. Lower levels (0.01-0.5 V) are realized using wideband inductive dividers. Specialized hardware and measurement techniques make it possible to achieve these uncertainties in test periods of approximately 1 min. Random errors introduced by the measurement system are typically less than 2 ppm (one standard deviation).

700,763
PB88-152830 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Electricity Div.
Automated Thermal Voltage Converter Intercomparisons.
Final rept.,
J. R. Kinard, E. S. Williams, and T. E. Lipe. 1986, 3p
Pub. in Proceedings of the IEEE (Institute of Electrical and Electronics Engineers) 74, n1 p105-107 Jan 86.

Keywords: Comparators, Automation, Reprints, *Voltage converters (Ac to AC), *Voltage converters (Dc to dc), Calibration, IEEE-488 standard, Intercomparison.

An automated system for the intercomparison of thermal voltage converters at the National Bureau of Standards-Gaithersburg is described. It employs a two-channel comparator with components interfaced using the IEEE-488 bus standard. The design and performance of the system are presented, and several advantages and disadvantages of this and other automated comparator systems are discussed.

700,764
PB88-153911 Not available NTIS
National Bureau of Standards (NBS), Boulder, CO. Electromagnetic Fields Div.
Automatic Frequency Response of Frequency-Modulated Generators Using the Bessel Method.
Final rept.,
J. R. Major, E. M. Livingston, and R. T. Adair. 1985, 23p
See also PB86-122801. Sponsored by Army Communications-Electronics Command, Fort Monmouth, NJ. Pub. in Proceedings of the Annual Test and Measurement World Expo (4th), San Jose, CA., May 14-16, 1985, v1 p78-100.

Keywords: *Signal generators, *Frequency response, Frequency modulation, Curve fitting, Frequency meters, Bessel null.

The paper describes a Bessel null technique to measure the frequency response of a frequency-modulated

rf carrier and a program to automate frequency response measurements of signal generators with output frequencies from 0.450 to 2000 MHz. The measurements obtained using this technique are more accurate than those obtained by a highly trained technician using a manual system. Automated measurement of the process is desirable since the manual method is subject to the following problems: (1) excessive time; (2) error in finding the null; and, (3) lack of assurance that the null is the first Bessel null. Automated measurements can be performed using a system controller, a spectrum analyzer, a function generator, and a voltmeter (all of which are compatible and controllable remotely).

Electromechanical Devices

700,765
PB88-109251 Not available NTIS
National Bureau of Standards (NBS), Boulder, CO. Electromagnetic Fields Div.
Study of Measurements of Connector Repeatability Using Highly Reflecting Loads.
Final rept.,
J. R. Juroshek. 1987, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques MTT-35, n4 p457-460 Apr 87.

Keywords: *Electric connectors, Electrical measurement, Radio frequencies, Transmission lines, Reproducibility, Network analyzers, Reprints, Reflection coefficients, Automatic network analyzers.

The paper investigates the repeatability of measurements of the reflection coefficient Gamma of highly reflecting devices with changes in the RF connector joint. The changes in the connector joint are due to disconnecting and reconnecting the connector pair. It is shown that many of the measurement discrepancies observed in practice can be explained with a simple connector model. The paper shows that the sensitivity of measuring RF connector changes can be increased by using highly reflecting loads. The basic principles described in the paper should be beneficial to connector designers who need to observe small changes in connector parameters and to the work of calibration standards designers, where small connector imperfections are a major part of their measurement uncertainty.

Optoelectronic Devices & Systems

700,766
PB87-161659 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Radiometric Physics Div.
Semiquantitative Model for the Oxide Bias Experiment and Its Application to the Study of p(1+) nn(1+) Photodiode Degradation.
Final rept.,
J. Verbeut. 1984, 6p
Pub. in Applied Optics 23, n23 p4339-4344, 1 Dec 84.

Keywords: *Photodiodes, Silicon dioxide, Silicon, Interfaces, Efficiency, Reprints.

A model is presented to explain the effect of oxide bias on photodiode collection efficiency. It attempts to distinguish the effects of charge density from those of recombination velocity at the Si-SiO₂ interface. It has been tested by comparison with experimental oxide-bias curves recorded on a p(+)nn(+) photodiode with a thermally grown oxide at different stages of its degradation by excessive oxide bias and partial restoration by exposure to UV radiation. The results indicate that both the interface charge density and trap density are affected in the degradation process. This study has also shown that oxide bias does not restore the collection efficiency strictly to unity.

700,767
PB87-181277 (Order as PB87-181251, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.

Far Ultraviolet Detector Standards, L. R. Canfield, and N. Swanson. 28 Nov 86, 16p
Included in Jnl. of Research of the National Bureau of Standards, v92 n2 p97-112 Mar-Apr 87.

Keywords: *Ultraviolet detectors, *Standards, *Far ultraviolet radiation, Photodiodes, Quantum efficiency, Calibration, Photoionization, US NBS.

A description is given of the NBS program in which special photodiodes for the far ultraviolet spectral region (5-254 nm) are made available as transfer standards. These detectors are calibrated in terms of quantum efficiency (photoelectrons per incident photon) as a function of wavelength. Descriptions are also given of the calibration principles, calibration systems, and photodiode types involved in this program. Calibrations reference to the photoionization of rare gases.

700,768
PB87-227609 PC A05/MF A01
National Bureau of Standards (NBS), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Far Ultraviolet Detector Standards.
Final rept.,
L. R. Canfield, and N. Swanson. Jun 87, 89p NBS/SP-250/2
See also PB87-179883. Also available from Supt. of Docs as SN003-003-02810-0. Library of Congress catalog card no. 87-619832.

Keywords: *Ultraviolet detectors, *Far ultraviolet radiation, *Photodiodes, *Standards, Quantum efficiency, *Calibration, Transfer standards, Photoionization, US NBS.

A description is given of the NBS program in which special photodiodes for the far ultraviolet spectral region (5-254nm) are made available as transfer standards. These detectors are calibrated in terms of quantum efficiency (photoelectrons per incident photon) as a function of wavelength. Descriptions are also given of the calibration principles, calibration systems, and photodiode types involved in this program. Calibrations reference to the photoionization of rare gases.

700,769
PB87-234001 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Radiometric Physics Div.
Photodiode Quantum Efficiency Enhancement.
Final rept.,
R. L. Booker, and J. C. Geist. Jul 82, 11p
Pub. in Optical Radiation News, n40 p1-11 Jul 82.

Keywords: *Photodiodes, Quantum efficiency, Reprints.

The newsletter contains descriptions of technical procedures and results of the NBS program in radiometry, photometry, and spectrophotometry, and reports of significant meetings in the field.

700,770
PB88-139027 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Radiometric Physics Div.
Silicon Photodiode Physics as a Basis for Accurate Radiometry.
Final rept.,
J. Geist. 1985, 4p
Pub. in Transducers '85: Proceedings of the International Conference on Solid-State Sensors and Actuators-Digest of Technical Papers, Philadelphia, PA., June 11-14, 1985, p266-269.

Keywords: *Photodiodes, *Radiometry, Silicon, Standards, Quantum efficiency, Reviews.

The physics behind the operation of silicon photodiodes is reviewed from the point of view of their use as standards of quantum efficiency in radiometric measurements.

700,771
PB88-147582 Not available NTIS
National Bureau of Standards (NBS), Boulder, CO. Electromagnetic Technology Div.

Numerical Study of Currents and Fields in a Photoconductive Detector.

Final rept.,
R. L. Peterson. 1987, 8p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Jnl. of Quantum Electronics QE-23, n7 p1185-1192 Jul 87.

Keywords: *Photoconductive cells, *Photodetectors, Reprints, Schottky diodes, Picosecond pulses, Successive overrelaxation method.

A numerical study of the current, field, and carrier density distributions within a photoconductive detector is presented. The photodetector, an interdigitated Schottky barrier diode, is made with metallic fingers of alternating voltage bias on a thin semiconductor layer grown on a transparent dielectric substrate. The Poisson and continuity equations for electrons and holes are treated in two dimensions. A modified successive line overrelaxation method, faster than the capacitance matrix method, is developed as the Poisson solver. A simple alternative to the Scharfetter-Gummel treatment of current density is also introduced. The authors investigate steady-state cases with and without optical illumination, and transient responses to picosecond optical pulses.

Power & Signal Transmission Devices

700,772
PB87-161501 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Approach for Evaluating Effects of Wall Losses on Quarter-Wave Short-Circuit Impedance Standards.
Final rept.,
H. B. Sequeira, and B. C. Yates. Nov 85, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques MTT-33, n11 p1106-1109 Nov 85.

Keywords: *Waveguides, *Electrical impedance, *Standards, Perturbation theory, Transmission loss, Power loss, Reflection, Reprints, Coaxial configurations.

The conservation of energy principle and first-order perturbation theory have been applied to obtain formulas for the physical lengths and reflection coefficient magnitudes of quarter-wave coaxial and rectangular waveguide short-circuit impedance standards. The expressions for the physical lengths ensure zero phase angle at the mating interface when wall losses are present. The method can be extended to include small dielectric and magnetic losses, and requires only knowledge of the loss-free solutions. It can also be applied to other waveguiding structures which support uncoupled modes.

700,773
PB88-131677 PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Investigation of a Ray-Mode Representation of the Green's Function in a Rectangular Cavity.

Technical note,
D. I. Wu, and D. C. Chang. Sep 87, 48p NBS/TN-1312

Also available from Supt. of Docs as SN003-003-02832-1. Prepared in cooperation with Colorado Univ. at Boulder.

Keywords: *Green function, *Reverberation chambers, Poisson transformation, Modal response, Rectangular waveguides, Numerical solution.

It is known that a point-source excited field in a rectangular cavity can be represented either in terms of summation of modes or in terms of rays produced by the equivalent image sources. Both representations involve series that are slowly convergent, so computation of fields inside the cavity is difficult. To obtain a numerically efficient scheme, a hybrid ray-mode representation is developed here using the finite Poisson summation formula. The modal representation is modified in such a way that all the modes near resonance are retained while the truncated remainder of the mode series is expressed in terms of a weighted contribution of rays. For a large cavity, the contribution of rays from far away images becomes small, therefore the ray sum can be approximated by one or two domi-

nant terms without a loss of numerical accuracy. To illustrate the accuracy and the computational simplification of this ray-mode representation, numerical examples are included with the conventional mode series (summed at the expense of long computation time) serving as a reference.

700,774
PB88-139142 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Screening the Performance of Organic Insulators under Cryogenic Neutron Irradiation.

Final rept.,
M. B. Kasen, and R. B. Stoddard. 1986, 7p
Sponsored by Department of Energy, Washington, DC.
Pub. in Advances in Cryogenic Engineering Materials, v32 p153-159 1986.

Keywords: *Electrical insulation, *Neutron irradiation, *Radiation damage, Superconducting magnets, Cryogenics, Fiber composites, Polyimide resins, *Physical radiation effects.

Specimens and test procedures are being developed for determining the significant parameters influencing resistance of organic insulators to neutron irradiation at 4 K. The specimens are 3.2-mm-diameter rods of exceptionally high quality produced by a method allowing a large number of experimental variables to be evaluated. Flexural and torsional shear tests performed with these specimens indicate that such tests will be useful in studying cryogenic neutron irradiation damage to the fiber-matrix interface. Results of 76-K tests on unreinforced and glass-fiber reinforced epoxy and polyimide materials are presented.

700,775
PB88-147301 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Simple Technique for Determining Joint Losses on a Coaxial Line from Swept-Frequency Reflection Data.

Final rept.,
W. C. Daywitt. 1987, 6p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p468-473 Jun 87.

Keywords: *Coaxial cables, Electrical measurement, Electric connectors, Attenuation, Reflectometers, Reprints, Automatic network analyzers.

A need to separate connector loss from swept-frequency automatic network analyzer (ANA) measurements to check an attenuation calculation for a low-loss coaxial line has led to a simple graphical technique for determining joint losses. Measurements show that in addition to the connector loss, it is also possible to determine joint losses around center conductor bead supports on the line itself. Preliminary results indicate that losses in the millidecibel range can be determined to a precision of a few tenths of a millidecibel or better, even though the data are obscured by considerable connector loss and calibration error. Results were checked by independent measurements and show excellent agreement.

700,776
PB88-147590 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Studies of NbTi Strands Extracted from Coreless Rutherford Cables.

Final rept.,
L. F. Goodrich, E. S. Pittman, J. W. Ekin, and R. M. Scanlan. 1987, 4p
Contract DE-AI05-85ER40240
Sponsored by Department of Energy, Washington, DC.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics MAG-23, n2 p1642-1645 Mar 87.

Keywords: Niobium intermetallics, Titanium intermetallics, Degradation, Reprints, *Superconducting cables, Critical current, Niobium titanium.

The electromechanical properties of NbTi strands extracted from coreless Rutherford cables were studied to clarify the relative effects of strand location and field angle on current degradation that occurs in cables that have been compacted into a keystone shape. Detailed critical-current measurements were made on two samples which were fabricated under controlled conditions. These are prototype cables for high energy

physics applications. Specific factors that are addressed are the nature, location, and amount of degradation. The information is intended to lead to methods for reducing the amount of critical-current degradation in cable manufacture.

700,777
PB88-152848 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Complex Admittance of a Lossy Coaxial Open Circuit with a Hollow Center Conductor.

Final rept.,
W. C. Daywitt. 1987, 10p
Pub. in Metrologia 24, p13-22 1987.

Keywords: *Coaxial cables, *Electrical impedance, Reflectance, Reprints, *Admittance.

The reflection coefficient and complex discontinuity admittance of a coaxial open circuit with a hollow center conductor are derived from fields correct to first order in the skin depth. Results show an admittance terminating the line at the plane of the discontinuity and consisting of a resistance in parallel with a capacitive reactance. The first-order fields are also used to derive equations for the characteristic admittance, series impedance, and shunt admittance of the line. These equations include terms neglected in the well-known expressions used to calculate the line parameters, enabling error limits to be assigned to the latter.

700,778
PB88-155791 PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Center for Electronics and Electrical Engineering.

Measurement of Shielding Effectiveness of Different Cable and Shielding Configurations by Mode-Stirred Techniques.

R. L. Jesch. Oct 87, 24p NBSIR-87/3076
Sponsored by Army Aviation Systems Command, St. Louis, MO.

Keywords: *Transmission lines, *Electric connectors, *Electromagnetic shielding, Radiofrequency interference, Very high frequencies, Ultrahigh frequencies, Superhigh frequencies, Helicopters, Avionics, *Electric cables.

The shielding effectiveness of cable configurations having different shielding arrangements and of shielding configurations used to terminate cable shields for helicopter wiring were measured by mode-stirred techniques. The mode-stirred measurements were taken at discrete frequencies between 200 MHz and 6 GHz. In addition, shielding effectiveness data on the shielding configurations were also obtained in a TEM cell down to 1 MHz. A description of the cable and shielding configurations is given, along with plots of the measured shielding effectiveness data as a function of frequency.

Resistive, Capacitive, & Inductive Components

700,779
PB87-151619 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.

Some Notions Concerning the Behavior of Transducers.

Final rept.,
F. R. Breckenridge, T. M. Proctor, N. N. Hsu, and D. G. Eitzen. 1986, 10p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Progress in Acoustic Emission III, p675-684 1986.

Keywords: *Transducers, Nondestructive tests, Performance.

The ideal receiving transducer would produce an output waveform exactly proportional to the displacement (or velocity) of a point on the medium in one of the three principal directions, and the transducer, itself, would not alter the motion of the point. Real receiving transducers may fail these criteria in several ways: Here, the authors report on how these limitations affect transducer performance and describe the authors efforts to overcome, or at least, measure the

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transducer shortcomings. The relation between sources and receivers is considered. Finally, the authors describe a type of transducer constructed at NBS.

700,780
PB87-161139 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
More Recent Improvements on the NBS (National Bureau of Standards) Conical Transducer.
Final rept.,
T. M. Proctor. Dec 86, 9p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Jnl. of Acoustic Emission 5, n4 p134-142 Oct-Dec 86.

Keywords: *Transducers, Reprints, *Acoustic emission testing, Acoustic emissions, US NBS.

In 1980 the author developed a point contact high fidelity transducer with an acoustic emission receiver. Early details of the construction and its response were given in the Journal (Proctor, 1982). Improvements to the original design have been made to the frequency and time responses. A reduction in physical size has also been achieved, and the electrode durability has been improved. A new electrode system, and an improved system for attaching the active element to the back, are described. The use of compound backings is also discussed.

700,781
PB87-161147 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
NBS (National Bureau of Standards) Conical Transducer: Analysis.
Final rept.,
M. Greenspan. Jan 87, 11p
Pub. in Jnl. of the Acoustical Society of America 81, n1 p173-183 Jan 87.

Keywords: *Transducers, Reprints, *Acoustic emission testing.

The NBS conical transducer is a sensitive, broadband device for the measurement of surface displacement as a function of time. Its uses include acoustic-emission testing. Here, the operation of this transducer is subjected to a straightforward analysis. Although several approximations, some more dubious than others, are made, the model predicts the main features rather well. The important parameters are the size and shape of the active element, the source impedance (looking into the area whose deflection is being measured), and the terminating impedance (back load).

700,782
PB87-161493 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
Shielding Effectiveness Measurements of Plastics.
Final rept.,
J. W. Adams, and E. Vanzura. Oct 86, 4p
See also report dated January 1986, PB86-183605.
Pub. in EMC Technology and Interference Control News 5, n5 p39, 42-44 Sep-Oct 86.

Keywords: *Plastics, *Electromagnetic shielding, Measurement, Effectiveness, Reprints.

Measurement of shielding effectiveness (SE) of plastic materials presents problems because of the insulating nature of many plastics. A method of making the measurements using a flanged coaxial holder overcomes these limitations.

700,783
PB87-161519 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Very Low Noise, Tightly Coupled, dc SQUID Amplifiers.
Final rept.,
B. Muhlfelder, J. A. Beall, M. W. Cromar, and R. H. Ono. 27 Oct 86, 3p
Pub. in Applied Physics Letters 49, n17 p1118-1120 27 Oct 86.

Keywords: Josephson junctions, Magnetometers, Superconductors, Reprints, *SQUID devices.

The authors have fabricated and tested thin film, niobium edge junction, double transformer, dc superconducting quantum interference devices (SQUID's) that

were stable under room-temperature storage and thermal cycling and that had very good noise performance. The input inductance, approximately 1.7 micro H, was large enough to facilitate good matching to many experiments. When the SQUID was operated as a small-signal amplifier, the minimum detectable energy per unit bandwidth (Se) was 5×10 to the -33rd power J/Hz at 100 kHz, referred to the SQUID loop (uncoupled). The minimum detectable energy per unit bandwidth was 1.8×10 to the -31st power J/Hz at 100 kHz, referred to the input coil. The SQUID's had good characteristics for flux-locked operation since the small signal Se was low over a substantial range of bias current and magnetic flux. For operation in a flux-locked feedback circuit, Se was 6×10 to the -32nd power J/Hz at 1 kHz.

700,784
PB87-161618 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Vector Transducer Calibration.
Final rept.,
J. A. Simmons, and H. N. G. Wadley. 1984, 8p
Pub. in Proceedings of Annual Review of Progress in Quantitative Nondestructive Evaluation Conference (10th), Santa Cruz, CA., August 7-12, 1983, p699-706 1984.

Keywords: *Transducers, Ultrasonic radiation, *Calibration, Acoustic emissions, Deconvolution, Elastodynamics.

A receiving ultrasonic or acoustic emission transducer converts a vector property of an elastic wave (particle displacement, velocity or acceleration) to a scalar voltage that is then subsequently processed and analyzed. Recent theoretical advances have enabled prediction of these vector wave quantities and attempts are underway to make accurate measurements that can be compared with theory. An essential step in the process is the calibration of transducers; not just for spectral sensitivity, but for their absolute vector response. A simple scheme for determining the vector calibration of a transducer is derived here from the properties of the Green's tensor of an isotropic elastic body.

700,785
PB87-165585 PC A06/MF A01
National Bureau of Standards (NEL), Boulder, CO. Center for Electronics and Electrical Engineering.
Electromechanical Properties of Superconductors for High-Energy Physics Applications.
J. W. Elkin, L. F. Goodrich, J. Moreland, E. S. Pittman, and A. F. Clark. Dec 86, 112p NBSIR-86/3061
Sponsored by Department of Energy, Washington, DC.

Keywords: *Superconducting magnets, Superconductors, Niobium intermetallics, Titanium intermetallics, Stresses, *Superconducting cables, *Superconducting wires, *High energy physics, *Niobium titanium.

The report covers the first year of a 33-month project to establish a systematic base of experimental data on electromechanical effects in superconducting wire and cables for high-energy-physics magnet applications. The research is focused in four general research areas: electromechanical relationships in NbTi, studies of NbTi strands extracted from cables, sausing effects in NbTi, and studies of the NbTi energy gap.

700,786
PB87-181822 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Disclinations: Their Relation to the Anisotropies of Rare-Earth Hard Magnets.
Final rept.,
M. Melamud, L. H. Bennett, and R. E. Watson. 1987, 4p
Pub. in Scripta Metallurgica 21, p573-576 1987.

Keywords: *Magnets, Magnetic anisotropy, Rare earth elements, Reprints, *Disclinations, Wigner-Seitz method.

It is shown that the disclination pattern obtained by a Wigner-Seitz analysis of the local environments in rare-earth transition-metal crystal structures are correlated with the observed magnetic anisotropies.

700,787
PB87-230975 PC A04/MF A01

National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 92, Number 4, July-August 1987.

Aug 87, 56p
See also PB87-230983 through PB87-231015, and PB87-181251. Also available from Supt. of Docs as SN703-027-00017-2.

Keywords: Superconductivity, Gas chromatography, Wave propagation, Stresses, Concrete, Failure, Non-destructive tests, *SQUID devices, SQUID(Detectors), *Catalytic cracking, *Impact-echo method.

No abstract available.

700,788
PB87-230983 (Order as PB87-230975, PC A04/MF A01)
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Sinusoidal Response of dc SQUIDs (Superconducting Quantum Interference Devices) for rf Power Measurements.
R. L. Peterson. 28 Jan 87, 7p
Included in Jnl. of Research of the National Bureau of Standards, v92 n4 p253-259 Jul-Aug 87.

Keywords: Radiofrequency power, Superconductivity, Attenuation, *SQUID devices, *SQUID(Detectors), Sine waves, Voltage.

Current, power, and attenuation measurements with rf SQUIDs are based on the fact that the voltage from the microwave readout circuit can be made a nearly sinusoidal function of the magnetic flux threading the SQUID. The authors point out here that an asymmetric dc SQUID with sufficiently low inductance can achieve a very sinusoidal output voltage with good modulation depth. The spectral purity of the sinusoid can be substantially better than that obtained with rf SQUID systems.

700,789
PB88-117544 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Operation of a Y-Ba-Cu-O rf SQUID (Superconducting Quantum Interference Device) at 81 K.
Final rept.,
J. E. Zimmerman, J. A. Beall, M. W. Cromar, and R. H. Ono. 1987, 2p
Pub. in Applied Physics Letters 51, n8 p617-618, 24 Aug 87.

Keywords: Barium oxides, Yttrium oxides, Copper oxides, Critical temperature, Superconductors, Reprints, *Squid devices, *Barium copper yttrium oxides.

An rf superconducting quantum interference device (SQUID) has been made from bulk Y-Ba-Cu-O. The device displays quantum interference effects and operates with useful signal levels up to 81 K. The SQUID is formed from a ring of Y-Ba-Cu-O which is broken in the cryogenic environment and then recontacted. Estimates of the SQUID noise performance are given.

700,790
PB88-117585 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Global Stability of Phase Lock Near a Chaotic Crisis in the rf-Biased Josephson Junction.
Final rept.,
R. L. Kautz. 1987, 14p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Jnl. of Applied Physics 62, n1 p198-211, 1 Jul 87.

Keywords: *Josephson junctions, Phase locked systems, Digital simulation, Superconductivity, Stability, Reprints, Voltage standards, Chaos.

The global stability of phase lock in the rf-biased Josephson junction is studied through digital simulations. Global stability is determined by calculating the lifetime of the phase-locked state in the presence of thermal noise. The results are used to determine the optimum critical-current density for series-array voltage standards.

700,791
PB88-120951 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

Resistive, Capacitive, & Inductive Components

Current-Voltage Characteristics of Nanoampere Josephson Junctions.

Final rept.,
R. H. Ono, M. W. Cromar, R. L. Kautz, R. J. Soulen,
J. H. Colwell, and W. E. Fogle. 1987, 4p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics MAG-23, n2
p1670-1673 Mar 87.

Keywords: *Josephson junctions, Electron tunneling, Electric current, Reprints, Voltage.

The authors have studied the current-voltage characteristics of small area tunnel junctions at temperatures below 1 K. The junctions were made in an edge geometry with a Nb base electrode and had areas less than 0.5 micrometer squared, and critical currents in the nA range. Although the measured 1-V characteristics resemble those of ordinary hysteretic junctions, the supposed zero-voltage portion of the curve proved to have a finite slope and to deviate from zero voltage. For these junctions it is apparently possible for occasion 2pi phase slips to occur without switching to the usual voltage state. The behavior can be explained either by macroscopic quantum tunneling, or by a model in which the effective shunt conductance of the junction is frequency dependent.

700,792

PB88-141122

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Electrical Failures Due to Cracks in Multilayer Ceramic Capacitors.

Final rept.,
S. W. Freiman, and A. C. Gonzalez. 1986, 11p
Contract N00014-84-F-0019
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Multilayer Ceramic Society, p191-201 1986.

Keywords: *Ceramic capacitors, *Capacitors, Electrical faults, Crack propagation, Fractures(Materials), Dielectrics, Reprints.

The purpose of the study was to relate electrical failure to the growth of cracks in multilayer ceramic capacitors. Indentation procedures were used to determine K(IC) in both NPO and X7R capacitor compositions. The presence of the metal electrodes in the capacitor was shown to retard crack growth, making the material look 'tougher' than the ceramics alone. It was also shown that a crack intersecting two electrodes would cause electrical failure if, and only if, a conducting medium was present. A test was devised which could separate 'good' capacitors from those containing large enough cracks to eventually lead to failure. The failure-time predictions are in good agreement with actual times-to-failure determined by loading a specimen slowly in a testing machine while monitoring the leakage current.

700,793

PB88-141189

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.

Design and Calibration of a Novel Piezoelectric Point Contact High Fidelity Ultrasonic Transducer.

Final rept.,
S. E. Fick, N. N. Hsu, and T. M. Proctor. 1985, 3p
Pub. in Through the Eyes of an Eagle: Proceedings of the World Conference on Nondestructive Testing (11th), Las Vegas, NV., November 3-8, 1985, p891-893.

Keywords: *Piezoelectric transducers, Waveforms, Design, *Ultrasonic wave transducers, *Calibration.

The report describes the design and construction of a transducer which can generate a point contact normal force whose waveform faithfully reproduces that of the electrical drive signal, and produces an electrical output whose voltage waveform faithfully reproduces the time waveform of the vertical displacement at the point of mechanical contact. The transducer uses a small conical active element with a massive backing. Details of the associated electronic circuitry are presented. Novel applications to which the new transducer is uniquely suited are also discussed.

700,794

PB88-156070

PC A03/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Preparation of Thin Film Polyvinylidene Fluoride Shock Wave Pressure Transducers.

Annual rept.,
A. J. Bur, and S. C. Roth. Dec 87, 24p NBSIR-87/3680
Sponsored by Naval Surface Weapons Center, Silver Spring, MD.

Keywords: *Pressure sensors, *Piezoelectric gages, Ferroelectric materials, Shock waves, Transducers, Vinyl plastics, Fluorine compounds, *Vinylidene fluoride polymers.

Thin film polyvinylidene fluoride transducers have been prepared by a poling procedure which involves the repeated cycling of the applied electric field over the ferroelectric hysteresis curve. Using the procedure, it is possible to prepare a uniformly poled transducer and to establish, with precision, the final remnant polarization. The remnant or permanent polarization is calculated by measuring the total poling charge and subtracting from it that which arises from the resistance and capacitance of the specimen. By this method the authors were able to prepare ten gages with the same remnant polarization with a precision of 0.5%. X-ray observations and measurements of density on an unpoled specimen show that the film is biaxially oriented, contains both alpha and beta phase crystals, and is 50% crystalline.

Semiconductor Devices

700,795

PB87-150744

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Microelectronics Dimensional Metrology in the Scanning Electron Microscope. Part 1.

Final rept.,
M. T. Postek, and D. C. Joy. Nov 86, 6p
Pub. in Solid State Technology 29, n11 p145-150 Nov 86.

Keywords: *Microelectronics, *Line width, *Dimensional measurement, *Metrology, Reprints, *Very large scale integration, *VHSIC circuits, *Scanning electron microscopes, Defects(Materials).

The increasing integration of microelectronics into the submicrometer region for VHSIC and VLSI applications necessitates the examination of these structures both for linewidth measurement and for defect inspection by systems other than the optical microscope. The low beam-voltage scanning electron microscope has been employed recently in this work due to its potentially high spatial resolution and to its large depth of field. The applications of the scanning electron microscope to microelectronics inspection and metrology are discussed in light of the present instrument specifications and capabilities, and the processing controls required for submicrometer processing are examined.

700,796

PB87-153862

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Electrical Linewidth Measurement in the Near- and Sub-Micron Linewidth Region.

Final rept.,
L. W. Linholm, D. Yen, and M. W. Cresswell. 1985, 10p
Pub. in Proceedings of International Symposium on Very Large Scale Integration Science and Technology (3rd), Toronto, Ontario, Canada, May 13-16, 1985, p299-308.

Keywords: *Integrated circuits, *Line width, *Lithography, Silicon, Electrical measurement.

The measurement accuracy of the cross-bridge resistor test structure and test method has been compared to well-characterized optical measurements for samples with near-micrometer and sub-micrometer design dimensions patterned in polysilicon films. Results are presented which show that the electrical measurements agree with the corresponding optical measurements to within the respective uncertainties of both measurements.

700,797

PB87-161873

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Electromigration and the Current Density Dependence.

Final rept.,
H. A. Schafft, T. C. Grant, A. N. Saxena, and C. Y. Kao. 1985, 7p
Pub. in Proceedings of Annual Reliability Physics Symposium (23rd), Orlando, FL., March 26-28, 1985, p93-99.

Keywords: *Integrated circuits, *Microelectronics, Circuit interconnections, Reliability(Electronics), Current density, *Electromigration.

Three papers have proposed theoretical models which attribute the variation of n observed to Joule heating. Such heating must be included when determining the accelerated stress temperature. The present work was begun to test experimentally these proposed explanations. Results indicate that an unambiguous determination of $t(50)$ at use conditions can be made using $n = 1.4$ as the exponent for the stress current density. In order to make the determination, one must take proper account of the effects of Joule heating and of increases in current density and temperature due to resistance increases of the test line during the test.

700,798

PB87-163622

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Modeling of the Process Sensitivity of Submicron Silicon MOSFETs.

Final rept.,
C. L. Wilson, P. Roitman, J. F. Marchiando, and J. L. Blue. 1984, 2p
Pub. in Electrochemical Society Extended Abstracts 84-2, p709-710 1984.

Keywords: *Field effect transistors, *Metal oxide transistors, Semiconductor junctions, Finite element analysis, Mathematical models, Silicon, Reprints, *MOSFET, Two-dimensional calculations.

When short-channel MOSFET transistor models are compared to experimental data, the uncertainty in the process models used as inputs often requires that some of the process model parameters be adjusted to fit the data. In the work the process sensitivity of the source-drain junction is modeled. It was found that sensitivity of the saturated drain current to the source-drain junction depth increases sharply at some critical value of the junction depth. The value of junction depth is reached when the junction depth is equal to the zero biased depletion region width. As the contribution of the source drain junction to the sum of the depletion width and the junction depth becomes significant, the total change in channel field caused by the source-drain junction is a maximum.

700,799

PB87-163630

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Two-Dimensional Modeling of N-Channel MOSFETs Including Radiation-Induced Interface and Oxide Charge.

Final rept.,
C. L. Wilson, and J. L. Blue. 1984, 5p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science 31, n6
p1448-1452 1984.

Keywords: *Field effect transistors, *Metal oxide transistors, Mathematical models, Finite element analysis, Reprints, *MOSFET, Two-dimensional calculations, Physical radiation effects, Interactive graphics.

A model of the radiation-induced charges produced in n-channel MOSFETs is presented. The model is applicable for the unirradiated device and accurately predicts device characteristics for doses of up to 500 krad(Si). The model is verified by comparing the results obtained with the model to n-channel MOSFETs for doses of 0, 10, 50, 100, and 500 krad(Si). Detailed comparison of the model with a 7.8 micrometer channel length transistor, to eliminate short-channel effects, shows excellent agreement between the model and measured current-voltage characteristics in the subthreshold region, the triode region, and the saturation region. Analysis of the model parameters shows that the oxide charge and interface trap density are linear with dose in these devices. The mobility decrease used in the model can best be accounted for by

the combined effects of scattering from oxide and interface charge in the channel.

700,800
PB87-165197 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Semiconductor Electronics Div.
Semiconductor Measurement Technology: A Bibliography of NBS (National Bureau of Standards) Publications for the Years 1962-1986,
J. Walters. Feb 87, 124p NBSIR-87/3522
See also PB87-112298.

Keywords: *Semiconductor devices, *Semiconductors(Materials), *Bibliographies, Integrated circuits, Metrology, Measurement, Reliability(Electronics), Dimensional measurement, Interfaces, Silicon, Germanium, Gallium arsenides, Packaging, Mathematical models, US NBS, Test methods, Listings.

The list of publications contains reports of work performed at the National Bureau of Standards (NBS) in the field of Semiconductor Measurement Technology. The publications are grouped by author in a given year, with the current year appearing first in the listing. An index by topic area is provided. Each topic is followed by year and reference number of the appropriate publication. For the reader's convenience, a list by author is also given. Most of the publications listed herein resulted from work carried out as part of the NB Semiconductor Technology Program (STP). The Program serves to focus NBS research on improved measurement technology for the use of the semiconductor device community in specifying materials, equipment, and devices in national and international commerce, and in monitoring and controlling device fabrication and assembly. The research leads to carefully evaluated, well-documented measurement methods, data, reference artifacts, models and theory, and associated technology which when applied by the industry are expected to contribute to higher yields, lower cost, and higher reliability of semiconductor devices and to provide a basis for controlled improvements in fabrication processes and device performance.

700,801
PB87-173738 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Semiconductor Electronics Div.
Device Physics for Modeling GaAs Bipolar Transistors.
Final rept.,
H. S. Bennett. 1986, 15p
Pub. in Proceedings of Semiconductor Research Corporation Topical Research Conference, Tempe, AZ., April 24-25, 1986, p1-15.

Keywords: *Mathematical models, Gallium arsenides, Silicon, *Bipolar transistors.

The accuracy and reliability of predictions from numerical simulations of advanced bipolar transistors depend on model input parameters. These parameters include the variations with doping and carrier concentrations in both n-type and p-type material of (1) the valence and conduction band edges, (2) the effective intrinsic carrier concentrations, (3) the minority carrier mobilities, and (4) the minority carrier lifetimes. The paper contains a summary of recent advances in device physics for modeling silicon bipolar transistors with submicrometer dimensions and high concentrations of dopant ions and carriers. It also contains preliminary results in device physics for modeling those regions of GaAs bipolar transistors which have high concentrations of either dopant ions or carriers. The latter results are based on lessons learned from modeling advanced silicon bipolar devices.

700,802
PB87-199352 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Precision Engineering Div.
Nondestructive Submicron Dimensional Metrology Using the Scanning Electron Microscope.
Final rept.,
M. T. Postek. 1987, 12p
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6B p1327-1338 1987.

Keywords: *Microelectronics, *Integrated circuits, *Nondestructive tests, *Dimensional measurement, *Line width, Metrology, *Scanning electron microscopy, *Very large scale integration, *Very high speed integrated circuits, *VASIC (Circuits).

The increasing evolution of microelectronics into the submicron region necessitates non-destructive examination of these structures both for linewidth measurement and defect inspection by systems other than the optical microscope. The scanning electron microscope operated in the low beam-voltage mode has been recently employed in this work due to its potentially high spatial resolution and depth of field. The paper discusses the realistic applications of the scanning electron microscope to non-destructive microelectronics inspection and metrology in light of the present instrument specifications and capabilities, and relates it to the processing controls required for submicron metrology.

700,803
PB87-200333 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Semiconductor Electronics Div.
Monte Carlo Calculation of Primary Kinematic Knock-On in SIMS (Secondary Ion Mass Spectrometry).
Final rept.,
J. Albers. 1987, 23p
Pub. in American Society for Testing and Materials Special Technical Publication 960, p535-557 1987.

Keywords: Semiconductor devices, Monte Carlo method, Sputtering, Reprints, *Secondary ion mass spectroscopy, Recoils, Ion implantation.

Secondary Ion Mass Spectrometry (SIMS) occupies a central position in atomic profiling of semiconductor device structures. One of the possibilities for distortion of the profiles is the phenomenon of knock-on where the incident sputtering ion transfers enough kinetic energy to the impurity atoms to push them deeper into the material before they can be sputtered and counted. The effects of sputtering and primary kinematic knock-on are investigated by means of a Monte Carlo code previously used to study ion implantation processes. In particular, the dependence of the primary kinematic knock-on on the mass and energy of the sputtering ion, as well as the mass of the impurity atom, are presented.

700,804
PB87-200341 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Semiconductor Electronics Div.
Some Aspects of Spreading Resistance Profile Analysis.
Final rept.,
J. Albers. 1987, 22p
Pub. in American Society for Testing and Materials Special Technical Publication 960, p480-501 1987.

Keywords: *Electrical resistivity, *Semiconductor devices, *Integrated circuits, Mathematical models, Finite element analysis, Reprints, *Spreading resistance, Very large scale integration, Laplace equation, Poisson equation.

The calculation of resistivity profiles (and carrier density profiles) from spreading resistance requires the use of a correction factor. The present status of the calculation of the correction factor based upon the Schumann and Gardner multilayer solution of Laplace's equation is reviewed and discussed. Recent calculations of carrier densities from atomic densities are also discussed. In particular, the numerical solutions of the semiconductor equations are reviewed, and their implications in the interpretation of spreading resistance measurements for profiling shallow layers are presented. The limitations of the multilayer Laplace equation analysis of spreading resistance in VLSI profiling are also discussed.

700,805
PB87-200358 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Semiconductor Electronics Div.
Ellipsometric Instrumentation for Optical Metrology of Thin Films.
Final rept.,
D. Chandler-Horowitz, and G. A. Candela. 1987, 7p
Pub. in Proceedings of SEMICON/West 1987, San Mateo, CA., May 19-21, 1987, p126-132.

Keywords: *Ellipsometers, *Semiconductor devices, *Thin films, Optical measurement, Polarimetry, Substrates, Metrology, Refractive index.

Nondestructive optical characterization of thin film structures on substrates by ellipsometry is a precise measurement technique which may lead to accurate

metrology. In order to study problems important to semiconductor technology, the authors have built a spectroscopic, multi-angle of incidence, rotating analyzer ellipsometer. The primary metrological requirement for accuracy is to obtain the uncertainties in the instrumental data for a particular sample surface. These data are the ellipsometric values for delta, psi, the angle of incidence phi, and the wavelength lambda. Then a mathematical analysis involving surface modeling is performed to find both the best values of the film parameters and their uncertainties. The ability of this instrument with its increased accuracy can lead to a better understanding of complex multilayered samples, such as possible semiconductor device materials like SIMOX.

700,806
PB87-201646 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Precision Engineering Div.
Submicrometer Optical Linewidth Metrology.
Final rept.,
R. D. Larrabee. 1987, 10p
Pub. in Proceedings of the 1987 Measurement Science Conference, Irvine, CA, pV-D(1)-V-D(10), January 29-30, 1987.

Keywords: *Integrated circuits, *Line width, *Optical measurement, *Standards, *Dimensional measurement, Metrology, Very large scale integration, Edge detection.

The National Bureau of Standards (NBS) has had a continuing program to develop optical linewidth standards for the integrated-circuit industry for over 10 years. The past work has concentrated on the development and the certification of photomask linewidth and pitch standards. The recent work is directed at extending the feature sizes on these standards to cover the range from 0.5 to 30 micrometers, and at doubling the certification accuracy to 0.025 micrometers. Features with heights larger than approximately 1/4 wavelength of light cannot be modeled as zero-thickness layers as is done for photomasks. The development of models to handle this thick-layer case and to develop practical edge-detection criteria are currently under development at NBS. However, at the present time, it is generally not possible to interpret the image profiles of thick features and thereby measure an accurate linewidth. The basic obstacles that must be overcome to achieve accurate submicrometer feature size measurements for these features are reviewed and the prospects for future NBS optical standards for features such as photoresist lines on silicon wafers are assessed. Some suggestions about what to do until these standards become available are given.

700,807
PB87-213476 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 92, Number 3, May-June 1987.
Jun 87, 94p
See also PB87-213484 through PB87-213526 and PB87-181251. Also available from Supt. of Docs as SN703-027-00016-4.

Keywords: *Research, Weight measurement, Mass, Error analysis, Integrated circuits, Dimensional measurement, Optical measurement, Line width, Microelectronics, Nondestructive tests, Argon ions, Scanning electron microscopy, Very large scale integration, Very high speed integrated circuits, VHSIC(Circuits), Charge-exchange reactions, Ion-molecule collisions.

Articles:
Two theories of experimental error;
Submicrometer linewidth metrology in the optical microscope;
Submicrometer microelectronics dimensional metrology--Scanning electron microscopy;
Instrument-independent CAD spectral databases--Absolute cross-section measurements in QQQ instruments;
Note on the choice of a sensitivity weight in precision weighing.

700,808
PB87-213492 (Order as PB87-213476, PC A05/MF A01)
National Bureau of Standards (NEL), Gaithersburg,
MD. Precision Engineering Div.

Submicrometer Linewidth Metrology in the Optical Microscope,
D. Nyssönen, and R. D. Larrabee. 9 Jan 87, 18p
Prepared in cooperation with CD Metrology, Inc., Germantown, MD.
Included in Jnl. of Research of the National Bureau of Standards, v92 n3 p187-204 May-Jun 87.

Keywords: *Integrated circuits, *Dimensional measurement, *Optical measurement, *Line width, Process control, Metrology, Very large scale integration.

Although submicrometer optical linewidth measurement is possible for 0.3 micrometer feature sizes, current instrumentation and linewidth standards, particularly for wafers, will have to radically improve in accuracy as well as in precision to meet the anticipated needs of the integrated circuit (IC) industry for submicrometer dimensional metrology. The paper discusses the effects of inadequate precision and accuracy on process control in IC fabrication and suggests some ways of circumventing these limitations until better instrumentation and standards become available.

700,809
PB87-213500

(Order as PB87-213476, PC A05/MF A01)
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Submicrometer Microelectronics Dimensional Metrology: Scanning Electron Microscopy,
M. T. Postek, and D. C. Joy. 9 Jan 87, 24p
Prepared in cooperation with A.T. and T. Bell Labs., Murray Hill, NJ.
Included in Jnl. of Research of the National Bureau of Standards, v92 n3 p205-228 May-Jun 87.

Keywords: *Microelectronics, *Integrated circuits, *Dimensional measurement, *Nondestructive tests, *Line width, Metrology, *Scanning electron microscopy, *Very large scale integration, *Very high speed integrated circuits, *VHSIC(Circuits).

The increasing integration of microelectronics into the submicrometer region for VHSIC and VLSI applications necessitates the examination of these structures both for linewidth measurement and defect inspection by systems other than the optical microscope. The low beam-voltage scanning electron microscope has been recently employed in this work due to its potentially high spatial resolution and large depth of field. The paper discusses applications of the scanning electron microscope to microelectronics inspection and metrology in light of the present instrument specifications and capabilities, and relates the scanning electron microscope to the controls required for submicrometer processing.

700,810
PB87-223749 PC A02/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Double-Level Metallization: Annual Report for October 1, 1985 to September 30, 1986,
G. P. Carver, D. B. Novotny, R. Hershey, and J. E. Luther. Jun 87, 25p NBSIR-87/3579

Keywords: *Integrated circuits, *Microelectronics, *Metallizing, *Semiconductor devices, Fabrication, Polyimide resins, Aluminum silicon alloys, Silicon dioxide, Tests, Chemical vapor deposition.

An outline for a double-level metal process for the fabrication of circuits having a minimum linewidth of 3 micrometers is described. The process is designed to be implemented in the Microelectronics Processing Facility at Fort Meade, Maryland, where single-level metallization circuits are already in production. A summary is included of the research performed in the Semiconductor Processing Research Laboratory at the National Bureau of Standards.

700,811
PB87-224143 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Spreading Resistance Measurements - An Overview.
Final rept.,
J. R. Ehrstein. 1987, 27p
Pub. in American Society for Testing and Materials Special Technical Publication 960, p453-479 1987.

Keywords: *Silicon, Electrical measurement, Reviews, Reprints, *Spreading resistance, Ion implantation, Depth profiles, Doped materials.

Spreading Resistance is the most versatile electrical technique for characterizing depth profiles in silicon. However, it is being increasingly challenged as an analytical method by shrinking device geometries. Consequently, refinement of such aspects as probe conditioning, sample preparation, and bevel angle measurement is needed, and traditional practice regarding calibration, algorithms, and profile interpretation must be reexamined. Based on examples drawn from the author's work, multilaboratory experiments, and recent literature to illustrate and discuss these topics, this paper attempts to summarize the current status of the measurement and its interpretation, showing both strong points and apparent limitations.

700,812
PB87-224614 PC A15/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
RADC/NBS (Rome Air Development Center/National Bureau of Standards) Workshop. Moisture Measurement and Control for Microelectronics (4),
D. Kane, B. A. Moore, and E. J. Walters. Jun 87, 343p NBSIR-87/3588
See also report dated May 84, PB84-219559. Sponsored by Rome Air Development Center, Griffiss AFB, NY.

Keywords: *Semiconductor devices, *Integrated circuits, *Moisture content, *Meetings, Measurement, Hermetic seals, Mass spectroscopy, Moisture meters, Packaging, Quality control, Reliability(Electronics).

The fourth Workshop on Moisture Measurement and Control for Microelectronics served as a forum on moisture and/or materials reliability problems and on ways to control them or measure their extent. Twenty-two presentations are included which contain detailed information on hermeticity measurement and definition; development of standard packages for mass spectrometric calibrations; moisture interaction with various materials; and techniques that can be used to measure moisture microelectronics. It was clear from several presentations in the workshop that a very systematic approach is needed when organic materials are involved; all the variables must be identified and studied one at a time. This is the key to lot-to-lot reproducibility, materials selection, and control; hence a better reliability at the design phase will decrease the need for testing; hence the cost, thus resulting in a greater satisfaction to the customer.

700,813
PB88-109061 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Fundamental Principles for Gallium Arsenide Devices.
Final rept.,
H. S. Bennett. 1987, 3p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) International Symposium on Circuits and Systems, Philadelphia, PA., May 4-7, 1987, p12-14 1987.
Keywords: *Field effect transistors, *Gallium arsenides, Mathematical models, Simulation, Silicon, Bipolar transistors, Heterojunctions.

Recent advances in physics for submicron silicon devices suggest lessons or principles that are valid when numerically simulating the behavior of GaAs devices. These lessons from physics for silicon devices are summarized, and their implications for GaAs devices are given.

700,814
PB88-109103 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Thermal Analysis of Electromigration Test Structures.
Final rept.,
H. A. Schafft. 1987, 9p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices ED-34, n3 p664-672 Mar 87.

Keywords: *Microelectronics, Electronic test equipment, Thermal analysis, Reprints, *Electromigration, Metallization, Temperature profiles.

Analytical expressions are derived for estimating the temperature profile along a straight-line resistor test structure due to the joule heating generated by a high current-density stress, such as is used in accelerated

stress tests to characterize metallizations for electromigration. It is shown how an improved estimate of the mean metallization stress temperature may be made and how the thickness and thermal conductivity of the underlying electrical insulator affect the temperature profile of the metallization. Recommendations for the design of electromigration test structures are developed that will promote reduced temperature gradients in the metallization during stress testing and improved reproducibility of electromigration characterizations.

700,815
PB88-109111 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Comprehensive Test Chip for the Characterization of Multi-Level Interconnect Processes.
Final rept.,
D. J. Radack, J. C. Swartz, L. W. Linholm, and M. W. Cresswell. 1987, 7p
Pub. in Proceedings of International IEEE (Institute of Electrical and Electronics Engineers) VLSI Multilevel Interconnection Conference (4th), Santa Clara, CA., June 15-16, 1987, p238-244 1987.

Keywords: *Integrated circuits, *Circuit interconnections, Electronic test equipment, Performance, Evaluation, *Very large scale integration, Chips(Electronics), Test methods.

A test chip for the evaluation and characterization of multi-level interconnect processes has been developed. The test chip contains test structures which allow a process engineer to make comparative, quantitative measurements for evaluating the performance of selected processes and equipment. The paper describes the design and testing of selected test structures and presents initial test results.

700,816
PB88-109129 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Sub-Micron Lithography Characterization Using an Expert System.
Final rept.,
M. W. Cresswell, N. Pessall, R. J. Betsch, L. W. Linholm, and D. J. Radack. 1987, 8p
Pub. in Proceedings of SPIE (Society of Photo-Optical Instrumentation Engineers) Integrated Circuit Metrology, Inspection, and Process Control Conference, Santa Clara, CA., March 4-6, 1987, p304-311 1987.

Keywords: *Integrated circuits, *Semiconductor devices, *Lithography, Artificial intelligence, Performance, Automation, Expert systems, Test methods, Chips(Electronics).

The paper describes a test chip, test results, rule generation techniques, and an expert system for characterizing the performance of a sub-micron lithography process. Examples of test results, data reduction techniques, and expert system output are given. The objective of the work is to develop a system for automatic process diagnosis.

700,817
PB88-109137 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Innovative Measurement of Specific Contact Resistivity Confirms Lower Aluminum-Silicon Contact Resistance.
Final rept.,
G. P. Carver, D. B. Novotny, and J. J. Kopanski. 1987, 7p
Pub. in Proceedings of International IEEE (Institute of Electrical and Electronics Engineers) VLSI Multilevel Interconnection Conference (4th), Santa Clara, CA., June 15-16, 1987, p337-343 1987.

Keywords: *Integrated circuits, *Electric contacts, Electrical resistivity, Aluminum, Silicon, *Contact resistance, Schottky barriers, Schottky diodes, Spreading resistance.

New accurate measurements prove that the value of the aluminum-silicon specific contact resistivity is much smaller than the value determined previously by the use of two-level planar contact resistor structures. Values of the specific contact resistivity between an aluminum alloy containing 1.5 percent silicon and silicon wafers were measured for p-type silicon resistivities in the range from 0.006 to 25 ohm-cm and for n-type silicon resistivities in the range from 0.0014 to

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0.0026 ohm-cm. The specific contact resistivity values obtained are about five times smaller than values reported from two-level planar structures, suggesting that aluminum may be useful for contact dimensions as small as 0.5 micrometer on a side. With the new results, multilevel conductor systems can be designed for optimal performance.

700,818

PB88-110697

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Submicrometer Optical Linewidth Metrology.

Final rept.,

R. D. Larrabee. 1987, 5p

See also PB87-201646.

Pub. in Proceedings of SPIE (Society of Photo-Optical Instrumentation Engineers) Integrated Circuit Metrology, Inspection, and Control, Santa Clara, CA., March 4-6, 1987, p46-50 1987.

Keywords: *Integrated circuits, *Line width, *Dimensional measurement, Optical measurement, Metrology, Standards, *Very large scale integration, Edge detection.

The National Bureau of Standards (NBS) has had a continuing program to develop optical linewidth standards for the integrated circuit industry for over 10 years. The past work has concentrated on the development and the certification of photomask linewidth and pitch standards. The recent work is directed at extending the feature sizes on these standards to cover the range from 0.5 to 30 micrometers, and at doubling the certification accuracy to 0.025 micrometer. The basic obstacles that must be overcome to achieve accurate submicrometer feature size measurements for these features are reviewed, and the prospects for future NBS optical standards for features such as photoresist lines on silicon wafers are assessed. Some suggestions about what to do until these standards become available are given.

700,819

PB88-121918

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Submicrometer Dimensional Metrology in the Scanning Electron Microscope.

Final rept.,

M. T. Postek. 1987, 6p

Pub. in SPIE (Society of Photo-Optical Instrumentation Engineers) - Integrated Circuit Metrology, Inspection, and Process Control, v775 p166-171 1987.

Keywords: *Integrated circuits, *Line width, *Dimensional measurement, Metrology, Standards, Reprints, *Scanning electron microscopes, Scanning electron microscopy.

The National Bureau of Standards has initiated a program to develop scanning electron microscope linewidth measurement standards for the integrated circuit community. The program involves the development of: a scanning electron microscope-based linewidth measurement and standard reference material certification instrument, the necessary electron beam/sample interaction modelling, and the appropriate micrometer and submicrometer artifacts. The basic problems that must be overcome to achieve accurate submicrometer feature size measurements in the scanning electron microscope for these artifacts will be reviewed and some suggestions of what can be done to 'bridge-the-gap' until such standards become available will be given.

700,820

PB88-138805

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Alternative EMI (Electromagnetic Interference) Measurement Techniques for Microelectronic Circuits.

Final rept.,

G. R. Reeve. 1986, 4p

Pub. in Proceedings of International Conference on Electromagnetic Compatibility, EMC EXPO 86, Washington, DC., June 16-19, 1986, pT26.1-T26.4.

Keywords: *Integrated circuits, *Electromagnetic interference, Microelectronics, Very large scale integration, Very high speed integrated circuits, Reverberation chambers, Optoelectronic devices.

With increasingly complex integrated circuits being designed for the Very Large Scale Integrated Circuit

(VLSI), and the Very High Speed Integrated Circuit (VHSIC) programs, using larger chip areas and smaller device geometries, there is some concern that these units, either by themselves or in application circuits, will prove more susceptible to the effects of electromagnetic interference (EMI). Existing techniques using pin voltage upset measurements may not be sufficient to properly characterize the behavior of these integrated circuits (ICs) in the presence of EMI. Some possible adaptations of EMI measurement techniques presently in use or being developed at the National Bureau of Standards (NBS) and other laboratories are presented for consideration.

700,821

PB88-138839

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Status: Interlaboratory Electromigration Experiment.

Final rept.,

H. A. Schafft. 1985, 4p

Pub. in Proceedings of the Wafer Reliability Assessment Workshop, Lake Tahoe, CA., October 20-23, 1985, p213-216.

Keywords: *Electromigration, Test methods.

The purpose of the experiment is to assess the reproducibility of electromigration characterizations, the median-time-to-failure, t_{50} . Of more lasting importance, the purpose is also to develop guidelines for the design of test structures, for methods to measure t_{50} , and for reporting characterization results.

700,822

PB88-138847

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Measurements for VLSI Models.

Final rept.,

K. F. Galloway. 1985, 8p

Pub. in Proceedings of the International Workshop on the Physics of Semiconductor Devices (2nd), Delhi, India, December 5-10, 1983, p98-105 1985.

Keywords: *Integrated circuits, Computerized simulation, Measurement, *Very large scale integration, Computer aided design.

The complexity of VLSI makes an experimental approach to design and fabrication unrealistic. Accurate, computer-based models for simulating processes, devices, and circuits are required to competitively develop VLSI technologies. The effectiveness of these models is often limited by the accuracy of the physical parameters used as input for the simulations. The paper summarizes results from two recent projects on measurement technology for obtaining parameters for VLSI models to illustrate the research in this area at the National Bureau of Standards.

700,823

PB88-138854

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Metrological Challenges in Semiconductor Technology: Electrical Measurements of Dimensions and Materials Properties Using Integrated Circuit Test Structures.

Final rept.,

K. F. Galloway, S. E. Diehl, and L. W. Linholm. 1987, 3p

Pub. in Proceedings of the International Conference on Semiconductor and Integrated Circuit Technology, Beijing, China, October 19-26, 1986, p685-687 1987.

Keywords: *Integrated circuits, *Microelectronics, *Dimensional measurement, Electrical measurement, Metrology, Wafers, *Very large scale integration, Chips(Electronics).

The effective characterization and control of the materials, processes, devices, and circuits for very-large-scale integration (VLSI) is a major concern for semiconductor technology development. The paper reviews the types of metrological requirements associated with VLSI semiconductor technology and examines dimensional measurements and materials characterization at the wafer or chip level. Integrated circuit test structures for electrical measurements of dimensions and material properties are described.

700,824

PB88-141338

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Submicron Device Physics for Numerical Simulations.

Final rept.,

H. S. Bennett. 1987, 7p

Pub. in Physics of Amorphous Semiconductor Devices, SPIE (Society of Photo-Optical Instrumentation Engineers), v763 p134-140 1987.

Keywords: *Semiconductor devices, Mathematical models, Simulation, Bipolar transistors, Amorphous silicon, Subminiaturization, Heterojunctions, Amorphous materials, Numerical solution.

Recent advances in physics for submicron, bipolar-crystalline devices suggest principles that are valid when modeling bipolar devices with noncrystalline regions such as those with polysilicon, polycrystalline silicon, and hydrogenated amorphous silicon emitters. These principles from crystalline device physics are summarized, and their implications for the noncrystalline regions of bipolar devices are given.

700,825

PB88-147418

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Charge-Sheet Model Fitting to Extract Radiation-Induced Oxide and Interface Charge.

Final rept.,

K. F. Galloway, C. L. Wilson, and L. C. Witte. 1985, 5p

Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science 32, n6 p4461-4465 1985.

Keywords: *Metal oxide transistors, *Electric charge, Mathematical models, Reprints, *MOSFET, One-dimensional calculations, Physical radiation effects, Charge sheet model.

A method for extracting values of oxide and interface charge from the current-voltage (I-V) characteristics of long-channel MOSFETs is described. The one-dimensional charge-sheet model developed by Brevs provides the basis for the I-V characteristics. The I-V characteristics given by this model are optimized with respect to a set of experimental data for an irradiated device with the flatband voltage and the mobility the only free parameters. Simple relationships between these parameters and the radiation-induced interface and oxide charge are assumed.

700,826

PB88-147426

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Modeling Silicon Emitters for VLSI Transistors.

Final rept.,

H. S. Bennett. 1987, 5p

Pub. in Solid-State Electronics 30, n11 p1137-1141 1987.

Keywords: *Integrated circuits, Carrier mobility, Silicon, Reprints, *Very large scale integration, *Bipolar transistors, Density of states, Carrier lifetime, Band theory.

The accuracy and reliability of predictions from numerical simulations of advanced bipolar transistors for VLSI applications depend on model input parameters. These parameters include the variations with doping and carrier concentrations in both n-type and p-type silicon of (1) the valence and conduction band edges, (2) the effective intrinsic carrier concentrations, (3) the minority carrier mobilities, and (4) the minority carrier lifetimes. This paper reviews recent advances in device physics for modeling the emitters of bipolar transistors with submicrometer dimensions and high concentrations of dopant ions and carriers.

700,827

PB88-147434

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Testability Measures for the Design of Digital ICs (Integrated Circuits).

Final rept.,

M. E. Zaghloul. 1987, 11p

Pub. in Semicustom Design Guide II, n2 p98-108 1987.

Keywords: *Integrated circuits, Design, Tests, Algorithms, Comparison, Reprints, Digital circuits.

The paper is an overview of testability measures in the design of digital integrated circuits. Commercial testability algorithms are described and compared. Recent developments on testability measures which enhance the role of testability are discussed.

700,828
PB88-152780 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Time Perturbation Analysis for the MOS (Metal-Oxide-Silicon) System.
Final rept.,
M. Gaitan, and I. D. Mayergoyz. 1987, 7p
Pub. in *Fundamental Research on the Numerical Modeling of Semiconductor Devices and Processes*, p77-83 1987.

Keywords: *Capacitors, Electron traps, Hole traps, Interfaces, Silicon, Silicon dioxide, *Metal oxide semiconductors.

The development of a numerical implementation of the small signal response of the MOS (Metal-Oxide-Silicon) capacitor using time perturbation analysis is discussed. The effects of nonconstant doping profiles and interface and bulk traps are included. The model uses Fermi-Dirac statistics to describe the occupancy of the interface and bulk traps. The oxide region is considered to have no mobile carriers and any fixed oxide charge distribution is modeled as a charge sheet at the Si-SiO₂ interface. The technique can be used to find the small signal response of the device from the static solution.

700,829
PB88-152798 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Effect of Selected Aqueous Semiconductor Reagents on Commercial Piping of Perfluoroalkoxy Fluorocarbon Resin and of Ethylene-Chlorotrifluoroethylene Fluoropolymer Resin.
Final rept.,
J. F. Imbalzano, J. R. Moody, and R. L. McKenzie. 1986, 3p
Sponsored by Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
Pub. in *Solid State Technology* 29, n8 p135-137 Aug 86.

Keywords: *Semiconductor devices, *Fluorohydrocarbons, Contamination, Water, Polymers, Materials tests, Chemical attack, Reprints, *Fluoropolymers, *Fluorohydrocarbon resins, Reagents, Acids, Alkalies.

Eliminating contamination in semiconductor devices requires that the polymeric materials which contact the harsh aqueous reagents used in their production be unaffected by those reagents. A comparative study was conducted of the effects of aqueous acid, aqueous alkali, and 18 megohm water, at concentrations and conditions common in the semiconductor industry, on commercial piping of perfluoroalkoxy (PFA) fluorocarbon resin, and of ethylene-chlorotrifluoroethylene (ECTFE) fluoropolymer resin. The results are discussed.

700,830
PB88-153960 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Scanning Electron Microscope Linewidth Measurement Standards Program at the National Bureau of Standards.
Final rept.,
M. T. Postek, R. D. Larrabee, and W. J. Keery. 1987, 6p
Pub. in *EMSA (Electron Microscope Society of America) Bulletin* 17, n2 p59-64 Nov 87.

Keywords: *Electron microscopy, *Line width, *Dimensional measurement, Metrology, Reprints, *Scanning electron microscopes.

The development of the linewidth measurement standards requires the development of: (1) a scanning electron microscope based linewidth measurement certification instrument; (2) computer models to predict the electron beam/sample/instrument interaction within the SEM; and (3) the actual micrometer and submicrometer feature-size standards per se. The presentation outlines some of the basic problems that must be overcome to achieve accurate submicrometer feature-size measurements in the scanning electron microscope, and offers some suggestions of what can be done until

suitable standards for such measurements become available.

700,831
PB88-154745 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Reproducibility of Electromigration Measurements.
Final rept.,
H. Schafft, T. Staton, J. Mandel, and J. Shott. 1987, 9p
See also AD-A177 369. Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices* ED-34, n3 p673-681 Mar 87.

Keywords: *Integrated circuits, Electrical measurement, Metallizing, Precision, Reliability(Electronics), Reproducibility, Reprints, *Very large scale integration, *Electromigration, Interlaboratory comparisons.

The reproducibility of median-time-to-failure (t(50)) measurements was determined in an interlaboratory experiment in which 11 laboratories and a reference laboratory took part. Each laboratory used a method of its choosing to test equivalent samples under the same conditions of current density and oven temperature. The between-laboratory reproducibility of t(50) measurements normalized to one metallization temperature was dependent on current-density stress; at 1.0 MA/sq cm it was within 15 percent, while at 2.5 MA/sq cm it was generally within 50 percent. The primary source for variability is in estimating the temperature rise of the test metallization due to joule heating. Recommendations are given for the design and test of electromigration test structures to improve the reproducibility of t(50) measurements.

700,832
PB88-155767 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
Low Accelerating Voltage Pitch Standard Based on the Modification of NBS (National Bureau of Standards) SRM (Standard Reference Material) 484.
M. T. Postek. Nov 87, 14p NBSIR-87/3665
Sponsored by Harry Diamond Labs., Adelphi, MD.

Keywords: *Standards, Dimensional measurement, Integrated circuits, Nondestructive tests, Line width, Metrology, Wafers, *Scanning electron microscopes, *Standard reference materials.

The National Bureau of Standards (NBS) is actively developing micrometer and submicrometer standards for the scanning electron microscope (SEM). This report summarizes the progress made to extend the imaging range of the presently available SRM 484 for use as an interim standard for low accelerating voltage magnification calibration applications for this instrument. NBS is actively developing micrometer and submicrometer standards for dimensional metrology in the SEM. The only magnification standard reference material (SRM) presently available for calibrating scanning electron microscopes is SRM 484. The standard provides a known pitch between gold lines in a nickel matrix and has proven useful for many SEM applications. However, SRM 484 was developed prior to the recent interest in nondestructive, low accelerating voltage SEM operation. The driving force for nondestructive inspection at low accelerating voltages has been the semiconductor industry for integrated circuit mask and wafer inspection and measurement.

700,833
PB88-155783 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Effect of the Gate Oxide Thickness on the Speed of MOS Integrated Circuits.
J. S. Kim. Dec 87, 19p NBSIR-87/3668

Keywords: *Integrated circuits, Metal oxide transistors, Velocity, Thickness, Oxides, Gates(Circuits), *Very large scale integration, MOSFET.

A simple analysis is presented for the effect of the gate oxide thickness on the circuit speed in a short-channel CMOS/inverter delay circuit. The present analysis is performed within the first-order theory of the MOS transistor. The result of the analysis shows that an optimum value of the gate oxide thickness exists, beyond which a further scaling of the gate oxide will not improve but degrade the circuit speed. The circuit speed

corresponding to this optimum oxide thickness is the ultimate upper limit theoretically possible in a given MOS integrated circuit. The optimum value of the gate oxide thickness, to the first order approximation, is proportional to the channel width W, but it is independent of the channel length L. In particular, for wide channel devices, this optimum value exceeds the 5 nm - 30 nm range, which is of practical significance in the design and processing of advanced VLSI circuits.

700,834
PB88-156716 PC A10/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Silicon-on-Insulator: A Categorized Bibliography Including Abstracts.
Special pub.,
A. Baghdadi, and E. J. Walters. Dec 87, 215p NBS/SP-400/80
Also available from Supt. of Docs. as SN003-003-02839-8. Library of Congress catalog card no. 87-619901. Sponsored by Army Strategic Defense Command, Huntsville, AL.

Keywords: *Bibliographies, Thin films, Materials, Silicon nitrides, Abstracts, *SOI (Semiconductors), SOS (Semiconductors), Recrystallization, Epitaxial growth, Molecular beam epitaxy, Polysilicons, INSPEC data base, Engineering index data base, Chemical abstracts data base.

The bibliography of silicon-on-insulator SOI technology was compiled from a literature search of three data bases: INSPEC, Engineering Index, and Chemical Abstracts. The bibliography has been categorized according to the technique used to produce the SOI substrate. It includes the abstracts for most of the papers. It can either be used to obtain a quick evaluation of the 'state of the art' in a particular SOI technique, or as a guide for further in-depth study.

General

700,835
PB87-150777 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
NBS (National Bureau of Standards) Absolute Ampere Experiment.
Final rept.,
P. T. Olsen, V. E. Bower, W. D. Phillips, E. R. Williams, and G. R. Jones. Jun 85, 7p
Pub. in *Institute of Electrical and Electronics Engineers Transactions on Instrumentation and Measurement* IM-34, n2 p175-181 Jun 85.

Keywords: Electrical measurement, Fundamental constants, Precision, Reprints, *Ampere, Current balances, Superconducting coils.

A current balance was constructed with superconducting field coils, for the realization of the SI ampere by comparing mechanical to electrical work. The estimated ultimate accuracy of the realization is 0.1 ppm. Preliminary results obtained with a room temperature version of the apparatus are presented and discussed.

700,836
PB87-151460 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.
Measurement Assurance and Accreditation.
Final rept.,
J. W. Locke. Jan 86, 3p
Pub. in *Proceedings of the Institute of Electrical and Electronics Engineers* 74, n1 p21-23 Jan 86.

Keywords: *Microwaves, Attenuation, Power, Reflection, Calibrating, *Measurement assurance problems, *Accreditation.

The National Bureau of Standards has offered to accreditation laboratories for making microwave power, attenuation, and reflection coefficients. The accreditation would be based upon full documentation of the applicant laboratory's procedures and participation in appropriate measurement assurance programs. Although five calibration laboratories expressed interest in the program, a source of funding for developing the measurement assurance programs has not been found.

ELECTROTECHNOLOGY

General

700,837
PB87-152161 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Electrosystems Div.
**Precision Programmable Step Generator for Use in
Automated Test Systems.**
Technical note,
H. K. Schoenwetter, D. R. Flach, T. M. Souders, and
B. A. Bell. Dec 86, 99p NBS/TN-1230
Also available from Supt. of Docs as SN003-003-
02786-3. Sponsored by Sandia National Labs., Albu-
querque, NM.

Keywords: Pulse generators, Transient response,
*Step generators, *Waveform recorders, *Automatic
test equipment.

A precision voltage step generator has been designed
for use in automated systems to test the dynamic re-
sponse of waveform recorders and other instruments.
The programmable pulse parameters include transi-
tion polarity, pulse length, and repetition rate. The ini-
tial and final levels of voltage steps are each program-
mable within the range of + or - 1 V for a 50 ohm
termination and within + or - 5 V for a high impedance
load. Voltage steps within these ranges settle to within
+ or - 0.02% of full scale range (FSR) in less than 22
and 26 ns, respectively, for small load capacitance.
The corresponding transition durations are approxi-
mately 6 and 7 ns.

700,838
PB87-157095 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
**Directional Scanning Technique for Characteriza-
tion of Complex Electromagnetic Environments.**
Final rept.,
J. Randa, and M. Kanda. 1985, 4p
Pub. in Proceedings of AP-S International Symposium
on Antennas and Propagation-Symposium Digest,
Vancouver, Canada, June 17-19, 1985, p521-524.

Keywords: *Electromagnetic environments, Electro-
magnetic compatibility, Electromagnetic interference,
Plane waves, Electric fields, Simulation, *Directional
scanning.

The problem of characterizing complicated electro-
magnetic environments without actually measuring the
field(s) throughout the entire volume of interest is of
great practical importance in the areas of EMI/EMC
electromagnetic hazard assessment, etc. The ques-
tion is how to obtain useful information about the
volume of interest from a reasonably small number of
measurements. A recent suggestion which appears to
hold considerable promise is to use a directional probe
to measure at one point the field incident from different
directions and then to reconstruct or bound the field
throughout the volume by using these measurements
in conjunction with a plane-wave expansion of the
field. The authors have now completed the formulation
and performed simulations for the (vector) electric
field, and they report the results in this paper. Simu-
lation results are encouraging.

700,839
PB87-157103 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
**Multiple-Source, Multiple-Frequency Error of an
Electric Field Meter.**
Final rept.,
J. Randa, and M. Kanda. 1985, 8p
Pub. in Institute of Electrical and Electronics Engineers
Transactions on Antennas and Propagation AP-33, n1
p2-9 Jan 85.

Keywords: *Electric fields, *Electric measuring instru-
ments, Dipole antennas, Error analysis, Reprints, Elec-
tric field strength.

Electric field meters (EFM's) are typically calibrated
using single-frequency, single-source standard fields.
The response to multiple sources or nonsinusoidal
time dependence may be different, however. Possible
errors in a multiple-source, multiple-frequency environ-
ment are analyzed for an EFM consisting of an electri-
cally short dipole antenna with a diode load and an RF
filter transmission line. Also considered are errors in
the assumption of equal electric and magnetic energy
densities in a multiple plane-wave environment. Typi-
cal errors of field intensity measurements are about
one to three dB but in some circumstances they can
exceed 10 dB.

700,840
PB87-161410 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
**Impact of Automation on NBS (National Bureau of
Standards) Noise Temperature Measurements.**
Final rept.,
D. F. Wait. Jan 86, 4p
Pub. in Proceedings of the Institute of Electrical and
Electronics Engineers 74, n1 p117-120 Jan 86.

Keywords: *Standards, *Calibrating, Reflectometers,
Linearity, Automation, Reprints, *Thermal noise,
*Noise temperature.

The accuracy of calibrating a thermal noise source
using the National Bureau of Standards' automated ra-
diometer and cryogenic, primary noise standards is
typically + or - 2%, compared with + or - 3% for cor-
responding services that used manual radiometers
and hot primary standards. Using the automated ra-
diometer, a noise source can typically be calibrated at
three frequencies in the time a manual radiometer re-
quires to calibrate one. The automated radiometer
contains a 6-port reflectometer, and noise sources
with reflection coefficients as great as 0.3 can be toler-
ated without significantly affecting the calibration accu-
racy. This makes it practical to use a single broad-band
coaxial noise standard from 0.03 GHz to 14 GHz.

700,841
PB87-161451 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
**Standards for Electromagnetic Field Measure-
ments.**
Final rept.,
M. Kanda, E. B. Larsen, M. Borsero, P. G. Galliano,
and I. Yokoshima. Jan 86, 9p
Pub. in Proceedings of the Institute of Electrical and
Electronics Engineers 74, n1 p120-128 Jan 86.

Keywords: *Electromagnetic fields, *Standards, An-
echoic chambers, Electric fields, Magnetic fields,
Probes, Electromagnetic measurement, Calibration.

The paper describes the methodology for standard
electromagnetic field measurements using anechoic
chambers, open-sites, guided wave structures, and
probes as transfer standards.

700,842
PB87-162046 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Electricity Div.
**Electrical Units, Fundamental Constants, and the
1983 Least-Squares Adjustment.**
Final rept.,
B. N. Taylor. Jun 85, 8p
Pub. in IEEE (Institute of Electrical and Electronics En-
gineers) Transactions on Instrumentation and Meas-
urement IM-34, n2 p155-162 Jun 85.

Keywords: *Fundamental constants, *Units of meas-
urement, *Standards, Reprints, Josephson effect,
Quantum Hall effect, Volt, Ohm, Ampere.

The review touches upon four topics: (1) The Interna-
tional System or SI electrical units, specifically, the
volt, ohm, and ampere, and so called laboratory or as
maintained units for the same quantities; (2) the rela-
tionships between these laboratory units, experiments
to realize their SI definitions, and the fundamental con-
stants of nature; (3) the 1983 least-squares adjustment
of the constants; and (4) future electrical measure-
ments research which can improve our knowledge of
the constants.

700,843
PB87-164026 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
**Finite-Element Action Approach to the Character-
ization of Complex Electromagnetic Environ-
ments.**
Final rept.,
J. Randa, and M. Kanda. 1985, 6p
Pub. in Proceedings of International Symposium on
Antennas and EM Theory, Beijing, Peoples' Republic
of China, August 1985, p48-53.

Keywords: *Electromagnetic environments, Finite ele-
ment analysis, Numerical solution.

The authors outline an approach to the characteriza-
tion of complicated electromagnetic environments

based on a finite-element approximation to the action
functional of the electromagnetic field. A stationary
point of the action is found by a numerical search, sub-
ject to constraints imposed by boundary conditions
and by measurements of the field at some number of
points. The technique is illustrated by a simple exam-
ple.

700,844
PB87-164034 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
**Summary of NBS (National Bureau of Standards)
Calibration Services and Systems.**
Final rept.,
C. A. Hoer. Jan 86, 4p
Pub. in Proceedings of the Institute of Electrical and
Electronics Engineers 74, n1 p32-35 Jan 86.

Keywords: Standards, Attenuation, Phase shift, Electri-
cal impedance, Power, Millimeter waves, Microwave
frequencies, *Calibration, National Bureau of Stand-
ards, Voltage.

This paper gives a brief summary of the calibration
services available at the Boulder Laboratories of the
National Bureau of Standards for attenuation, phase
shift, impedance, power, and voltage at RF and micro-
wave frequencies.

700,845
PB87-166450 (Order as PB87-166401, PC A05/MF A01)
National Bureau of Standards (NML), Gaithersburg,
MD. Center for Basic Standards.
**Report on the Session of the Consultative Com-
mittee on Electricity (17th),**
B. N. Taylor. 11 Dec 86, 7p
Included in Jnl. of Research of the National Bureau of
Standards, v92 n1 p55-61 Jan-Feb 87.

Keywords: *Units of measurement, Meetings, Consult-
ative Committee on Electricity, Quantum Hall effect,
Josephson effect, Volt, Ohm.

The report provides the background for and summa-
rizes the main results of the 17th session of the Con-
sultative Committee on Electricity (CCE) of the Interna-
tional Committee of Weights and Measures held in
September 1986. Included are decisions made by the
CCE which promise to have a profound effect on the
standardization of national representations of the volt
and ohm and thus on the international compatibility of
electrical measurements. In particular, on January 1,
1990, worldwide changes in the basis for such repre-
sentations are planned which will lead to an increase
in the U.S. legal unit of voltage of about 9 parts-per-
million (ppm) and in the U.S. legal unit of resistance of
about 1.5 ppm.

700,846
PB87-171708 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Electrosystems Div.
**Techniques and Instruments for Automated Elec-
trical Measurements.**
Final rept.,
N. M. Oldham. 1986, 3p
Pub. in Jnl. of Metrology Society of India 1, n1 p25-27
1986.

Keywords: *Electric measuring instruments, Automa-
tion, Reprints.

No abstract available.

700,847
PB87-172003 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Error Bound for Near-Field Array Synthesis.
Final rept.,
D. A. Hill. Nov 86, 4p
Pub. in Institute of Electrical and Electronics Engineers
Transactions on Electromagnetic Compatibility EMC-
28, n4 p273-276 Nov 86.

Keywords: *Electromagnetic fields, Arrays, Synthesis,
Error analysis, Reprints, Near field.

An expression for the upper bound of any component
of the electric or magnetic field at any point in a region
is derived in terms of a product of two surface field
integrals. The result is most useful for bounding errors
in near-field array synthesis, but might have other ap-

plications where upper bounds on field magnitudes are desired.

700,848

PB87-179388 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Calibration of Aspirator-Type Ion Counters and Measurement of Unipolar Charge Densities.

Final rept.,
M. Misakian, R. H. McKnight, and C. Fenimore. Feb 87, 12p
See also report dated May 86, PB86-213147. Sponsored by Department of Energy, Washington, DC.
Pub. in Jnl. of Applied Physics 61, n4 p1276-1287, 15 Feb 87.

Keywords: *Calibrating, Power transmission lines, Measurement, Reprints, *Ion counters, *Ion density, *Ion detection, HVDC systems.

The characterization of a parallel plate apparatus which can produce a unipolar charge density that is suitable for calibrating aspirator-type ion counters operating in the ground plane is described. The influence of a dc electric field, air motion, Coulomb repulsion, and diffusion on the transport of ions into the ion counter are examined to determine their effects on instrument calibration and measurements in the vicinity of high-voltage dc transmission lines. A charge density which is known with an uncertainty of less than + or - 9% is used to check the performance of an ion counter with and without a duct at its entrance.

700,849

PB87-180899 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Compact Fiber Sensors for the Measurement of Low Level Electric Currents.

Final rept.,
G. W. Day. 1986, 4p
Sponsored by Department of Energy, Washington, DC.
Pub. in Proceedings of International Conference on Optical Fiber Sensors (4th), Tokyo, Japan, October 7-9, 1986, p81-84.

Keywords: *Electric current, *Ammeters, Electrical measurement, Faraday effect, Birefringence, Fiber optics, Detectors, Optical fibers.

Recent progress in the development of fiber current sensors includes the fabrication of low loss, low birefringence, 3 cm dia. coils by annealing, and the demonstration of a noise equivalent current of 180 microamperes per root Hertz.

700,850

PB87-181293
(Order as PB87-181251, PC A05/MF A01)
National Bureau of Standards, Gaithersburg, MD.
Free-Field Reciprocity Calibration of Microphones, E. D. Burnett, and V. Nedzelitsky. 24 Dec 86, 22p
Included in Jnl. of Research of the National Bureau of Standards, v92 n2 p129-151 Mar-Apr 87.

Keywords: *Microphones, *Acoustic measurement, Anechoic chambers, *Calibration.

Standardized methods for the primary free-field calibration of laboratory standard microphones deal with Type L (ANSI S1.10-1967, R1977) 'one-inch' diameter microphones. However, the use of '1/2-inch' diameter microphones for measurement of the sound pressure level in acoustic fields is increasing. Consequently, the NBS has developed a fixed-cost measurement service for the free-field calibration of these microphones by the reciprocity method over the range 2.5 kHz to 20 kHz. For this service, the apparatus and procedures, including essential properties of the anechoic chamber in which the calibrations are performed, are described.

700,851

PB87-183083 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
Status and Future Directions of Picosecond Domain Waveform Measurements.
Final rept.,
N. S. Nahman. 1986, 27p
Pub. in Time-Domain Measurements in Electromagnetics, Chapter 2, p45-71 1986.

Keywords: *Waveforms, Electrical measurement, Optical measurement, *Picosecond pulses, Time domain.

A review of the state-of-the-art of picosecond time domain waveform measurements is presented which includes measurements in both the electrical and optical regions of the electromagnetic spectrum. The review is the latest edition of a series of reviews on high speed pulse measurements compiled by the author since 1967.

700,852

PB87-195418 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, April to June 1986 with 1987 CEEE Events Calendar,
E. J. Walters. May 87, 35p NBSIR-87/3556
See also PB86-247608.

Keywords: *Electronics, *Electrical engineering, Metrology, Signal processing, Bibliographies.

This is the fifteenth issue of a quarterly publication providing information on the technical 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 1986. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

700,853

PB87-199311 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Precision Calibration of Phase Meters.
Final rept.,
R. S. Turgel, and D. F. Vecchia. 1987, 3p
Pub. in Proceedings of IEEE Instrumentation and Measurement Conference, Boston, MA, April 27-29, 1987, p135-137.

Keywords: *Phase meters, Statistical analysis, *Calibration.

A procedure and statistical analysis for the calibration of precision phase meters has been developed. The method can be applied equally to the calibration of any instrument that has a nominally linear response characteristic. Using statistical tests, the method checks whether the calibration data fits a linear model and then determines the linear equation from which the corrected calibration values are computed. Because random fluctuations tend to mask the limiting mean of the instrument response, the corrections are based on the values computed from the calibration curve, rather than on the actual calibration data.

700,854

PB87-201653 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Characterizing Square and Triangular Waveforms.
Final rept.,
G. N. Stenbakken. 1987, 3p
Pub. in Proceedings of the Institute of Electrical and Electronics Engineers Instrumentation and Measurement Conference, Boston, MA, p9-11, April 27-29, 1987.

Keywords: *Waveforms, *Square waves, Measurement, Sampling, *Triangle waves.

A method has been developed for determining the parameters and errors of square and triangular waveforms relative to idealized waveforms, even when the waveforms are highly distorted. The method is based on measurements obtained by sampling the waveform. Then, an idealized waveform is fitted to this sampled data using a least-squared-error algorithm. The errors in the waveform are defined as the deviations between the data samples and the ideal waveform. Also, the parameters of the measured waveform are defined as the corresponding parameters of the fitted ideal waveform.

700,855

PB87-201661 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Characterization of a Sampling Voltage Tracker for Measuring Fast, Repetitive Signals.

Final rept.,
T. M. Souders, H. K. Schoenwetter, and P. S. Hetrick. 1987, 4p
Pub. in Institute of Electronics and Electrical Engineers Instrumentation and Measurement Conference, Boston, MA, p24-243, April 27-29, 1987.

Keywords: Frequency response, Tests, *Sampling voltage trackers.

An equivalent time sampling and digitizing system is described, together with test methods for characterizing its dynamic performance. Time base errors, linearity errors, step response parameters, and frequency response are considered, and typical measurement results are included. The system is capable of state of the art measurements at rf frequencies.

700,856

PB87-203808 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.
Method for Measuring Complex Permeability at Radio Frequencies.

Final rept.,
R. B. Goldfarb, and H. E. Bussey. 1987, 4p
Pub. in Review of Scientific Instruments 58, n4 p624-627 Apr 87.

Keywords: *Magnetic permeability, Radio frequencies, Ferrites, Reprints, *Impedance measurement.

An established method for measuring complex rf magnetic permeability is based on the change in inductance and resistance of a coaxial transmission line upon insertion of a sample toroid. It is not necessary to wind coils on the toroid or correct for geometric demagnetization factors. The use of modern commercial impedance analyzers, as described in the paper, makes measurements from 1 kHz to 1 GHz particularly easy, fast, and accurate.

700,857

PB87-210324 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
NBS (National Bureau of Standards) Wideband Sampling Wattmeter.
Technical note (Final),
G. N. Stenbakken, O. B. Laug, T. H. Kibalo, B. A. Bell, and A. G. Perrey. May 87, 116p NBS/TN-1221
Also available from Supt. of Docs as SN003-003-02796-1.

Keywords: *Wattmeters, Power measurement, Computer programs, Schematic diagrams, Design, Performance, Sampling, Pascal programming language, Calibration.

The design and operation of a wideband sampling wattmeter capable of measuring distorted power signals with fundamental frequencies from 1 Hz to 10 kHz and harmonics up to 100 kHz is described. The microcomputer 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 some of these errors. A hardware multiplier-accumulator allows a large number of power signal samples to be integrated for each measurement. Sampling rates are variable up to a maximum of 300 kHz. A direct-memory-access unit is used to capture 4096 samples of both the voltage and current signals. These data are used to calculate the average and rms values of these signals. The technical note gives schematic diagrams of the circuits used in this wattmeter and describes their operation. The software is also described, and flow charts and selected program listings are provided for the programs written in Pascal. The results of calibration of the instrument over the past year are also presented.

700,858

PB87-210340 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, July to September 1986 with 1987 CEEE Events Calendar,
E. J. Walters. Jun 87, 29p NBSIR-87/3563
See also PB87-195418.

ELECTROTECHNOLOGY

General

Keywords: *Electronics, *Electrical engineering, Metrology, Signal processing, Bibliographies.

This is the sixteenth issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. The issue of the CEEE Technical Progress Bulletin covers the third quarter of calendar year 1986. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

700,859
PB87-212536 PC A06/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Limits to the Precision of Electro-Optic and Magneto-Optic Sensors.

Technical note,
G. W. Day, P. D. Hale, M. Deeter, T. E. Milner, and D. Conrad. Mar 87, 123p NBS/TN-1307
Also available from Supt. of Docs as SN003-003-02801-1. Sponsored by Bonneville Power Administration, Portland, OR., Empire State Electric Energy Research Corp., New York, and Electric Power Research Inst., Palo Alto, CA.

Keywords: *Detectors, *Electrooptics, *Magnetooptics, *Voltage measuring instruments, *Electric current meters, *Fiber optics, Electric power, Reproducibility, Precision, Stability, Optical fibers.

The principles of electro-optic and magneto-optic sensors suitable for use in power system applications are reviewed with particular attention to the properties of materials and components that limit the precision of such sensors. Data on a number of materials are collected and presented. For high-precision electro-optic sensors, it is recommended that crystals of point symmetry (bar 4)3m be used. For high-precision magneto-optic sensors, a lead glass with a low stress-optic coefficient is recommended. Choices for other components are also suggested. For both types of sensors, a precision of roughly plus or minus 1 percent over a 100 C temperature range should be attainable. To achieve a precision better than that, it will be necessary to use temperature compensation techniques, several of which are proposed and discussed.

700,860
PB87-223442 PC A02/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Publication Announcements Covering Center Programs, July to September 1986 with 1987 CEEE Events Calendar.
E. J. Walters. Jul 87, 19p NBSIR-87/3600
See also PB86-247608.

Keywords: *Electronics, *Electrical engineering, *Semiconductor devices, Metrology, Signal processing, Bibliographies.

This is the tenth issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the Center for Electronics and Electrical Engineering Technical Publication Announcements covers the third quarter of calendar year 1986. Abstracts are provided by technical area for papers published this quarter.

700,861
PB87-224648 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, January to March 1987 with 1987 CEEE Events Calendar.
E. J. Walters. Jul 87, 26p NBSIR-87/3589
See also PB87-195418.

Keywords: *Electronics, *Electrical engineering, Metrology, Signal processing, Bibliographies, Superconductors.

This is the eighteenth issue of a quarterly publication providing information on the technical 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 1987. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

700,862
PB87-225397 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
High Accuracy, 10 Hz-1 MHz Automatic AC Voltage Calibration System.
Final rept.,
N. M. Oldham, M. E. Parker, A. Young, and A. G. Smith. 1987, 3p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) Instrumentation and Measurement Technology Conference (1987), Boston, MA., April 27-29, 1987, p279-281.

Keywords: *Voltmeters, Alternating current, *Calibration, Automatic.

An automatic system for calibrating high accuracy ac voltmeters and calibrators is described. The system is based on traditional coaxial thermal voltage converters to provide measurement uncertainties of 5-20 ppm in the audio frequency range and 5-150 ppm over the full range from 10 Hz-MHz. Specialized hardware and measurement techniques make it possible to achieve these uncertainties in test periods of approximately one minute. Random errors introduced by the system are typically less than 2 ppm (one standard deviation).

700,863
PB87-226890 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, October to December 1986 with 1987 CEEE Events Calendar.
E. J. Walters. Jul 87, 29p NBSIR-87/3577
See also PB87-210340.

Keywords: *Electronics, Electrical engineering, Metrology, Signal processing, Bibliographies.

This is the seventeenth issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the CEEE Technical Progress Bulletin covers the fourth quarter of calendar year 1986. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

700,864
PB87-232047 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Prebreakdown Cathode Processes in Liquid Hydrocarbons.
Final rept.,
G. J. FitzPatrick, E. O. Forster, R. E. Hebner, and E. F. Kelley. 1987, 6p
Sponsored by Department of Energy, Washington, DC. Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electrical Insulation EI-22, n4 p453-458 Aug 87.

Keywords: *Electric discharges, *Dielectric breakdown, *Hydrocarbons, *Electrical insulation, High speed photography, Toluene, Liquids, Cathodes, Reprints, *Breakdown(Electronic threshold).

Measurements are presented of the initiation of pre-breakdown streamers at a point cathode in liquid hydrocarbons. Using a computer implementation of the method of images, the electric field is computed for selected geometries to confirm that the field strengths in the vicinity of these streamers are probably high enough so that electron multiplication processes can occur. High magnification photographs of streamer initiation show that the initial streamer velocity is $(2.8 \pm 0.4) \times 10$ to the 4th power cm/s in toluene.

700,865
PB87-232054 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
NBS (National Bureau of Standards) Josephson Array Voltage Standard.
Final rept.,
C. A. Hamilton, R. L. Kautz, F. L. Lloyd, R. L. Steiner, and B. F. Field. 1987, 4p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p258-261 Jun 87.

Keywords: *Josephson junctions, *Standards, Arrays, Reprints, *Voltage standards.

A Josephson voltage standard based on a series array of 2076 junctions is described. When irradiated with a 15-mW signal at a frequency of 96 GHz, the array produces 15 000 quantized levels between -1.5 and 1.5 V. Initial results on high-precision comparisons with a Zener reference standard are given.

700,866
PB87-233607 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
AC Voltage and Current Measurements.
Final rept.,
N. M. Oldham. 1986, 2p
Pub. in Jnl. of Metrology Society of India 1, n3 p17-18 1986.

Keywords: *Voltage measuring instruments, *Electric current meters, *Voltmeters, *Ammeters, Electrical measurement, Alternating current, Reprints.

Definitions and various measurement techniques for the measurement of ac voltage and current are given.

700,867
PB87-233862 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Report on the NBS/CEEE (National Bureau of Standards/Center for Electronics and Electrical Engineering) Survey of Electronic Measurement Needs Below 10 MHz.
Final rept.,
B. A. Bell. 1987, 14p
Pub. in Proceedings of National Conference of Standards Laboratories Workshop and Symposium (1987) 'Innovation: Key to the Future', Denver, CO., July 12-16, 1987, p75-1--75-14.

Keywords: *Electromagnetic interference, Electric measuring instruments, Surveys, *Automatic test equipment.

The paper describes the results of a recent survey conducted by the Electrosystems Division of the Center for Electronics and Electrical Engineering (CEEE) at the National Bureau of Standards (NBS). A summary analysis is provided of the data obtained on questions concerning (1) critical electrical quantities and associated instrumentation and devices, (2) Automatic Test Equipment (ATE)/complex measurement systems, and (3) conducted electromagnetic interference.

700,868
PB87-233870 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
NBS (National Bureau of Standards) Calibration System for AC Voltage.
Final rept.,
N. M. Oldham, and M. E. Parker. 1987, 6p
Pub. in Proceedings of National Conference of Standards Laboratories Workshop and Symposium (1987) 'Innovation: Key to the Future', Denver, CO. July 12-16, 1987, p47-1--47-6.

Keywords: *Voltage measuring instruments, *Voltmeters, Alternating current, *Calibration, Automatic.

An automatic system for calibrating high accuracy ac voltmeters and calibrators is described. The system relies on measurements using coaxial thermal voltage converters to achieve ac-voltage uncertainties of 5-150 ppm from 0.01-600 volts over the frequency range of 10 Hz-1 MHz. Specialized hardware and measurement techniques make it possible to achieve these uncertainties in test periods of approximately one minute. Random errors introduced by the system are typically less than 2 ppm (one standard deviation).

700,869
PB88-109178 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
Expanding Need for Microwave and Millimeter Wave Calibration Services.
Final rept.,
R. T. Adair, G. Reeve, and L. E. Gatterer. 1987, 11p
Pub. in NCSL Newsletter 27, n1 p21-31 Jan 87.

Keywords: *Millimeter waves, *Microwaves, Standards, Surveys, Ultrahigh frequencies, Superhigh fre-

quencies, Extremely high frequencies, Reprints, *Calibration.

Several technology surveys concerning microwave and millimeter wave measurement needs and capabilities have recently been conducted by the National Bureau of Standards, Boulder Laboratories, and other organizations. The results of some of these studies, which covered the frequency range from 1 GHz to above 200 GHz, are summarized. Current microwave and millimeter wave standards and calibration capabilities at the National Bureau of Standards are reviewed and compared with national needs. The lack of national standards in certain frequency bands may lead to problems with the specification, acceptance testing, calibration, and critical use of some components and systems. Plans to fulfill unmet needs in the frequency range are also presented.

700,870

PB88-109194

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

In Search of a More Realistic Accuracy Statement for Microwave Metrology.

Final rept.,
G. F. Engen. 1986, 3p
Pub. in Proceedings of Conference on Automated Radio Frequency Task Group (27th), Baltimore, MD., June 5-6, 1986, p181-183.

Keywords: *Microwave equipment, *Metrology, Electrical measurement, Electric connectors, Accuracy.

Historically, the accuracy achieved by the microwave metrologist has been limited by detector performance, hardware imperfections, and connector problems. Today the effect of hardware imperfections has been largely eliminated by more complete modeling. Moreover, the performance of the detection systems has been improved to the point where in many cases the non-ideal connector behavior is the major error source. Although important refinements in the connectors have also been realized, it is quite possible that these have not kept pace with the other developments. In any case it is useful to pose the following question: Assume a measurement system which, apart from being fitted with connectors typical of those in general use, is otherwise perfect. How much measurement accuracy can one realistically claim for it.

700,871

PB88-109244

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

1.25-MHz Attenuation Measurement System.

Final rept.,
R. A. Ginley, and C. M. Allred. 1986, 4p
Contract CCG-156
Sponsored by Department of Defense Calibration Coordination Group, Redstone Arsenal, AL.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-35, n4 p463-466 Dec 86.

Keywords: *Attenuation, Electrical measurement, Medium frequencies, Reprints.

A system has been developed to make highly accurate measurements of nominally 6-dB increments of attenuation at 1.25 MHz. Initial experiments indicate a typical systematic error of 5 micro B (1 micro B = 0.00001 dB) with a resolution of 1 micro B. A special linearity measurement system (LMS) using NBS-constructed linear tuned hybrids and power detectors has been used to determine the nonlinearity of a tuned 1.25-MHz power detector. The detector utilizes a single thermistor bead design with thermal isolation to obtain nearly linear tracking of a 4:1 change in input power. The nonlinear correction for this change, determined by the LMS, is on the order of 13 micro B for the detector presently in use. This calibrated detector and another of similar design are used in the attenuation measurement system (AMS) to make power ratio measurements to determine the change in attenuation of the device under test (DUT).

700,872

PB88-110226

PC A03/MF A01
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Horn Design Equations for the NBS (National Bureau of Standards) Horn-Type Noise Standards,

W. C. Daywalt. Aug 87, 18p NBSIR-87/3073
Sponsored by Department of the Air Force, Washington, DC., and Naval Ocean Systems Center, San Diego, CA.

Keywords: *Horns, Millimeter waves, Electromagnetic noise, Reflection, Attenuation, Computation, Noise standards, Braun equations.

Equations are given for calculating the interior dimensions of the horn pickup in the NBS millimeter wave noise standards. These dimensions insure negligible internal horn reflections, resulting in an accurate calculation of the horn attenuation. Measurements in the WR10 horn show a reflection of magnitude less than 0.001.

700,873

PB88-110366

PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Survey of Electronic Measurement Needs Below 10 MHz,

J. R. Sorrells. Jun 87, 92p NBSIR-87/3549

Keywords: *High frequencies, *Electronic equipment, Electrically powered instruments, Precision, Surveys, Test equipment, Measuring instruments.

The results of a survey to assess the electronic measurement needs from dc to 10 MHz are presented. The questionnaire used in the survey covered three broad areas of measurement need: (1) basic electrical quantities and related precision instruments; (2) automatic test equipment and other complex measurement systems; and (3) conducted electromagnetic interference. The data provided by 527 respondents are summarized, and the results of various analyses are described. Several conclusions, suggested by the analyses, are also discussed.

700,874

PB88-111174

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Effect of Pressure on Streamer Inception and Propagation in Liquid Hydrocarbons.

Final rept.,
R. E. Hebner, E. F. Kelley, G. J. FitzPatrick, and E. O. Forster. 1987, 5p
Sponsored by Department of Energy, Washington, DC. Pub. in Proceedings of International Conference on Conduction and Breakdown in Dielectric Liquids (9th), Salford, United Kingdom, July 27-31, 1987, 5p 1987.

Keywords: *Dielectric breakdown, *Electrical faults, *Hexanes, *Toluene, *Breakdown (Electronic threshold).

The paper shows that for pressures between 0.1 and 5.0 MPa, the structure of a streamer originating from a cathode is significantly modified while that initiating from an anode is relatively unchanged, in toluene and hexane. For cathode streamers, the inception voltage increased from 40 + or - 6kV at 0.1 MPa to 99 + or - 22kV at 5.0 MPa. For anode streamers, the inception voltage increased from 53 + or - 6kV at 0.1 MPa to 123 + or - 55kV at 5.0 MPa.

700,875

PB88-111224

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Digitally Synthesized Power Calibration Source.

Final rept.,
N. M. Oldham, O. B. Laug, and B. C. Waltrip. 1987, 6p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p341-346 Jun 87.

Keywords: *Waveform generators, *Watt hour meters, *Wattmeters, *Electric power meters, Digital systems, Energy, Power measurement, Reprints, *Calibration.

A digitally synthesized source of 'phantom' power for calibrating electrical power and energy meters is described. Independent sources of voltage, current, and phase angle are programmable between 0 and 240 V, 0 and 5 A, and 0 and 360 deg respectively. The accuracy of the active and reactive power is estimated to be within + or - 100 ppm of the full-scale apparent power (volt-amperes).

700,876

PB88-113782

PC A05/MF A01
National Bureau of Standards (NEL), Boulder, CO. Electrosystems Div.

Research for Electric Energy Systems - An Annual Report (1986),

R. E. Hebner. Sep 87, 80p NBSIR-87/3643
See also report for 1985, PB86-191814. Sponsored by Department of Energy, Washington, DC. Div. of Electric Energy Systems.

Keywords: *Electric power, Electric measuring instruments, Dielectrics, Dielectric breakdown, Sulfur hexafluoride, Electrical insulation, Interfaces, Space charge, Insulating oil.

The report documents the technical progress in the five investigations which make up the project 'Support of Research Projects for Electrical Energy Systems', funded by the U.S. Department of Energy. To support the measurement of ions in the dc transmission line environment, techniques to measure ion mobility were evaluated. In addition, techniques were developed to determine the sensitivity of an AM radio to detect partial discharges in a biological exposure facility. Within the project to develop measurement techniques and obtain basic data for gaseous dielectrics, a theoretical method was developed to evaluate the consistency among electron collision, transport, and dielectric strength data for binary gas mixtures; the gas phase hydrolysis rates for SOF2 and SOF4 were measured; the corona discharge oxidation mechanisms were identified and the role of negative ions on the SOF4 yield was determined. Progress in interfacial measurements included the optical measurement of the electric field distribution as a streamer initiates. Progress in developing measurements for nanosecond dielectrics was in the characterization of the errors in the measurement of voltage pulses using E-dot probes and the identification of the reduction of breakdown voltage in oil for faster pulses.

700,877

PB88-117643

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Assessment of Future Optical Measurements of Voltage and Current in Electric Power Systems.

Final rept.,
D. L. Hillhouse. 1987, 70p
Sponsored by Electric Power Research Inst., Palo Alto, CA., Bonneville Power Administration, Portland, OR., and Empire State Electric Energy Research Corp., New York.
Pub. in Optical Power Line Voltage and Current Measurement Systems, EPRI EL-5431, v2 70p Sep 87.

Keywords: *Electric current meters, *Voltage measuring instruments, *Electrooptics, *Magnetooptics, Power measurement, Birefringence, Reprints.

The report summarizes the results of an investigation into the technical and economic reasons for improving power system voltage and current measurements, with special emphasis on the prospects for using optical technology. The investigation assesses information from interviews with representatives of utilities and manufacturing companies, along with other information from published sources. The report concludes with a recommendation for a carefully structured and coordinated program of research and development.

700,878

PB88-121967

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Software Correction of Measured Pulse Data.

Final rept.,
N. S. Nahman. 1986, 67p
Pub. in Fast Electrical and Optical Measurements, v1, NATO ASI Series E, n108 p351-417 1986.

Keywords: *Waveforms, *Electromagnetic pulses, Light pulses, Convolutional integrals, Signal processing, Correction, Ill posed problems, Deconvolution, Computer applications.

The fundamental concern in the software correction of measured pulse waveform data is the solution of an ill-posed deconvolution problem which arises when one (or both) of the known waveforms is (are) corrupted by errors due to interference, noise, instrumentation drift, etc. The variables concerned are related to each other by the convolution integral. When one of the integrand functions is unknown while the other two functions are known, the convolution equation becomes an integral equation for the unknown waveform. Solution of an ill-posed deconvolution problem is obtained by signal processing or filtering and at most yields an estimate

General

for the unknown waveform. The objective of the discussion is to bring out the ideas of ill-posedness and to give examples of applications to pulse measurement problems which require deconvolution, i.e., the removal (correction) of pulse source effects and/or measurement system effects as encountered in signal pulse waveform measurements and system impulse response measurements.

700,879

PB88-121975 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Calibration and Error Analysis of a Picosecond Pulse Waveform Measurement System at NBS (National Bureau of Standards).

Final rept.,
W. L. Gans. 1986, 5p
Pub. in Proceedings of the IEEE (Institute of Electrical and Electronics Engineers) 74, n1 p86-90 Jan 86.

Keywords: *Electromagnetic pulses, *Waveforms, Electrical measurement, Error analysis, *Calibration, Deconvolution, Picosecond pulses.

The primary system used at NBS, Boulder, CO, to measure fast (picosecond-nanosecond range), repetitive, electrical pulse parameters consists essentially of a wide-band (dc-18 GHz) sampling oscilloscope interfaced to a minicomputer. The paper describes the major calibration and analysis techniques used to reduce the effects of errors inherent in the system, both deterministic and random in nature.

700,880

PB88-123690 PC A04/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

NBS (National Bureau of Standards) Measurement Services: Standard Cell Calibrations.

Special pub. (Final),
B. F. Field. Oct 87, 56p NBS/SP-250/24
Also available from Supt. of Docs. as SN003-003-02825-8. See also PB88-123708. Library of Congress catalog card no. 87-619872.

Keywords: Direct current, *Standard cells, *Calibration, *Voltage standards, Josephson effect, US NBS.

The note describes the procedures used at NBS to calibrate standard cells in terms of the U.S. Legal Volt. The two calibration services that are offered by the Electricity Division are discussed; Regular Calibration of client standards at NBS, and the Volt Transfer Program which is a process to determine the difference between the U.S. Legal Volt and the volt as maintained by a client laboratory. The operational procedures used to compare standard cells and to maintain the U.S. Legal Volt via the ac Josephson effect are discussed in detail.

700,881

PB88-123757 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.

Solid-State Voltage Standard Performance and Design Guidelines.

Technical note (Final),
B. F. Field. Sep 87, 29p NBS/TN-1239
Also available from Supt. of Docs. as SN003-003-02822-3. Sponsored by Department of Defense, Washington, DC.

Keywords: *Standards, Avalanche diodes, Direct current, Recommendations, *Voltage standards, Standard cells.

The Electricity Division has examined and analyzed the performance of all presently available high-quality solid-state (Zener) dc voltage standards. Based on these examinations and the authors knowledge of standards laboratory requirements, the authors have developed a set of guidelines to define what is needed in a modern solid-state standard to supplement or replace cadmium-sulfate standard cells. Specific design goals are presented to serve as a guide for writing a detailed solid-state voltage standard specification, and also as a guide to anyone evaluating such a standard.

700,882

PB88-129929 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

AC Power and Energy Measurements.

Final rept.,
N. M. Oldham. 1986, 3p
Pub. in MAPAN--Jnl. of Metrology Society of India 1, n4 p5-7 1986.

Keywords: *Power measurement, Electrical measurement, Alternating current, Reprints.

Definitions and various techniques for the measurement of active and reactive electrical power are given.

700,883

PB88-130315 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Progress Bulletin Covering Center Programs, April to June 1987, with 1987 CEEE Events Calendar.
E. J. Walters. Oct 87, 43p NBSIR-87/3644
See also PB87-224648.

Keywords: *Electronics, *Electrical engineering, Metrology, Signal processing, Bibliographies, Superconductors.

This is the nineteenth issue of a quarterly publication providing information on the technical 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 1987. Abstracts are provided by technical area for both published papers and papers approved by NBS for publication.

700,884

PB88-130323 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
Center for Electronics and Electrical Engineering Technical Publication Announcements Covering Center Programs, January to March 1987, with 1987 CEEE Events Calendar.
E. J. Walters. Aug 87, 20p NBSIR-87/3655
See also PB87-223442.

Keywords: *Electronics, *Electrical engineering, *Semiconductor devices, Metrology, Signal processing, Bibliographies.

This is the twelfth issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the Center for Electronics and Electrical Engineering Technical Publication Announcements covers the first quarter of calendar year 1987. Abstracts are provided by technical area for papers published this quarter.

700,885

PB88-138748 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Simultaneous Measurement of Light Emission, Current Pulses and Growth of Prebreakdown Streamers in Hexane.

Final rept.,
E. F. Kelley, M. Nehmadi, R. E. Hebner, P. J. McKenny, and E. O. Forster. 1987, 6p
Sponsored by Department of Energy, Washington, DC.
Div. of Electric Energy Systems.
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) Annual Report Conference on Electrical Insulation and Dielectric Phenomena, Gaithersburg, MD., October 18-22, 1987, p132-137.

Keywords: *Hexanes, High speed photography, Dielectric breakdown, Light pulses, Optical measurement, Electric current, Electrical measurement, *Breakdown(Electronic threshold).

High-speed, image-converter photography is used to document the growth characteristics of prebreakdown phenomena emanating from a cathode needle in a needle-sphere electrode system placed in a liquid. The cathode streamer growth characteristics are compared to the pulsed nature of the current feeding the streamer and light emission from the streamer. The fact that there is a strong temporal correlation between the current and light pulses is confirmed. However, it is found that no strong correlation exists between this pulse-like behavior and the growth of the prebreakdown event, but that the streamer is found to grow rather uniformly despite the discreet nature of the current supplied. This information should contribute to the

development of theoretical modeling efforts on the generation and development of prebreakdown phenomena in liquids.

700,886

PB88-138763 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.
Techniques for Measuring the Shielding Effectiveness of Materials.

Final rept.,
P. F. Wilson, and M. T. Ma. 1987, 6p
Pub. in Proceedings of the International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility (7th), Zurich, Switzerland, March 3-5, 1987, p547-552.

Keywords: *Electromagnetic shielding, Transmission lines, Electrical measurement, Effectiveness, Reverberation chambers, Time domain.

Four methods for measuring the shielding effectiveness of materials under various conditions are considered. Coaxial transmission line holders and a time-domain systems are used to simulate plane-wave shielding performance. The dual TEM cell and an apertured TEM cell in a reverberation chamber are used to investigate near-field shielding capability. Both theoretical and experimental results are discussed.

700,887

PB88-138771 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Shielding Effectiveness Measurements Using an Apertured TEM Cell in a Reverberation Chamber.

Final rept.,
P. F. Wilson, and M. T. Ma. 1986, 5p
Pub. in Proceedings of the IEEE (International Electrical and Electronics Engineers) International Symposium on Electromagnetic Compatibility, San Diego, CA., September 16-18, 1986, p265-269.

Keywords: *Electromagnetic shielding, Electrical measurement, Effectiveness, Reverberation chambers, Near field.

Near-field shielding effectiveness measurements are performed in a reverberation chamber using an apertured transverse electromagnetic cell as the receiver. The configuration allows one to investigate the electric and magnetic field shielding properties of a material simultaneously. Coupling to the cell is modeled using small aperture theory, and predicted results agree well with measured data.

700,888

PB88-138789 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Preliminary Evaluation of Reverberation Chamber Method for Pulsed RF Immunity Testing.

Final rept.,
M. L. Crawford, and G. H. Koepke. 1986, 9p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronic Engineers) International Symposium on Electromagnetic Compatibility, San Diego, CA., September 16-18, 1986, p270-278.

Keywords: *Electromagnetic compatibility, Radiofrequency pulses, *Reverberation chambers, Test methods.

The paper describes the evaluation of the performance characteristics of a reverberation chamber excited by pulsed rf (1.0 microsec to 10 microsec, 0.001 duty cycle) in the frequency range, 0.9 GHz to 10 GHz. The purpose of the work was to investigate the potential use of a reverberation chamber for pulsed rf immunity testing of electronic equipment. Information given includes a description of the reverberation chamber evaluated, the instrumentation used for performing the measurements, and results obtained showing the pulse dispersion characteristics of the chamber.

700,889

PB88-138797 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Measuring Electromagnetic Interference. Part 1. Open-Field Sites and TEM Cells.

Final rept.,
M. T. Ma, M. Kanda, M. L. Crawford, and E. B. Larsen. 1986, 13p
Pub. in Test and Measurement World, p72-84 Feb 86.

Keywords: *Electromagnetic interference, Electrical measurement, Reprints.

Measuring radiated electromagnetic power is essential to demonstrate conformance to regulations and specifications. A number of methods are available -- open-field sites, TEM cells, reverberating chambers and anechoic chambers. Selection of a suitable technique requires a knowledge of the strengths and limitations of each. Proper interpretation of measured results then requires an intimate knowledge of the characteristics of the chosen site.

700,890

PB88-147392 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Should the Classical Variance Be Used as a Basic Measure in Standards Metrology.

Final rept.,
D. W. Allan. 1987, 9p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p646-654 Jun 87.

Keywords: *Metrology, Electrical measurement, Standard deviation, Statistics, Variance(Statistics), Standards, Reprints, Uncertainty.

Studies of frequency standards, standard-volt cells, and gauge blocks provide examples of long-term random-correlated time series which indicate behavior that is not 'white' (not random and uncorrelated). The paper outlines and illustrates a straightforward time-domain statistical approach, which for power-law spectra yields an alternative estimation method for most of the important random power-law processes encountered. Knowing the spectrum provides for clearer uncertainty assessment in the presence of correlated random deviations. The statistical approach outlined also provides a simple test for a white spectrum, thus allowing a metrologist to know whether use of the classical variance is suitable or whether to incorporate better uncertainty assessment procedures, e.g., as outlined in the paper.

700,891

PB88-147442 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Office of Physical Measurement Services.
MM-Wave Measurement and Standards Requirements for Defense Technology.

Final rept.,
B. C. Belanger. 1985, 3p
Pub. in Microwave Jnl. 28, n7 p30-32 Jul 85.

Keywords: *Millimeter waves, Electrical measurement, Microwaves, Meetings, Standards, Reprints.

The paper describes a seminar on millimeter wave measurement requirements held at Harry Diamond Laboratories in April of 1985.

700,892

PB88-152814 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Electrosystems Div.
Operation of an Ion Counter in the Ground Plane under a Monopolar High-Voltage Line.

Final rept.,
R. H. McKnight. 1987, 8p
Sponsored by Department of Energy, Washington, DC. Pub. in Proceedings of the Hanford Life Sciences Symposium on Interaction of Biological Systems with Static and ELF Electric and Magnetic Fields (23rd), Richland, WA., October 2-4, 1984, p1-8 1987.

Keywords: *Transmission lines, Electric corona, Ion currents, Space charge, *Ion counters, HVDC systems, High voltage.

Studies have been made of the operation of an ion counter with the inlet located in the ground plane near a monopolar high-voltage line. Electric-field values at the ground plane ranged between 14.8 kV/m and 29.8 kV/m, while ion current densities varied from 0.1 to 0.43 (micro A/m squared). An observed variation in measured ion density with volumetric flow rate through the counter appears to be primarily due to losses in the

duct between the ground-plane opening and the ion-counter inlet.

700,893

PB88-152855 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Dynamic Performance of Digital Recorders Used for Monitoring High Voltage Impulse Tests.

Final rept.,
J. Kuffel, R. Malewski, R. Van Heeswijk, and R. A. Lawton. 1986, 5p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-35, n4 p591-595 Dec 86.

Keywords: *Recording instruments, Electrical measurement, Monitors, Performance, Reprints, *Digitizers, Recorders, High voltage.

Frequency and time domain characteristics of digital transient recorders (in short digitizers) are discussed in order to establish the requirements on digitizers used for high voltage testing. Results of an experimental study performed on a 200 MHz, 8-bit digitizer (Tektronix 7612D) are presented and related to the design features of the instrument. The inherent design characteristics and their influence on the digitizer dynamic performance are analyzed in view of simulation of the digitizer through a computer model.

700,894

PB88-153952 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Precision Calibration of Phase Meters.

Final rept.,
R. S. Turgel, and D. F. Vecchia. 1987, 4p
See also PB87-199311.
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n4 p918-922 Dec 87.

Keywords: Statistical analysis, Reprints, *Calibration, *Phase meters, Linear model.

Using the calibration of a phase meter with a nominally linear response as an example, a statistical approach is discussed for predicting worst-case offsets of the meter response characteristic from the value of the reference standard. A linear calibration curve is used to model the meter response, and statistical tests are described which test the appropriateness of the model and whether the calculated calibration curve differs significantly from the ideal. Various levels of corrections to be applied can then be determined on the basis of these tests, and limits to offsets are calculated for each of the levels. By extending the approach, it is possible to predict limits of uncertainty when using the calibrated meter to make measurements.

700,895

PB88-162524 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Gallium Arsenide (GaAs)-Based Photoconductive Switches for Pulse Generation and Sampling Applications in the Nanosecond Regime.

Final rept.,
B. A. Bell, and A. G. Perrey. 1985, 2p
See also PB86-134954. Sponsored by Institute of Electrical and Electronics Engineers, Inc., New York. Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) Instrumentation and Measurement Technology Conference (IMTC '85), Tampa, FL., March 20-22, 1985 p216-217.

Keywords: *Electric potential, Calibrating, *Dielectric constant, Voltage converters, Voltage, Automatic test equipment.

The paper describes the design of a set of optoelectronic switches having an interdigitated electrode structure and implemented with high resistivity GaAs photoconductive substrates. A theoretical analysis is developed for determining the pulsed light ON state resistance (peak conductance), OFF state (dark) resistance and the associated capacitances for the various designed gap geometries. Data are provided on the processing steps used in successfully fabricating a working set of switches based on the theoretical design. A test apparatus is used to make measurements of the pulsed light conductance of these devices having nominal gap spacings of 5, 10, 20, and 40 micrometers.

ENERGY

Electric Power Transmission

700,896

DE87014558 PC A06/MF A01
National Bureau of Standards, Gaithersburg, MD.

Optical Power Line Voltage and Current Measurement Systems: Volume 1, Limits to the Precision of Electro-Optic and Magneto-Optic Sensors: Final Report.

G. W. Day, P. D. Hale, M. Deeter, T. E. Milner, and D. Conrad. Sep 87, 122p EPRI-EL-5431-V.1
See also PB87-212536.

Keywords: *Power Transmission Lines, Accuracy, Ammeters, Calibration, Design, Electro-Optical Effects, Magneto-Optical Effects, Monitors, Optical Fibers, Polarization, Temperature Dependence, Transfer Functions, Voltmeters, ERDA/200300, Electric measuring instruments.

This study began with a central question, "What precision can be achieved with an electro-optic voltage sensor or a magneto-optic current sensor." The answer has been pursued in numerous ways - through an investigation of the basic properties of materials and components (both as reported in the literature and new data generated in our laboratory), through attempts to demonstrate the feasibility of overcoming certain limitations in the properties of components, through analysis of some fundamental limitations, through the proposal of new or refined designs, and through discussions with numerous other investigators. It was concluded that ease of obtaining high precision (in a power systems context) is not included among the advantages of using optical sensors for measurement of electromagnetic quantities. The principal difficulty was that sensors have to maintain their calibration over broad temperature ranges (at least 100 sup 0 C) without the possibility of temperature stabilization. Specifically, using relatively standard approaches and an appropriate definition of precision, a precision not better than about +/-1% can be expected. Achieving this level of precision will require wise choices of materials, components, and design; numerous suggestions are offered. (ERA citation 12:045329)

700,897

PB87-172748 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

Reconductoring Study Using Reliability Assessments.

Final rept.,
M. E. Criswell, E. M. Hendrickson, and J. R. Goodman. 1984, 4p
Sponsored by Electric Power Research Inst., Palo Alto, CA.
Pub. in Proceedings of ASCE Specialty Conference on Probabilistic Mechanics and Structural Reliability (4th), Berkeley, CA., January 11-13, 1984, p123-126.

Keywords: *Transmission lines, *Reliability, Wind loads.

Both deterministic and reliability assessments were utilized to investigate the feasibility of reconductoring an 11-1/2 mile (18.5 km) long transmission line located near Fort Collins, Colorado. Reliability index values for each of the 67 single-pole tubular steel tangent structures were determined for four possible reconductoring options. Structural adequacy of these structures to resist high wind loadings was of primary interest. Significant potential cost savings, ranging from 37 to 63% of the replacement costs of these 67 structures, were found using reliability assessment techniques rather than conventional design procedures.

700,898

PB87-201679 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

ENERGY

Electric Power Transmission

Power Quality Site Surveys: Fiction and Fallacies. Final rept., F. D. Martzloff, and T. M. Gruzs. 1987, 13p. Pub. in Proceedings of the Industrial and Commercial Power Systems Technical Conference, Nashville, TN, p21-33, May 4-7, 1987.

Keywords: *Power lines, *Surges, *Overvoltage, *Site surveys, Disturbances, Monitors, Transients.

The quality of the power supplied to sensitive electronic equipment is an important issue. Monitoring disturbances of the power supply has been the objective of various site surveys, but results often appear to be instrument- or site-dependent, making comparisons difficult. After a review of the origins and types of disturbances, the types of monitoring instruments are described; a summary of nine published surveys reported in the last 20 years is presented. A close examination of underlying assumptions allows meaningful comparisons which can reconcile some of the differences. Finally, the paper makes an appeal for improved definitions and applications in the use of monitoring instruments.

700,899

PB87-225405 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.

Fast Transient Tests - Trivial or Terminal Pursuit. Final rept., F. D. Martzloff, and P. F. Wilson. 1987, 6p. Pub. in Proceedings of Electromagnetic Compatibility Symposium (1987), Zurich, Switzerland, March 3-5, 1987, p283-288.

Keywords: *Power lines, Surges, Attenuation, Transients.

Measurements, augmented by theoretical simulation techniques, have been performed to determine the attenuation of fast-transients propagating in typical power lines. The rise time of the applied pulses ranged from 0.7 to 50 ns. Theory and measurements agree and confirm that pulse attenuation increases significantly for shorter pulses.

Energy Policies, Regulations & Studies

700,900

PB88-130307 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.

Study of Three Measures for Energy Efficiency of Fossil Fueled Furnaces and Boilers.

Final rept., E. Kweller. Oct 87, 44p NBSIR-87/3645
Sponsored by Department of Energy, Washington, DC.

Keywords: *Boilers, *Furnaces, Operating costs, Fossil fuels, Measurement, Tests, *Energy efficiency.

The effectiveness of three measures of energy efficiency for furnaces has been demonstrated by comparison of the results for predicted energy saving against the cost savings predicted by the calculated total annual cost of operation using DOE test procedures. Two of the efficiency measures currently prescribed by DOE - the Annual Fuel Utilization Efficiency (AFUE) and the DOE Energy Factor (EF) are compared with an industry proposed energy factor - Seasonal Energy Utilization Factor (SEUF).

700,901

PB88-138227 PC A13/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.

Life-Cycle Costing Manual for the Federal Energy Management Program: A Guide for Evaluating the Cost Effectiveness of Energy Conservation and Renewable Energy Projects for New and Existing Federally Owned and Leased Buildings and Facilities.

R. T. Ruegg. Nov 87, 278p NBS/HB-135-REV-1987. Also available from Supt. of Docs as SN003-003-02833-9. Supersedes PB81-136269. Library of Congress catalog card no. 87-619884. Sponsored by Department of Energy, Washington, DC. Assistant Secretary for Conservation and Renewable Energy.

Keywords: *Federal buildings, Life cycle cost, Manuals, Energy conservation, Economic analysis, Energy management, Renewable energy sources.

The manual is a guide to understanding the life-cycle costing method and an aid to calculating the measures required for evaluating energy conservation and renewable energy investments in all Federal buildings. It expands upon the life-cycle costing criteria contained in the Program Rules of the Federal Energy Management Program and is consistent with those criteria. Its purpose is to facilitate the implementation of the Program Rules by explaining the life-cycle costing method, defining the measures, describing the assumptions and procedures to follow in performing evaluations, and giving examples. It provides worksheets, data tables, and other computational aids for calculating the required measurements.

Energy Use, Supply, & Demand

700,902

PB88-109913 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Energy Prices and Discount Factors for Life-Cycle Cost Analysis: Annual Supplement to NBS (National Bureau of Standards) Handbook 135 and NBS Special Publication 709, 1987 Edition.

Annual rept., B. C. Lippitt, and R. T. Ruegg. Jun 87, 97p NBSIR-85/3273-2

See also report dated Nov 85, PB86-142148. Sponsored by Department of Energy, Washington, DC. Assistant Secretary for Conservation and Renewable Energy.

Keywords: Buildings, Fuels, *Energy conservation, *Life cycle costs, Government buildings, Federal Energy Management Program, Average fuel prices, Energy price forecasts.

The report provides the 1987 annual edition of the energy price and discount factor tables used to supplement both the Federal life-cycle costing methodology as described in NBS Handbook 135 (HB 135) and private sector life-cycle cost analysis as described in NBS Special Publication 709 (SP 709). Tables A (7%), Ba, and C represent revisions of appendices A, B, and C, respectively, of HB 135. They should be used in life-cycle cost analyses of Federal energy conservation projects. Tables A (10%), Bb, and C are for use in life-cycle cost analyses of Federal non-energy conservation projects that require energy price forecasts. The last section of the report, the supplement for private sector life-cycle cost analysis, represents revisions to appendix B, Part I of SP 709 and is provided for the convenience of private sector analysts wishing to make use of Federal energy price forecasts.

Fuel Conversion Processes

700,903

PB87-208732 PC A04/MF A01
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.

Review of Needs for Thermophysical Property Data on Solid Feedstocks. 2. Oil Shale.

J. E. Callanan. Apr 87, 62p NBSIR-87/3064
See also PB82-241415.

Keywords: Heat of combustion, Thermal conductivity, Thermophysical properties, *Oil shales, Solid fuels.

The report, a comprehensive survey concerning oil shale, is the second in a series dealing with needs, particularly for thermophysical properties, for solid fuels/feedstocks. The survey shows the need for experimental work on heat of combustion, heat of retorting, heat capacity/enthalpy, thermal conductivity, thermal expansion and heat of immersion for raw, spent and burnt shale, for kerogen and for the mineral matter found in shale. These studies should be preceded by agreement on the properties necessary for good characterization of the shale and on the methods of measuring these properties; the thermal properties measurements should be made on well-characterized samples. Standardized measurement techniques do not

exist for thermal properties, with the possible exception of heat of combustion, and must be developed. Existing data must be evaluated and reliable data generated. Theoretical studies that will allow for modeling of thermal properties should proceed along with the experimental investigations to improve the ability to predict shale properties for process design. Recommendations for work appropriate to the National Bureau of Standards are included.

Fuels

700,904

PB87-151247 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Gas Analysis Modeling System (GAMS).

Final rept., R. P. O'Neill, J. Heinkel, W. G. Kurator, B. Mariner-Volpe, R. Stokes, A. Tawshunsky, W. Trapmann, L. Joel, P. Saunders, C. Witzgall, W. C. Mylander, and W. R. Stewart. Dec 84, 10p
Sponsored by Department of Energy, Washington, DC. Pub. in Operations Research Letters 3, n5 p227-236 Dec 84.

Keywords: *Natural gas, *Linear programming, *Dynamic programming, Mathematical models, Industries, Evaluation, Import, Economic factors, Simulation, Legislation, United States, Reprints, *Network analysis.

The paper gives an overview of a large integrated model of the natural gas industry in the United States. The system described has been used to evaluate the impacts of natural gas legislation before the U.S. Congress. Many common operations research tools such as linear programming, dynamic programming and network flow theory are used as various stages in the model.

700,905

PB87-193660 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Physical Properties of Pure Components of Natural Gas.

Final rept., D. Garvin, E. S. Domalski, R. C. Wilhoit, G. R. Somayajulu, and K. N. Marsh. 1986, 15p
Previously announced as PB86-208493.
Pub. in Gas Quality, p59-73 1986.

Keywords: *Natural gas, Physical properties, Combustion, Reprints.

The principal physical properties of components of natural gas that are of importance to the gas industry are those related to heating value and to volume. New recommendations for the heating values and molar volumes of components of natural gas and for their molar volumes are reported. These are based on a reassessment of the available experimental data. The new recommendations are valid for the temperature range from 0 to 25 deg C and for pressures up to about one atmosphere. The sources of the data are indicated and factors considered in the reassessment are presented. Heating values of components of natural gas are known to reach no better than 0.02 to 0.04 percent.

700,906

PB87-211959 PC A05/MF A01
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.

Basic Gas Metering. Annual Report April 1984-March 1985.

J. A. Brennan, S. E. McManus, C. F. Sindt, B. R. Bateman, and I. Vazquez. May 87, 84p GRI-87/0104
Contract GRI-5081-353-0422
Sponsored by Gas Research Inst., Chicago, IL.

Keywords: *Natural gas, Measurement, Orifice meters, Gas flow, *Metering, Gas meters.

This is a status report on the work sponsored by the Gas Research Institute (GRI) on basic gas metering. The work was either completed at or subcontracted by the National Bureau of Standards in Boulder, CO (NBS-B). Tasks dealing with flow conditioning, secondary flow standards, an orifice data base, mathematical modeling and interlaboratory comparisons are continu-

ing efforts. Tasks dealing with a theoretical base for the orifice meter, sonic nozzle calibrations, orifice water calibrations, and orifice air calibrations are complete. The task dealing with the laboratory quality orifice meter is in the final stages of completion. With the exception of the sonic nozzle calibrations, the status of each of these tasks is described below. The report on the sonic nozzle calibration will be published soon.

700,907

PB88-109871 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Self Heating Properties of Coal,
E. Braun. Aug 87, 109p NBSIR-87/3554
Sponsored by Bureau of Mines, Pittsburgh, PA.

Keywords: *Coal, *Autoignition, *Spontaneous combustion, Fire tests, Oxidation.

Three methodologies for predicting the likely occurrence of self-heating in underground coal mining environments were analyzed. No method was found to be completely satisfactory for general coal mine applications. One evaluation system was found to provide excellent guidelines for preplanning procedures prior to initiating full scale coal mine operations, but it relied on past mining experience. Another evaluation system used standard coal characterization parameters, while the third system used a thermal test method a predictor of self-heating potential. The self-heating properties of eight samples of western bituminous coal were determined using the Adiabatic Furnace and the Crossing Point Method. A brief review of pertinent literature is presented to provide an understanding of those factors affecting oxidative heating of coal.

Geothermal Energy

700,908

PB87-227583 PC A09/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.
Thermodynamic Properties of a Geothermal Working Fluid; 90% Isobutane-10% Isopentane.
Final rept.,
J. S. Gallagher, D. Linsky, G. Morrison, and J. M. H. Levett Sengers. Jun 87, 194p NBS/TN-1234
Also available from Supt. of Docs as SN003-003-02809-6. Prepared in cooperation with Department of Energy, Oakland, CA. Div. of Geothermal and Hydro-power Technology.

Keywords: Butanes, Pentanes, Tables(Data), Thermodynamic properties, Mixtures, *Geothermal power plants, *Working fluids.

Tables of thermodynamic properties, and dew and bubble properties, of a mixture of 90 mol % isobutane and 10 mol % isopentane, a working fluid in a binary geothermal power cycle are presented. The tables are generated by a formulation of the Helmholtz free energy, in which the mixture properties are mapped onto the known properties of pure isobutane by means of the principle of generalized corresponding states. The data base for the Helmholtz free energy formulation is new. The authors report data obtained in three different apparatus: critical-line and isopentane vapor pressure data obtained in a visual cell; vapor-liquid equilibria data obtained in a mercury-operated variable-volume cell; and pressure-volume-temperature data for the 90 mol %--10 mol % mixture obtained in a semi-automated Burnett-isochoric apparatus. The principles of the methods, and estimates of the reliability, are discussed and all experimental data are compared with the surface. The results are tables of specific volume, enthalpy, entropy, specific heat and density and temperature derivatives of the pressure at 10 K temperature increments from 240 to 600 K along isobars from 0.01 to 20 MPa. Separate tables are prepared from the dew and bubble properties of the 90-10 mixture.

700,909

PB88-120944 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Semi-Automated Burnett Facility: PVT of a Geothermal Working Fluid Mixture.

Final rept.,
D. Linsky, J. M. H. Levett Sengers, and J. S. Gallagher. 1987, 17p
Contract DOE-EA-77-A-01-6010
Sponsored by Department of Energy, Washington, DC.
Pub. in Fluid Phase Equilibria 36, p149-165 1987.

Keywords: *Binary fluid systems, *Working fluids, *Geothermal energy conversion, Bourdon tubes, Critical pressure, Critical volume, Critical temperature, Test equipment, Isochoric processes, Reprints, Burnett apparatus.

A high-quality Burnett PVT facility for the range of 0-200°C has been partially automated by coupling automated isochoric runs to a manually determined Burnett reference isotherm. An automated pressure injector, a voltage-operated capacitor for adjusting the transducer null, a Ruska spiral Bourdon gage, a programmable ratio transformer for temperature selection and control, and a laboratory computer form the ingredients of the semi-automated facility. The performance of the apparatus is demonstrated by PVT data acquired on a geothermal working fluid mixture in a range around its critical point of 141 degs C.

700,910

PB88-121959 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.
Semi-Automated Burnett PVT Apparatus: Properties of a Geothermal Working Fluid.
Final rept.,
D. Linsky, J. M. H. Levett Sengers, and H. A. Davis. 1987, 11p
Contract DOE-EA-77-A-01-6010
Sponsored by Department of Energy, Washington, DC.
Pub. in Proceedings of Symposium on Energy Engineering Sciences Instrumentation, Diagnostics and Material Behavior (5th), Argonne, IL, June 17-19, 1987, p26-36.

Keywords: *Geothermal fluids, *Thermodynamic properties, Pressure, Volume, Temperature, Binary fluid systems, Reprints, *Foreign technology.

A Burnett-isochoric facility has been constructed in which the equation of state of fluids and fluid mixtures can be obtained in automatic fashion along paths of constant volume. The apparatus has been used for the determination of the thermodynamic properties of a working fluid mixture for a binary geothermal power cycle.

Heating & Cooling Systems

700,911

PATENT-4 687 588 Not available NTIS
Department of Commerce, Washington, DC.
Refrigerant Mixture of Trichlorofluoromethane and Dichlorohexafluoropropane.
Patent,
M. O. McLinden, D. A. Didion, and C. D. MacCracken. Filed 5 Aug 86, patented 18 Aug 87, 4p PB88-111125, PAT-APPL-6-893 380
This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Patents, *Refrigerants, Chlorine organic compounds, *Methane/trichlorofluoro, *Propane/dichlorohexafluoro.

The invention is a refrigerant mixture consisting essentially of trichlorofluoromethane(R-11) and dichlorohexafluoropropane (R-216) which has a higher saturated vapor density than that of pure R-11 and which exhibits an azeotrope at approximately 74% by weight of R-11 and 26% by weight of R-216.

700,912

PB87-152286 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.

Performance of a Conventional Residential Sized Heat Pump Operating with a Nonazeotropic Binary Refrigerant Mixture,
W. Mulroy, and D. Didion. Oct 86, 67p NBSIR-86/3422
Contract DE-AC05-84OR21400
Sponsored by Department of Energy, Washington, DC.

Keywords: *Heat pumps, *Refrigerants, Air conditioning, Residential buildings.

The report presents laboratory performance measurements of a relatively unmodified residential heat pump designed for R22 when charged with a nonazeotropic, binary mixture of R13B1 and R152a. Results are presented for various sizes of fixed expansion devices. The effect of gliding temperature within the saturation zone was found to be small. The experimental investigation confirmed that flash distillation within the accumulator would improve low temperature heating performance. The measured performance was approximately 11% lower in both efficiency and capacity than R22 for air conditioning. The high temperature heating efficiency was 3% lower than R22. The low temperature heating capacity was 14% higher and efficiency 2% higher than R22. These results show a substantial improvement over R22 for heating applications at the expense of reduced cooling mode performance. Further performance enhancement for this or other mixtures is expected through various system modifications which remain to be studied.

700,913

PB88-139001 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.
Plan for the Development of Test Procedures for Differential Temperature Controllers Used in Solar Energy Systems.
Final rept.,
J. Greenberg. 1985, 6p
Contract DE-A101-76PR06010
Sponsored by Department of Energy, Washington, DC. Office of Solar Heat Technologies.
Pub. in Proceedings of Winter Annual Meeting American Society of Mechanical Engineers, Miami Beach, FL, November 17-21, 1985, 6p.

Keywords: *Solar heating, *Temperature control, *Control equipment, *Controllers, Solar energy, Environmental tests, Vibration tests, Thermistors, *Solar cooling systems, Sensors, Test methods.

From the inception of the active solar heating and cooling program, control system reliability problems have been identified as a major source of failure. Although the sensor elements of the control systems have contributed to a number of these failures and operational problems, recent reports indicate that the controllers themselves are a source of failure. Meetings with solar industry and government representatives cited solar controls as the highest ranked research area that is appropriate for Federal Government support and recommended, among other things, the development of standard test methods and evaluation procedures for controller hardware and controller interfaces. The paper discusses the various tests that are being considered in evaluating the performance of differential temperature controllers used in solar energy systems. The paper also addresses the various sensor types used in solar energy applications and recommends that the tests be performed using sensor simulators.

700,914

PB88-151931 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment Div.
Simulation of a Heat Pump Operating with a Nonazeotropic Mixture.
Final rept.,
P. A. Domanski, and D. A. Didion. 1985, 15p
Sponsored by Electric Power Research Inst., Palo Alto, CA.
Pub. in ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Transactions, v91 pt2B p1368-1382 1985.

Keywords: *Heat pumps, *Binary mixtures, Simulation, Refrigerants, Reprints.

The paper provides an overview of the model developed for simulation of steady-state performance of a heat pump working with a nonazeotropic binary mixture. The modeled heat pump consists of a hermetic,

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reciprocating compressor, flat-finned tube heat exchangers, a constant flow area expansion device, an accumulator, a four-way valve, and connecting tubing. The paper discusses basic concepts in formulation of models of major heat pump components and overall program iteration scheme. Verification of the model is presented in the cooling and heating operating modes for a heat pump charged with R13B1/R152a mixture.

700,915
PB88-153721 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.
Calculations of Maximum Allowable Heat Losses for Various Shallow Trench Heat Distribution Systems.
J. B. Fang. Nov 87, 119p NBSIR-87/3617
Sponsored by Corps of Engineers, Washington, DC., Naval Facilities Engineering Command, Alexandria, VA., and Air Force Engineering and Services Center, Tyndall AFB, FL.

Keywords: *Heat distribution systems, *Heat losses, Trenches, Finite element analysis, Computer applications.

The calculation of heat losses for shallow trench underground heat distribution systems was performed using a finite element computer program. The finite element analysis solved a two-dimensional steady-state heat transfer problem for two insulated pipes in a rectangular trench with surrounding soil. A life-cycle cost analysis was performed to determine the cost of construction and annual energy cost associated with pipe heat loss for underground concrete trench systems of different trench dimensions and insulated pipe sizes.

Reserves

700,916
PB88-162581 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Issue of Sky Conditions.
Final rept.,
G. Gillette, and S. Treado. 1985, 5p
Contract DE-AC05-84OR21400
See also DE85-010590. Sponsored by Department of Energy, Washington, DC.
Pub. in Lighting Design and Application 15, n3 p23-27 Mar 85.

Keywords: *Sky brightness, *Illuminance, *Daylighting, *Daylight, Cloud cover, Solar radiation, District of Columbia, Reprints, Washington DC.

The issue of sky conditions is explored as applied to current daylighting practice. Based on studies of hourly sky conditions in the Washington, DC area, an understanding was sought regarding the ability to estimate illuminances and sky luminances under skies of variable cloudiness. The meaning and validity of non-standard, non-perfect skies is discussed, and limits of non-perfection are explored and compared against measurements of hourly sky luminance, illuminance, and solar radiation.

Solar Energy

700,917
DE85010590 PC A03/MF A01
National Bureau of Standards, Washington, DC.
Issue of Sky Conditions.
G. Gillette, and S. Treado. Apr 85, 32p ORNL/Sub-81-22201/3
Contract AC05-84OR21400

Keywords: *Solar Radiation, *Washington DC, Availability, Cloud Cover, Daylighting, ERDA/320100, ERDA/140100.

The issue of sky conditions is explored as applied to current daylighting practice. Based on studies of hourly sky conditions in the Washington, DC area an understanding was sought regarding the ability to estimate illuminances and sky luminances under skies of vari-

able cloudiness. The meaning and validity of non-standard, non-perfect skies is discussed, and limits of non-perfect are explored and compared against measurements of hourly sky luminance, illuminance, and solar radiation. (ERA citation 10:025762)

700,918
DE86006907 PC A08/MF A01
Technical Univ. of Denmark, Lyngby. Lab. for Varmesolering.
Workshop on Service Life of Solar Collector Components and Materials Held at Lyngby, Denmark on 6 December 1983: Proceedings. Summaries.
P. V. Pedersen. Aug 84, 157p CONF-8312130-Sums.
IEA task workshop on service life of solar collector components and materials, Lyngby, Denmark, 6 Dec 1983.
Portions of this document are illegible in microfiche products.

Keywords: *Solar Collectors, Leading Abstract, Materials Testing, *Meetings, Performance, Service Life, Solar Absorbers, *Foreign technology, ERDA/141000.

This report presents the proceedings of the workshop on Service Life of Solar Collector Components and Materials held at the Technical University of Denmark in December 1983. 16 Participants from 10 different countries of the IEA Solar Heating and Cooling Programme, Task III were present at the workshop, and 15 papers were presented. The paper presentation and discussion covered: (1) accelerated material tests and service life testing, (2) complete collector tests, and (3) operational experience with solar collector systems. The report includes a short summary of each of the presented papers and discussion and conclusions reached in this connection. Each paper has been separately indexed for inclusion into the Energy Data Base. (ERA citation 11:022347)

700,919
PB87-151627 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Application of Transparent Enclosure Theory to Solar Energy Absorption by Cylindrical-Tubes in Sunspaces.
Final rept.,
M. E. McCabe, and M. Van Migom. 1985, 5p
Sponsored by Department of Energy, Washington, DC.
Pub. in Jnl. of Solar Energy Engineering-Transactions of the ASME 107, n1 p5-9 1985.

Keywords: *Solar energy, Reprints, Solar irradiance, Transparent enclosure.

A general matrix formulation for beam and diffuse radiative solar transfer is presented for an enclosure containing partially transparent walls. A two-dimensional model is formulated for the sunspace in which a typical cylindrical absorber tube is subdivided into a number of uniform elements and the window and sunspace surfaces are each represented as single elements. The matrix expressions are evaluated for incident solar flux conditions typical for a south vertical window on a clear winter day. The results are presented as dimensionless ratios of absorbed-to-incident solar flux as a function of the tube spacing to radius ratio. The spatial distribution of absorbed solar flux is presented at discrete time intervals for the cylindrical-tube. Space and time averaged values of absorbed solar flux are also presented for the cylinder, the window and the room. The potential application of these results for thermal modeling in passive solar applications is discussed.

700,920
PB87-153078 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Investigation of the Degradation of Aqueous Ethylene Glycol and Propylene Glycol Solutions Using Ion Chromatography.
Final rept.,
W. Rossiter, M. Godette, P. Brown, and K. Galuk. 1985, 13p
Sponsored by Department of Energy, Washington, DC. Office of Solar Heat Technologies.
Pub. in Solar Energy Materials 11, n5-6 p455-467 1985.

Keywords: *Degradation, *Ethylene glycol, Glycols, Reprints, *Propylene glycol, Solar collectors, Thermo-oxidation.

Aqueous solutions of ethylene glycol and propylene glycol produce acidic degradation products upon

thermo-oxidation. The increase in the concentrations of degradation products in solution was measured over time using the ion-chromatography exclusion (ICE) method analysis. Variables effecting the thermo-oxidation considered in the investigation were temperature, the presence of metals, and oxidative conditions. Comparisons were made with the pH values of the thermo-oxidatively degraded glycol solutions and the concentration of degradation products. It was found that different solutions having comparable pH values contained significantly different amounts of degradation products. It was concluded that the extent of degradation of the glycol can not be used as an indicator of the magnitude of the decrease in pH which the glycol solution may undergo during thermo-oxidation in the presence of metals.

700,921
PB87-161766 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Conclusions and Recommendations for the Testing of Flat-Plate Solar Collector Thermal Performance and Durability.
Final rept.,
D. Waksman, and W. C. Thomas. 1984, 6p
Sponsored by Department of Energy, Washington, DC.
Pub. in Proceedings of Winter Annual Mtg. American Society of Mechanical Engineers, New Orleans, LA, December 9-14, 1984, 6p 1984.

Keywords: Thermal measurements, Durability, Performance evaluation, *Solar collectors, *Flat plate collectors, Stagnation, U.S. NBS.

Efforts in the development of reliability/durability tests for solar collectors and their materials have been hampered by the lack of real time and accelerated degradation data that can be correlated with in-use conditions. In 1977, the Solar Collector Reliability/Durability Test Program was initiated at the National Bureau of Standards (NBS) to help generate the data required to develop methods for predicting the long term durability and reliability of flat-plate solar collectors and their materials. The paper summarizes the results obtained in this test program for full-size solar collectors. Recommendations are made regarding the use and limitations of thermal performance measurements and environmental exposure tests for assessing the durability of flat-plate solar collectors.

700,922
PB87-161774 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Assessment of Durability Testing Procedures for the Covers of Flat-Plate Solar Collectors.
Final rept.,
D. Waksman, W. E. Roberts, and W. E. Byrd. Jul 85, 21p
Sponsored by Department of Energy, Washington, DC.
Pub. in Durability of Building Materials 3, n1 p21-Jul 85.

Keywords: Coverings, Durability, Tests, Glazes, Reprints, *Flat plate collectors, *Solar collectors.

Efforts in the development of reliability/durability tests for solar collectors and their materials have been hampered by the lack of real time and accelerated degradation data that can be correlated with in-use conditions. In 1977, the Solar Collector Reliability/Durability Test Program was initiated at the National Bureau of Standards (NBS) to help generate the data required to develop methods for predicting the long term durability and reliability of flat-plate solar collectors and their materials. The paper summarizes the results obtained in the test program for cover materials used in flat-plate solar collectors. Recommendations are made regarding the environmental exposure of these materials and the measurement of changes in their performance.

700,923
PB87-161782 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Experimental Research at the NBS (National Bureau of Standards) Passive Solar Test Facility.
Final rept.,
B. M. Mahajan, and S. T. Liu. 1984, 7p
See also report dated Oct 84, DE85-003442. Sponsored by Department of Energy, Washington, DC.

Pub. in Proceedings of Conference on Passive and Hybrid Solar Energy Update, Washington, DC., September 5-7, 1984, p166-172 Oct 84.

Keywords: Research, Experimentation, Data acquisition, *Passive solar test facility, US NBS.

The National Bureau of Standards Passive Solar Test Building, constructed under the sponsorship of the U.S. Department of Energy, has been operational since October 1981. This test building has been constructed for the purpose of acquiring class A performance monitoring data for various passive systems under different experimental conditions. The performances of the three test cells in the building, each with different south-facing passive solar features, was monitored for two short periods during January-March of 1984. This paper briefly describes the test facility, data acquisition procedures, test conditions for the experiments. The paper presents representative results from these experiments, compares the performances of the three cells. The paper also compares data with the predicted values of the ratios of solar radiation quantities and energy requirements. The data and predicted values show good agreement suggesting that the procedures outlined in the Volume Three of Passive Solar Design Handbook for predicting these quantities are valid.

700,924

PB87-199337 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Building Materials Div.

Initial Results from Testing Passive Solar Components in the NBS (National Bureau of Standards) Calorimeter,
M. E. McCabe, and E. Hancock. 1983, 8p
Sponsored by Department of Energy, Washington, DC. Passive and Hybrid Solar Energy Div.
Pub. in Proceedings of Conference Passive and Hybrid Solar Energy Update, Washington, DC. September 26-28, 1983, p239-246.

Keywords: *Test facilities, Heat transfer, Thermal measurements, Windows, *Passive solar heating systems, *Calorimetry, Hybrid systems, US NBS, U values.

Studies of the thermal performance of passive solar buildings have indicated a need for precise measurement of solar and thermal energy transfer in modular passive/hybrid solar components under conditions of actual use. A description of the design and initial operational results for a new calorimetric test facility is presented in this paper. The facility is designed for testing of passive solar components at the National Bureau of Standards in Gaithersburg, MD. It is anticipated that the test facility will provide a substantial improvement in the measuring techniques for passive and hybrid solar components over other methods currently in use and thereby provide a firm technical basis from which laboratory test procedures can be evaluated.

700,925

PB88-141155 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Building Equipment Div.

Measured Performance of Solar Hot Water Systems Subjected to Various Collector Array Flow Rates.

Final rept.,
A. H. Fanney. 1985, 8p
Sponsored by Department of Energy, Washington, DC. Office of Solar Heat Technologies.
Pub. in Proceedings of Solar Buildings Conference, Washington, DC., March 18-20, 1985, p123-130.

Keywords: *Solar water heaters, *Solar collectors, Water heating, Performance evaluation, Thermodynamic properties, Reprints.

The thermal performance of solar domestic hot water (DSHW) systems is influenced by the solar collector array flow rate. An experimental investigation has been conducted at the National Bureau of Standards to quantitatively evaluate the effect. The paper describes the selection of the optimum collector array flow rate based on both analytical and experimental considerations, describes the experimental apparatus, and presents data which illustrates the increase in thermal performance possible by utilizing the optimal flow rate.

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700,926

PB87-164141 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Organic Analytical Research Div.

Quantification of Polycyclic Aromatic Hydrocarbons and Nitro-Substituted Polycyclic Aromatic Hydrocarbons and Mutagenicity Testing for the Characterization of Ambient Air Particulate Matter.
Final rept.,
S. A. Wise, S. N. Chesler, L. R. Hilpert, W. E. May, R. E. Rebert, C. R. Vogt, M. G. Nishioka, A. Austin, and J. Lewtas. 1985, 14p
Pub. in Environmental International 11, n2-4 p147-160 1985.

Keywords: *Air pollution, *Aromatic polycyclic hydrocarbons, Chemical analysis, Concentration(Composition), Reprints, *Particulate sampling, Air sampling.

As part of a study to identify mutagenic and potentially carcinogenic compounds in urban air particulate extracts, the polycyclic aromatic hydrocarbon (PAH) mixture isolated from a large sample collected in Philadelphia, PA, was characterized by liquid chromatography (LC), gas chromatography (GC), and gas chromatography-mass spectrometry (GC-MS). After isolation of the aromatic fraction from the extract using classical liquid-liquid partitioning and silica gel column chromatography, the PAH fraction was isolated by normal-phase LC. A number of the major PAH constituents were quantified by GC and LC. Quantification of the minor constituents was accomplished by further sub-fractionation of the PAH mixture into eight fractions based on the number of aromatic carbons in the PAH. These fractions were then characterized by GC and GC-MS. More than 100 PAH components were quantified in this sample. Approximately 40 unsubstituted PAH and 10 methyl-substituted PAH were identified based on GC retention, LC retention, fluorescence, and/or mass spectral data. Several nitro-substituted PAH were also found in the PAH fraction and the more polar fractions isolated from the original aromatic fraction.

700,927

PB87-173407 PC A04/MF A01
National Bureau of Standards (NBS), Gaithersburg, MD. Chemical Process Metrology Div.

Collection and Analysis of Organic Compounds in Air: An Annotated Bibliography (1976-1986),
F. E. Jones. Feb 87, 58p NBSIR-87/3527
Sponsored by Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD.

Keywords: *Air pollution, *Chemical analysis, Bibliographies, Adsorption, Organic compounds, *Air sampling, *Volatile organic compounds, Semivolatile organic compounds.

This is a selected and annotated bibliography of sources of methodology for the collection and analysis of volatile and semi-volatile organic compounds present in air. The most prevalent methodology is the collection and preconcentration of organic compounds in a tube or cartridge containing an adsorbent, and subsequent thermal desorption of the collected compounds on the column of a gas chromatograph (GC), GC/mass spectrometer (MS), or GC/MS/computer system for analysis. The performance of adsorbents such as porous polymer adsorbents, and the optimization and standardization of methodology are of particular interest. The bibliography comprises 68 general citations and 17 standard operating procedures.

700,928

PB87-218921 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Gas and Particulate Science Div.

Ambient Impact of Residential Wood Combustion in Elverum, Norway.

Final rept.,
T. Ramdahl, J. Schjoldager, L. A. Currie, M. Moller, J. E. Hanssen, G. A. Klouda, and I. Alfheim. 1984, 10p
Pub. in Science of the Total Environment 36, p81-90 Jun 84.

Keywords: *Wood combustion, *Air pollution, Norway, Reprints, *Combustion products, Biogenic carbon, Radiocarbon, Trace analysis.

Air pollution from wood combustion has been studied in Elverum, Norway (10,000 inhab.) during January and February 1982. Carbon-14 was used as a unique tracer for biomass combustion. Other compounds determined included total carbon, polycyclic aromatic hydrocarbons, metals and sulfate. Many samples were tested for mutagenicity. Wood carbon contributed to Approx. 60% of the total carbon in ambient fine particles smaller than 3 micrometers diameter. The emission of PAH from wood combustion contributed 60-70% to the total PAH emitted in the winter half-year. 1-Methyl-7-isopropyl-phenanthrene (retene) and methyl dehydroabietic acid may qualitatively be used as tracers for softwood combustion.

700,929

PB87-231346 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Fire Measurement and Research Div.

Wood Gasification at Fire Level Heat Fluxes.
Final rept.,
T. J. Ohlemiller, T. Kashiwagi, and K. Werner. 1987, 16p
Sponsored by Department of Energy, Washington, DC. Pub. in Combustion and Flame 69, p155-170 1987.

Keywords: *Air pollution, *Wood, *Gasification, Stoves, Thermal degradation, Reprints, Radiative heat transfer, Smoldering combustion.

The study was motivated by a need to understand the source of pollutant species emitted by wood burning stoves; the results are relevant also to fire research. The study examines the products generated when wood is heated in controlled conditions, without flaming, in atmospheres of varying oxygen concentration (0-21% O₂ in N₂). Small wood samples (typically 4 x 4 cm exposed face, 2-4 cm thick; mainly white pine and red oak, but also two tests with yellow pine) were subjected to uniform radiative heat fluxes (2-7.8 W/sq. cm.) on one face. Sample weight was followed in some tests and sample temperature (5 thermocouples in depth) in others since the two measurements could not be made together. In all tests, all evolved products were either monitored (H₂O, CO, CO₂, total hydrocarbons not condensable at -40 C) or trapped and analyzed (condensable organic species) by gas chromatography and mass spectroscopy. Many of the trends of the major products (CO, CO₂, H₂O, THC, total organic condensable or tar) are qualitatively intelligible in terms of the expected impact of varying temperature or oxygen level, for example. The extent of change in these major products is rather limited (factor of two to four) over the range of variables explored here. The organic condensate was difficult to analyze; it is estimated that only 20% of it would pass through a gas chromatograph.

700,930

PB87-233458 Not available NTIS
National Bureau of Standards (NBS), Gaithersburg, MD. Molecular Spectroscopy Div.

Infrared Measurements of the C10 Radical.
Final rept.,
J. B. Burkholder, P. D. Hammer, C. J. Howard, A. G. Maki, G. A. Thompson, and C. Chackerian. 1987, 23p
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in Jnl. of Molecular Spectroscopy 124, p139-161 1987.

Keywords: *Air pollution, Chlorine monoxide, Infrared, Radical, Spectroscopy, Reprints, Atmospheric chemistry, Molecular spectroscopy, Absorption intensity.

High-resolution infrared spectra of the fundamental (upsilon = 1-0) and first overtone (upsilon = 2-0) bands of the ClO (X2II(3/2), 2II(1/2) radical have been observed using a Fourier transform spectrometer and a diode laser. Frequencies and relative absorption line intensities have been measured and analyzed. An improved set of rovibrational constants for both 35ClO

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and 37ClO and a table of line positions and intensities are given. Relative intensity measurements are used to determine the rotational dependence of the intensities, and thereby determine the Herman-Wallis effect. An integrated band intensity of 11.3 plus or minus 2.0 cm⁻² atm (-1) is determined for $\nu_{\text{max}} = 1-0$ from the first Herman-Wallis constant in a manner independent of any concentration determination.

700,931
PB88-109145 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Determination of Polycyclic Aromatic Hydrocarbons and Alkylated-Polycyclic Aromatic Hydrocarbons in Particulate Extracts Using Negative Ion Chemical Ionization Mass Spectroscopy.
Final rept.,
L. R. Hilpert. 1987, 12p
Pub. in Biomedical and Environmental Mass Spectrometry 14, p383-394 1987.

Keywords: *Gas chromatography, *Mass spectrometry, Polycyclic aromatic hydrocarbons, Quantitative analysis, Reprints, Negative ion chemical ionization, Particulates, Diesel emissions.

Gas chromatography/mass spectrometry using a combination of electron impact (EI) and Negative Ion Chemical Ionization (NICI) was used for the determination of polycyclic aromatic hydrocarbons (PAH) and alkylated-PAH in extracts of two particulate materials which are Standard Reference Materials: SRM 1650 Diesel Particulate Matter, and SRM 1649 Urban Particulate Matter. The selectivity of NICI mass spectrometry for certain PAH enabled identification and selective determination of isomeric PAH and alkylated-PAH in the particulate SRMs. Quantitative determinations for methylfluoranthenes, methylpyrenes, methylbenzofluoranthenes and methylbenzo(a)pyrenes in the two particulates showed that the methyl-substituted species were present at levels as high as 30 percent of the parent-PAH concentrations. Similarities in the alkylated-PAH content of the air and diesel particulate materials are discussed in relation to the sources of the two materials.

700,932
PB88-110796 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Reference Filter Standards for the Analysis of Chrysotile Asbestos in Non-Occupational Environments.
Final rept.,
J. A. Small, and E. B. Steel. 1982, 13p
Pub. in Proceedings of International Colloquium on Dust Measuring Technique and Strategy (4th), Edinburgh, Scotland, September 1982, p343-355.

Keywords: *Filters, *Asbestos, *Serpentine, *Standards, Laboratories, Tests, *Foreign technology, *Air pollution sampling, Electron microscopy, Particulate sampling.

For the past four years the National Bureau of Standards (NBS) and the Environmental Protection Agency (EPA) of the United States have been cooperating on the development of standards to aid in the identification and characterization of asbestos in atmospheric samples. The final goal of this program is to provide a standard in the form of statistically predictable loading of chrysotile asbestos on a substrate suitable for sample preparation and counting with an electron microscope. Such a standard could be used by field laboratories to test sample preparation and asbestos counting procedures as well as for inter-laboratory comparisons. These standards consist of sections from Nuclepore filters which contain both a low loading and a medium loading of chrysotile asbestos in an urban air particulate matrix. In addition, each standard will also include a transmission electron microscope (TEM) grid prepared from the appropriate filter.

700,933
PB88-147533 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Power of 14C Measurements Combined with Chemical Characterization for Tracing Urban Aerosol in Norway.
Final rept.,
L. A. Currie, G. A. Klouda, J. Schjoldager, and T. Ramdahl. 1986, 8p
Pub. in Radiocarbon 28, n2A p673-680 1986.

Keywords: *Air pollution, *Aerosols, *Wood, *Aromatic polycyclic hydrocarbons, Norway, Measurements, Residential buildings, Reprints, *Carbon 14 compounds, Elverum(Norway).

Changing fuel patterns and increased awareness of health effects from combustion aerosols have generated considerable interest in the use of 14C as a biogenic-fossil aerosol source discriminator. Prior studies in the US demonstrated the importance of 14C measurement for estimating the woodburning contribution to urban aerosols. The present work treats a specific air pollution problem in the town of Elverum, Norway where large wintertime concentrations of aerosol carbon and polycyclic aromatic hydrocarbons (PAH) were suspected to come from residential wood combustion (RWC).

700,934
PB88-152871 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Source Apportionment of Carbonaceous Combustion Products by Micro-Radiocarbon Measurements for the Integrated Air Cancer Project (IACP).
Final rept.,
G. A. Klouda, L. A. Currie, A. E. Sheffield, S. A. Wise, B. A. Benner, R. K. Stevens, and R. G. Merrill. 1987, 8p
Pub. in Proceedings of the EPA/APCA Symposium on Measurement of Toxic and Related Air Pollutants, Research Triangle Park, NC., May 3-6, 1987, 8p.

Keywords: *Air pollution, *Combustion products, *Atmospheric models, *Radioactive contaminants, *Exhaust emissions, Sampling, Particulates, Carbon 14, Aerosols, Motor vehicles, *Air pollution sampling, *Cancer, Stationary sources.

Atmospheric particle samples were collected during the winter of 1984-1985 in Albuquerque, NM and Raleigh, NC by the EPA for the Integrated Air Cancer Project (IACP). Selected chemical fractions were analyzed for 14C to apportion mobile (motor vehicles) and stationary (residential wood combustion) sources. In addition, these results were used to validate the EPA Single Tracer Regression Model (STRM), also a technique for the source apportionment of aerosols.

700,935
PB88-152889 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Urban Atmospheric (14)CO and (14)CH4 Measurements by Accelerator Mass Spectrometry.
Final rept.,
G. Klouda, L. Currie, D. Donahue, A. Jull, and M. Naylor. 1986, 9p
Pub. in Radiocarbon 28, n2A p625-633 1986.

Keywords: *Air pollution, Exhaust emissions, Urban areas, Carbon 14, Mass spectroscopy, Winter, Carbon monoxide, Methane, Concentration(Composition), Reprints, Las Vegas(Nevada), Carbon 13.

Atmospheric gas samples (0.1 cubic m) were collected at ground level during January/February 1984 in Las Vegas, Nevada for (14)c/(13)c accelerator mass spectrometry measurements and total abundance of CO and CH4. During winter months in the locale, carbon monoxide concentrations occasionally exceed safe exposure levels, 10 to 100 times background, and are believed to result from vehicular emissions and/or residential wood burning. Carbon isotope measurements were carried out on two samples to estimate vehicle and wood burning source contributions to the air shed. Results of CO versus CH4 concentrations show a good correlation and preliminary (14C)/(13C) results of both species from two samples suggest that vehicle emissions is the predominate source of air pollution.

700,936
PB88-153671 PC A08/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.
Indoor Air Quality Modelling, Phase 2 Report. Residential Indoor Air Quality Simulation.
J. W. Axley. Oct 87, 158p NBSIR-87/3661
See also PB86-166626. Sponsored by Environmental Protection Agency, Washington, DC., and Department of Energy, Washington, DC.

Keywords: *Residential buildings, *Air pollution, Computerized simulation, Circulation, Mathematical models, Three dimensional flow, Computer programs, *Indoor air pollution, Space HVAC systems,

CONTAM86 computer program, Fortran 77 programming language, Atmospheric dispersion.

The interim report presents the results of Phase II of the NBS General Indoor Air Pollution Concentration Model Project. It describes the theoretical basis of a general-purpose nonreactive contaminant dispersal analysis model for buildings, the computational implementation of a portion of this model in the program CONTAM86, and examples of the application of the model to practical problems of contaminant dispersal analysis. Presently the model is being extended to handle problems of reactive contaminant dispersal analysis and full computational implementation of all portions of the model is being completed. The contaminant dispersal analysis model is based upon the idealization of building air flow systems as an assemblage of flow elements connected to discrete system nodes corresponding to well-mixed air zones within the building and its HVAC system. Equations governing the air flow processes in the building (e.g., infiltration, exfiltration, HVAC system flow, and zone-to-zone flow) and equations governing the contaminant dispersal due to the flow, accounting for contaminant generation or removal, are formulated by assembling element equations so that the fundamental requirement of conservation of mass is satisfied in each zone. The character and solution of the resulting equations are discussed, and steady and dynamic solution methods are outlined.

700,937
PB88-155882 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.
Method for Measuring the Effectiveness of Gaseous Contaminant Removal Devices. Progress Report.
B. M. Mahajan. Sep 87, 22p NBSIR-87/3666

Keywords: *Effectiveness, *Indoor air pollution, *Pollution control equipment, Air filters, Gases, Contaminants, Removal, Activated carbon, Space HVAC systems, Aluminum oxides, Performance evaluation.

The progress report briefly describes the test apparatus designed for measuring the effectiveness of filter medias, various components of the test loop, instrumentation, and contaminant concentration measuring techniques. The report also describes various aspects of the planned testing scheme that will be followed to accomplish the goals of the research project.

Solid Wastes Pollution & Control

700,938
PB87-167185 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Kinetics Div.
Hazardous Waste Aspects of MSW Combustion.
Final rept.,
W. Tsang. 1984, 10p
Pub. in Argonne National Laboratory Technical Report, ANL/CNSV-TM-144, Energy Munic. Waste Res., p259-268 1984.

Keywords: Combustion, Incineration, Reprints, *Hazardous wastes, *Combustors, Dioxin, Municipal solid wastes.

The paper is concerned with organic emissions from MSW combustors. The authors will begin with a brief survey of the basic principles that govern the high temperature oxidative destruction of organic compounds. This will be followed by a survey of the existing data concerning organic emissions from such devices. Serious problems with respect to measurement methodology and inadequacies in the nature of the information base will be discussed. The problem of dioxin emissions is discussed. Mechanisms for its formation and destruction will be described and the important controlling factors as well as major uncertainties indicated. The paper concludes by suggesting the type of laboratory measurements which can solve the many unanswered questions and the measurement strategies which may provide evidence for proper operation of MSW combustors.

700,939
PB87-233821 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
NBS (National Bureau of Standards) Approach for Improving the Quality of Leach Measurements on Solid Wastes.

Final rept.,
 B. I. Diamondstone, R. W. Burke, and E. L. Garner. 1981, 11p
 Pub. in Proceedings of International Conference on Solid Waste Sludges, and Residual Materials: Monitoring, Technology, and Management, Rome, Italy, June 17-20, 1981, p200-210.

Keywords: *Hazardous materials, *Leach measurements, *Solid wastes.

Historically, the National Bureau of Standards (NBS) has been charged with developing and maintaining the measurement capabilities that affect science and industry in the United States. In this capacity it frequently plays a third party role in which it utilizes its experience and expertise to develop standardized materials and methods to assess existing measurement needs. Recently, the United States Environmental Protection Agency and United States Department of Energy have sought to utilize the capability at NBS for improving the reliability of analytical measurements on solid wastes. The paper outlines the NBS approach towards improving the measurement capability in an area where little, if any, significant standardization exists. Specific topics to be discussed include the development of a new extractor design that improves the precision of commonly used leach tests and the preparation and characterization of a series of quality assurance standards for use in validating laboratory capabilities.

700,940
PB88-154646 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Assessing the Credibility of the Calorific Value of Municipal Solid Waste.

Final rept.,
 K. L. Churney, E. S. Domalski, A. E. Ledford, J. C. Colbert, S. S. Bruce, T. J. Buckley, R. C. Paule, and M. L. Reilly. 1986, 7p
 See also PB84-175470.

Pub. in Proceedings of the Biennial National Waste Processing Conference (12th), Denver, CO., June 1-4, 1986, p449-455.

Keywords: *Calorific value, Combustion, Laboratories, Reliability, Assessment, *Solid wastes, *Municipal wastes, *Refuse derived fuels, Technology assessment.

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) determined by the bomb calorimetric procedure currently used in commercial test laboratories. 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. Calorimetric data from measurements using both the kilogram-size flow and a gram-size bomb calorimeter show that, if proper techniques are implemented, it is possible to determine the calorific value of a multiton pile of waste using gram-size test samples within $\pm 0.3\%$.

700,941
PB88-155429 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Monitoring the Fate of Chlorine from MSW (Municipal Solid Waste) Sampling through Combustion. Part 1. Analysis of the Waste Stream for Chlorine.

Final rept.,
 E. S. Domalski, K. L. Churney, A. E. Ledford, and S. S. Bruce. 1986, 16p
 See also DE86-006829.
 Pub. in *Chemosphere* 15, n9-12 p1339-1354 1986.

Keywords: *Chlorine, *Combustion products, *Waste treatment, Maryland, New York, Sampling, Environmental transport, Reprints, *Ecological concentration, *Environmental transport, *Municipal wastes, Brooklyn(New York), Solid wastes.

The total chlorine and water soluble chlorine contents of the components of municipal solid waste (MSW) have been determined from sampling studies carried out at two sites, Baltimore County, MD, and Brooklyn, NY, for a five-day period. The total chlorine contents of

the MSW samples from Baltimore County, MD, and Brooklyn, NY, are 0.45 and 0.89 mass %, respectively.

HEALTH CARE

Data & Information Systems

700,942
PB87-162194 Not available NTIS

National Bureau of Standards, Gaithersburg, MD. Occupational Health and Safety Div.

Selecting a PC (Personal Computer) Database Management System for Health Physics Applications.

Final rept.,
 L. A. Slaback, and W. R. Webber. 1987, 10p
 Pub. in *Radiation Protection Management* 4, n1 p23-32 Feb 87.

Keywords: *Dosimetry, Reprints, *Health physics, *Data base management systems, *Personal computers, Health programs, Data management, Computer software, National Bureau of Standards.

An integrated system of data management is a necessity for the variety and volume of data encountered in many health physics programs. A Personal Computer (PC) Database Management System (DBMS) can fill these data management needs if it is designed and constructed properly. The article presents a suggested approach to PC database design and outlines the specific features that should be examined when choosing DBMS software. The approach was used to set up a health physics database system at the National Bureau of Standards in 1985. The NBS system is described, and an example of dosimetry data entry is used to illustrate how the system works.

INDUSTRIAL & MECHANICAL ENGINEERING

Environmental Engineering

700,943
PB87-171716 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Application of the Carnahan-Starling-DeSantis Equation of State to Mixtures of Refrigerants.

Final rept.,
 G. Morrison, and M. O. McLinden. 1986, 8p
 Sponsored by Electric Power Research Inst., Palo Alto, CA.

Pub. in Proceedings of ASME (American Society of Mechanical Engineers) Winter Annual Meeting, Anaheim, CA., December 7-12, 1986, p1-8.

Keywords: *Refrigerants, *Thermodynamic properties, Equations of state, Binary systems(Materials), Mixtures, Ternary systems, Reprints, R22/R114 refrigerant mixture.

A modification to the Carnahan-Starling equation of state to describe the properties of refrigerant materials and their binary and ternary mixtures is discussed. A detailed discussion of the ability to fit and predict the thermodynamic properties of R22 is included. The representations arising from limited and extensive data sets are compared. The binary mixture R22/R114 is discussed and compared briefly to other binary refrigerant mixtures. The ability of the model to describe ternary mixtures without any ternary information is discussed. Present uses of the model are discussed.

Industrial Safety Engineering

700,944
PB87-172276 PC A09/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Fire Toxicity Scaling.

E. Braun, B. C. Levin, M. Paabo, J. Gurman, and T. Holt. Feb 87, 198p NBSIR-87/3510

Sponsored by Consumer Product Safety Commission, Bethesda, MD.

Keywords: *Fire tests, *Toxicity, *Combustion products, *Polyurethane resins, Foams, Upholstery, Cotton fabrics, Concentration(Composition), Carbon dioxide, Carbon monoxide, Hydrogen cyanide, *Toxic substances, NBS Toxicity Test Method.

The toxicity of the thermal decomposition products from two flexible polyurethane foams (with and without a fire retardant) and a cotton upholstery fabric was evaluated by a series of small-scale and large-scale tests single mock-up upholstery chair tests during smoldering or flaming decomposition. In addition other fire property data such as rates of heat release, effective heats of combustion, specific gas species yields, and smoke obscuration were measured. The degree of toxicity observed during and following the flaming tests (both large-scale room burns and the NBS Toxicity Tests) could be explained by a 3-Gas Model which includes the combined toxicological effects of CO, CO₂, and HCN. Essentially no animal deaths were noted during the thirty minute exposures to the non-flaming or smoldering combustion products produced in the NBS Toxicity Test Method or the large-scale room test. In the large-scale room tests, little toxicological difference was noted between decomposition products from the burn room and a second room 12 meters away.

700,945
PB87-179230 PC A04/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Workshop on Fire Protection Technology: A Record of the U.S. Papers Prepared for the Workshop on Fire Protection Technology Held in Cairo, Egypt, April 27-28, 1986.

K. F. J. Heinrich, A. J. Fowell, D. M. Bluebond, I. A. Benjamin, and R. W. Bukowski. Apr 86, 71p NBSIR-86/3360

Sponsored by Agency for International Development, Washington, DC.

Keywords: *Fire protection, *Meetings, Fire detection systems, Fire safety.

A series of talks were given by the U.S. participants in the Workshop on Fire Protection Technology, within the framework of the cooperation of NBS with Egyptian institution. The Egyptian institution involved with this workshop is the National Institute for Standards. NBS proposed the Workshop in order to explain the value of fire safety to the intended audience. Papers presented include the following: The National Bureau of Standards and Its International Programs, Fire Tests in the United States, Fire Safety Codes in the United States, Engineering Applications for Fire Related Prediction Tools, Fire Detection and Alarm Systems, Fire Statistics and Their use in Fire Protection; Failure Analysis and Analytical Fire Investigation; Fire Organization in the United States, and Industrial Fire Suppression.

700,946
PB87-182010 PC A06/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Introduction to Fire Hazard Modeling.

R. W. Bukowski. Mar 86, 103p NBSIR-86/3349

Keywords: *Fire hazards, Toxicity, Computerized simulation.

An overview of the development and current capabilities of predictive methods for fire hazard analysis is provided. This includes a range of methods from simple, algebraic equations to complex, computer simulation models. In each case the form, major simplifying assumptions, calculated parameters, and limitations will be discussed. The specific application of these predictive methods to hazard analysis, and the availability of the data resources necessary to conduct a hazard analysis is described. Information on the use of a number of available models, with particular em-

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Industrial Safety Engineering

phasis on those which can be used on desk-top computers, is provided. A discussion of the predictive accuracy of select models is included. Some examples of hazard analyses using these methods are presented. The report is an overview of the author's previous publications on the subject.

700,947

PB87-197802 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
Elevator Piston Effect and the Smoke Problem.
Final rept.,
J. H. Klotz. 1986, 7p
Pub. in Fire Safety Jnl. 11, n3 p227-233 Dec 86.

Keywords: *Elevators(Lifts), *Smoke, *Evacuating(Transportation), Smoke abatement, Flow, Reprints, Handicapped persons, Piston effect.

The material in the paper is part of a joint project between the United States and Canada to evaluate the feasibility of elevator evacuation of the handicapped. The paper presents an analysis for the pressure differences produced by elevator car motion and it presents flow coefficients for flow around cars in elevator shafts based on test data. The results of an experiment to verify this piston effect analysis are presented. Also, practical considerations concerning piston effect and elevator smoke control are presented. An equation is developed to determine the upper limit of the pressure difference across an elevator lobby caused by piston effect.

700,948

PB87-199402 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
FIREDOC: A Fire Research Bibliographic Database.
Final rept.,
N. H. Jason. 1986, 8p
Pub. in New Technology to Reduce Fire Losses and Costs, p8-15 1986.

Keywords: *Fires, Reprints, Data bases, FIREDOC.

The fire research literature is very diversified and there is no 'simple' method to guarantee thorough literature searches on any given subject. The Center for Fire Research, National Bureau of Standards, has been involved in fire research since 1908. To increase the success rate of locating relevant documents and doing it in a more timely manner, the Center has implemented an on-line bibliographic database for its extensive and sometimes unique in-house literature collection. Using available supermicro hardware, FIREDOC was created as the on-line bibliographic database for the Fire Research Information Services (FRIS) collection. The steps that were taken to achieve an on-line system, the selection process for the hardware and software, and techniques on how to search the database are discussed.

700,949

PB88-153341 PC A05/MF A01
Maryland Univ., College Park. Dept. of Mechanical Engineering.
Transient Cooling of a Hot Surface by Droplets Evaporation, March 1986-March 1987,
Final rept.,
M. di Marzo, Z. Y. Wang, and W. H. Meng. Nov 87, 78p REPT-87-11, NBS/GCR-87/534
See also PB87-109468. Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Keywords: *Extinguishing, *Evaporative cooling, Aluminum, Drops(Liquids), Fire safety.

The report describes the research performed during the period March 1986-March 1987 under a joint research program between the Mechanical Engineering Department of the University of Maryland and the Center for Fire Research of the National Bureau of Standards. The study of droplet evaporation on a high thermal conductivity semi-infinite solid is investigated as well as the solid thermal behavior both theoretically and experimentally. The behavior of a low thermal conductivity solid is the objective of experimental studies. A coupled analytical model for the solid and the evaporating liquid is being derived to predict the cooling effect induced by the evaporating droplet.

700,950

PB88-155809 PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Fire Safety Inspection and Testing of Air Moving Systems,
J. H. Klotz. Nov 87, 40p NBSIR-87/3660
Sponsored by Public Buildings Service, Washington, DC.

Keywords: *Fire safety, *Space HVAC systems, Inspection, Tests, Smoke abatement, Stairways.

The paper discusses fire safety inspection and testing procedures for air moving systems. These systems include heating, ventilating and air conditioning systems; zoned smoke control systems; and pressurized stairwells. The detailed methods for inspection and testing presented in the appendices are initial efforts in the evolution of such methodology and it is anticipated that users will modify them to suit their needs.

Laboratory & Test Facilities

700,951

PB87-151601 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Automation of Vibration Testing at the National Bureau of Standards.
Final rept.,
B. F. Payne. 1984, 5p
Pub. in Proceedings of Annual Technical Meeting (30th) Inst. of Environmental Sciences, Orlando, FL., May 1-3, 1984 p478-482.

Keywords: *Vibration tests, *Calibrating, Automation, Measurement, Transducers, Computer applications, National Bureau of Standards, US NBS.

The National Bureau of Standards has been involved in vibration testing and calibration for many years. The developments in small computers in recent years have made possible a great improvement in the quality as well as the quantity of the experiments which can be performed in a laboratory with a given number of technical personnel. Often several experiments can be conducted simultaneously by using small dedicated computers. Laboratory automation has been efficiently employed in the evaluation and calibration of vibration transducers, using both comparison and absolute measurements. These measurements are fully automated, with interactive programs for controlling the test, setting test parameters, collecting and storing data and producing reports and graphs. The paper discusses the types of experiments and tests which are automated at NBS in the area of vibration measurements.

700,952

PB87-151841 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.
Zero Stability of Spinning Rotor Vacuum Gauges.
Final rept.,
K. E. McCulloh, S. D. Wood, and C. R. Tiltford. 1985, 4p
Pub. in Jnl. of Vacuum Science and Technology A-Vacuum Surfaces and Films 3, n3 p1738-1741 1985.

Keywords: *Vacuum gages, *Pressure measurement, Stability, Reprints.

Spinning rotor vacuum gages measure pressure by determining the rate of slowing of a magnetically suspended spinning ball over and above the slowing caused by a pressure independent residual drag. For accurate measurement in the high vacuum range, this residual drag must be determined and subtracted as an offset correction. The stability of this residual drag, temperature induced changes of the ball's moment of inertia, vibration, and random measurement noise will determine the stability and hence the lowest useable pressure of the gage. Examples are given of different types of instabilities and guidelines are presented for minimizing many of the sources of instability.

700,953

PB87-157178 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Fluxmeter Measurements at Low Thermal Levels: Some Problems.

Final rept.,
A. F. Robertson. 1985, 2p
Sponsored by Department of Transportation, Washington, DC.
Pub. in Fire Technology 21, n1 p75-76 1985.

Keywords: *Heat flux, *Fire tests, Measuring instruments, Error analysis, Reprints.

Letter to two journals to alert those using heat fluxmeters of possible errors. A brief note to alert users of heat fluxmeters to possible errors in measurement.

700,954

PB87-161816 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.
Fiber-Optic Thermometry.
Final rept.,
K. G. Kreider. 1985, 11p
Pub. in American Society for Testing and Materials, Special Technical Publication 895, p151-161 1985.

Keywords: *Temperature measuring instruments, Fiber optics, Sapphire, Reprints, Optical fibers, Calibration, High temperature.

A new type of temperature measuring device is being developed at NBS. The optical fiber thermometer is a contact sensor in which a thin film cup assumes the temperature of a fluid stream or contacted solid and emits blackbody radiation. The radiation is then conducted through a sapphire rod typically 1 mm in diameter and on to a photon detector. Research at NBS has focused on proving the feasibility of the system, developing calibration techniques, defining the precision, and optimizing the materials systems of the probe. The paper reviews the method of construction, calibration procedures for both single-wavelength and ratio thermometers, and evaluation of several tip geometries.

700,955

PB87-162152 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Length and Mass Div.
Force Balance Liquid Densimeter.
Final rept.,
R. M. Schoonover. 1984, 4p
Pub. in Proceedings of the International Conference of IMEKO Tech. Committee TC-3 on Measurement of Force and Mass (10th), Kobe, Japan, September 11-14, 1984, p107-110.

Keywords: *Liquids, *Flux density, *Densimeters, Density(Mass/Volume), Density measurement, Standards, Design.

The device described here represents a unique application of an electronic balance to determine the densities of liquids. The paper presented here is the design and analysis of this promising new liquid densimeter. The instrument is now under construction at the National Bureau of Standards and will undergo initial testing shortly. Upon completion, the densimeter will be used to certify liquid density standards that will be sold as Standard Reference Materials. The instrument should be able to provide standard density reference samples of liquid.

700,956

PB87-164075 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.
Design and Performance of a Ring-Shaped Clip Gauge for Fracture Mechanics Testing.
Final rept.,
R. L. Tobler, and J. A. Shepic. 1985, 4p
Sponsored by Department of Energy, Washington, DC.
Pub. in Jnl. of Testing and Evaluation 13, n4 p299-302 1985.

Keywords: *Fracture tests, *Strain gages, Cryogenics, Rings, Reprints, Fracture mechanics.

A ring-shaped clip-on displacement gage for fracture mechanics testing is described. The novel design of this gage offers advantages and operating conveniences compared to the conventional double-cantilever beam type gage referenced in ASTM fracture test standards. The construction of ring gages for room temperature and cryogenic applications is discussed.

700,957

PB87-166427

(Order as PB87-166401, PC A05/MF A01)
National Bureau of Standards (NML), Gaithersburg,
MD. Center for Radiation Research.

NBS (National Bureau of Standards) Scale of Radiance Temperature.

W. R. Waters, J. H. Walker, and A. T. Hattenburg. 17 Oct 86, 10p

Included in Jnl. of Research of the National Bureau of Standards, v92 n1 p17-26 Jan-Feb 87.

Keywords: *Temperature measurement, *Standards, Blackbody radiation, International Practical Temperature scale, High temperature, Calibration.

The paper describes the measurement methods and instrumentation used in the realization and transfer of the International Practical Temperature Scale (IPTS-68) above the temperature of freezing gold. The determination of the ratios of spectral radiance of tungsten-strip lamps to a gold-point blackbody at a wavelength of 654.6 nm is detailed. The response linearity, spectral responsivity, scattering error, and polarization properties of the instrumentation are described. The analysis of sources of error and estimates of uncertainty are presented. The assigned uncertainties (three standard deviations) in radiance temperature range from + or - 2K at 2573 K to + or - 0.5 K at 1073 K.

700,958

PB87-167201

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Temperature and Pressure Div.

Long-Term Stability of Two Types of Hot Cathode Ionization Gages.

Final rept.,
S. D. Wood, and C. R. Tilford. 1985, 4p
Pub. in Jnl. of Vacuum Science and Technology A-Vacuum Surfaces and Films 3, n3 p542-545 1985.

Keywords: *Ionization gages, Vacuum gages, Sensitivity, Stability, Nitrogen, Reprints.

The authors have monitored the nitrogen sensitivity of four gages each of two selected types of hot cathode ion gages over a 500 day test period. Gages of one type, a tungsten filament conventional triode, changed by about 12% during this time, with most of the decrease caused by 'high' pressure operation. Gages of the second type, a twin tungsten filament Bayard-Alpert gage, changed by no more than 6% and with no obvious correlation between sensitivity changes and 'high' pressure operation or exposure to air. There were also no significant differences in the sensitivity changes for the two filaments in a given Bayard-Alpert gage, although their operating times differed by a factor of ten.

700,959

PB87-167219

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Temperature and Pressure Div.

Sensitivity of Hot Cathode Ionization Gauges.

Final rept.,
C. R. Tilford. 1985, 5p
Pub. in Jnl. of Vacuum Science and Technology A-Vacuum Surfaces and Films 3, n3 p546-550 1985.

Keywords: *Ionization gages, Vacuum gages, Standards, Performance, Sensitivity, Reprints, Calibration.

An experimental program of some years duration has attempted to characterize several hot cathode ionization gage types in the high vacuum range by the uniformity, linearity, and stability of their nitrogen sensitivity. Results for six commonly used types are summarized here. Of the gages tested, the most promising overall performance was obtained from tubulated Bayard-Alpert gages with two tungsten filaments mounted 180 degrees apart about the grid. Conventional triode gages with tungsten filaments came close to this level of performance and have superior high pressure linearity.

700,960

PB87-180394

PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Automated Production Technology Div.

Description of NBS (National Bureau of Standards) Calibration Services in Mechanical Vibration and Shock.

Technical note,
D. C. Robinson, M. R. Serbyn, and B. F. Payne. Feb 87, 30p NBS/TN-1232
Also available from Supt. of Docs as SN003-003-02794-4.

Keywords: *Vibration meters, *Calibrating, Mechanical shock, Accelerometers.

Accurate calibration of accelerometers requires that accurate measurement techniques be developed and maintained. Calibrations of vibration exciters and pickups are performed by comparison with the response characteristics of NBS standard accelerometers or by absolute methods. The paper gives a summary of the various calibration procedures used in the calibration of accelerometers and reference exciters. The frequency ranges, vibration levels and accuracy statements for standardized tests designed to meet a variety of user needs are listed.

700,961

PB87-200317

Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.

Apparatus for Quasihydrostatic Measurement of Piezoelectric d(sub h) Coefficient.

Final rept.,
K. F. Schoch, A. S. DeReggi, and S. C. Roth. 1986, 4p
Pub. in Proceedings of the IEEE (Institute of Electrical and Electronics Engineers) International Symposium on Applications of Ferroelectrics (6th), Bethlehem, PA., June 8-11, 1986, p711-714 1986.

Keywords: *Piezoelectricity, Measuring instruments, Hydrostatics, Polymers, Composite materials.

Measurement of piezoelectric response of materials d(sub h) by a pressure pulse technique is described in the article. The sample is placed in a fluid-filled chamber fitted with a piston at one end. Impact on the piston creates a pressure pulse in the chamber, the duration and shape of which can be controlled. This method is effective with composite samples as well as polymer film samples.

700,962

PB87-201711

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Precision Engineering Div.

Noncontacting Optical Probe.

Final rept.,
F. S. Jing, A. W. Hartman, and R. J. Hocken. 1987, 5p
Pub. in Review of Scientific Instruments 58, n5 p864-868 May 87.

Keywords: *Optical measuring instruments, *Distance measuring equipment, Optical microscopes, Linearity, Probes, Sensitivity, Reprints, *Proximity devices, Simon probes.

A description is given of an optical probe, consisting of an optical microscope with modified internal illumination, a dual chopper with its two edges straddling the image plane, and a dual area sensor mounted behind the chopper. An analysis shows that the sensitivity of this proximity probe is essentially the same as that of the Simon probe, while its linearity is much better. Also, its construction is much simpler. A prototype has shown resolution of 0.02 micrometer and linearity errors of 0.5 micrometer (at 100 micrometers range), respectively.

700,963

PB87-213526

(Order as PB87-213476, PC A05/MF A01)
National Bureau of Standards (NML), Gaithersburg,
MD. Length and Mass Div.

Note on the Choice of a Sensitivity Weight in Precision Weighing.

R. S. Davis. 28 Nov 86, 4p
Included in Jnl. of Research of the National Bureau of Standards, v92 n3 p239-242 May-Jun 87.

Keywords: *Weight measurement, *Mass, Precision, Metrology, Sensitivity.

Good weighing practice usually dictates that, when using double-substitution weighing to determine the mass difference between two weights, the nominal value of the sensitivity weight used to calibrate the

optical scale of the mass comparator be at least four times greater than the difference of the two weights being compared. However, there are times when other considerations must override this rule. The authors examine the theoretical basis for the rule and the penalty for violating it. Finally, they propose a modified weighing scheme which imposes a much less stringent rule for the size of the sensitivity weight. The new scheme requires an additional balance reading, but does not increase the overall measurement time significantly.

700,964

PB87-218962

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electrosystems Div.

View of Metrology Support for ATE (Automatic Test Equipment) Systems.

Final rept.,
T. F. Leedy. 1987, 1p
Pub. in Reflector 35, n9 p20, 1 May 87.

Keywords: *Metrology, Reprints, *Automatic test equipment, *Calibration.

For successful calibration of a test system, a combination of traditional laboratory calibration techniques and built-in test techniques is usually desired. This talk will include an overview of some of the activities that are relevant to the calibration of automatic test systems that are currently being performed by the Electrosystems Division of the National Bureau of Standards.

700,965

PB87-224457

Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Ionizing Radiation Physics Div.

Polystyrene Absorbed-Dose-Rate Calorimeter.

Final rept.,
S. R. Domen, and W. Z. Ba. 1987, 4p
Pub. in Nuclear Instruments and Methods in Physics Research B24/25, p1054-1057 1987.

Keywords: *Calorimeters, Specific heat, Thermistors, Radiation, Reprints, *Absorbed dose, Cobalt 60, Polystyrene.

A simple portable calorimeter was constructed by embedding a calibrated thermistor on the axis of a polystyrene rod. The instrument was positioned on the axis of a cylindrical array of 60Co rods. The duration of the measurement was approx. 70 s. Absorbed dose rates of approx. 70 Gy/min were measured to a daily precision of several tenths of a percent standard deviation. The results are in good agreement with earlier measurements made with a graphite calorimeter. An absorbed dose of 620 kGy resulted in no detectable change in thermistor sensitivity. The specific heat capacity of the polystyrene presumably increased approx. 0.0024%/kGy. The use of a chart recorder was not necessary.

700,966

PB87-227591

PC A02/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Acoustic Measurements Group.

Requirements for the Calibration of Mechanical Shock Transducers.

Technical note (Final),
D. C. Robinson. Jun 87, 22p NBS/TN-1233
Also available from Supt. of Docs. as SN003-003-02807-0. Sponsored by Department of Defense Calibration Coordination Group, Redstone Arsenal, AL.

Keywords: *Mechanical shock, *Transducers, Accelerometers, Calibrating, Standards.

The use of obsolete, inadequate, or nonexistent calibration standards during weapons system development and acquisition make DoD and its contractors unable to validate system performance legally during testing, evaluation and production acceptance. To correct current weakness and to meet the DoD calibration requirements of the immediate future in the area of mechanical shock new accelerometer calibration standards must be produced and existing standards must be improved. The report describes the results of a survey of various government agencies and government contractors who are actively engaged in the measurement of shock motions of 100 g or higher. As part of the effort to establish current needs for the calibration of accelerometers, a study was made of the accuracy requirements in various engineering applications for the measurement of shock motions up to 200,000 g, and an evaluation was made of the accuracy required to calibrate such transducers for various

INDUSTRIAL & MECHANICAL ENGINEERING

Laboratory & Test Facilities

ranges of accelerations. Based on the study, several recommendations are made for improving the state of calibration standards for mechanical shock accelerometers.

700,967
PB87-227625 PC A07/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Radiometric Standards in the Vacuum Ultraviolet.
Final rept.,
J. Z. Klose, J. M. Bridges, and W. R. Ott. Jun 87,
140p NBS/SP-250/3
Also available from Supt. of Docs as SN003-003-02806-1. See also PB87-174041. Library of Congress catalog card no. 87-619833.

Keywords: *Calibrating, *Measurement, Standards, Services, Quality assurance, Radiometry, Far ultraviolet radiation.

The radiometric calibration program carried out by the vacuum ultraviolet radiometry group in the Atomic and Plasma Radiation Division of the National Bureau of Standards is presented in detail. The calibration services are first listed, followed by descriptions of the primary standards, which are the hydrogen arc and the blackbody line arc, and the secondary standards, which are the argon mini- and maxi-arcs and the deuterium arc lamp. Next, the calibration methods involving both spectral radiance and irradiance are discussed along with their uncertainties. Finally, the intercomparison of standards as a method of quality control is described.

700,968
PB87-233680 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Precision Engineering Div.
Microspheres and Focal Spots: Applications of Microspheres in Dimensional Metrology.
Final rept.,
A. W. Hartman, and F. S. Jing. Oct 86, 9p
Pub. in Precision Engineering 8, n4 p203-211 Oct 86.

Keywords: *Dimensional measurement, *Length, Optical microscopes, Magnification, Distortion, Reprints, *Microspheres, Calibration.

Besides containing size information, microspheres can also mark the end points of microlength with very high precision. These features are applied to micrometrology tasks that involve optical microscopy. Examined are length measurements in a microscope field of view, microlength scales with selectable length of their divisions, straightness of ways and runout of bearings. Microspheres have proven particularly useful in the precision determination of magnification and image distortion in optical microscopes.

700,969
PB87-233789 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Precision Engineering Div.
Testing Tools: Development of Measurement Standards for Edge Characterization of Intraocular Lenses.
Final rept.,
E. C. Teague, F. E. Scire, D. W. Vahey, and E. P. Mueller. Jan 83, 7p
Pub. in Medical Devices: Measurements, Quality Assurance, and Standards, Chapter 6, p67-73 Jan 83.

Keywords: *Lenses, Reprints, *Testing tools, *Intraocular lenses.

No abstract available.

700,970
PB87-234084 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Precision Engineering Div.
Standards for Particle Size.
Final rept.,
A. W. Hartman. 1987, 13p
Pub. in Proceedings of International Conference on Liquid Borne Particle Inspection and Metrology, Arlington, VA., May 11-13, 1987, p109-121.

Keywords: *Particle size, *Standards, Light scattering, Reviews, Calibration, Microspheres, US NBS.

An overview is given of particle size standards available from the National Bureau of Standards and from

commercial sources. Both monodisperse and polydisperse materials are reviewed. A discussion is given of several measurement techniques used to calibrate these materials.

700,971
PB88-111190 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Electrosystems Div.
Accurate Frequency Response Determinations from Discrete Step Response Data.
Final rept.,
T. M. Souders, and D. R. Flach. 1987, 7p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36 n2 p433-439 Jun 87.

Keywords: *Frequency response, Signal processing, Error analysis, Measurement, Transfer functions, Reprints.

An approach is presented for quickly obtaining the complex frequency response of a system from sampled step-response data. Digital signal processing techniques are used extensively. An analysis of errors resulting from sampling, quantization, first differencing, and record length is included.

700,972
PB88-123765 PC A14/MF A01
National Bureau of Standards, Gaithersburg, MD.
Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices as Adopted by the 72nd National Conference on Weights and Measures, 1987 (1988 Edition),
H. V. Oppermann. Sep 87, 305p NBS/HB-44
Also available from Supt. of Docs. as SN003-003-02820-7. Supersedes PB87-108569.

Keywords: *Measuring instruments, *Weight indicators, *Handbooks, Specifications, Tolerances (Mechanics), Requirements, Standards.

Handbook 44 was first published in 1949, having been preceded by similar handbooks of various designations and in several forms beginning in 1918. The 1988 edition was developed by the Committee on Specifications and Tolerances of the National Conference on Weights and Measures, with the assistance of the Office of Weights and Measures of the National Bureau of Standards. It includes amendments adopted by the 72nd annual meeting of the National Conference on Weights and Measures in 1987. Handbook 44 is published in its entirety each year following the annual meeting of the National Conference on Weights and Measures.

700,973
PB88-138367 PC A16/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.
NBS (National Bureau of Standards) Measurement Services: Platinum Resistance Thermometer Calibrations.
Special rept.,
B. W. Mangum. Oct 87, 369p NBS/SP-250/22
Also available from Supt. of Docs as SN003-003-02831-2. Library of Congress catalog card no. 87-619875.

Keywords: *Resistance thermometers, *Temperature measurement, *Standards, Platinum, *Calibration, Uncertainty.

The document describes in detail the instruments and the measurement methods used in the realization and transfer of the International Practical Temperature Scale of 1968, Amended Edition of 1975 (IPTS-68/75), as maintained at the NBS in the region from 13.81 K to 903.89 K. This is the region in which the platinum resistance thermometer, meeting certain specifications, is the standard instrument for interpolating between the defining fixed points of the scale at which it is calibrated. An analysis of the sources of error encountered in calibration, and estimates of uncertainty and its propagation, are presented.

700,974
PB88-139167 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

New Video-Optical Method for Whole-Field Strain Measurements.

Final rept.,
J. C. Moulder, D. T. Read, and J. F. Cardenas-Garcia. 1986, 6p
Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in Proceedings of SEM (Society for Experimental Mechanics) Spring Conference on Experimental Mechanics, New Orleans, LA., June 8-13, 1986, p700-705.

Keywords: *Strain measurement, Optical measurement, Diffractometers, Metrology, Photographic analysis, Moire effects, Deformation.

A new method for measuring entire two-dimensional strain fields in either transparent or opaque solids is described. The method consists of applying strippable film grids to the specimen and recording their deformation during mechanical testing in 35-mm photographs. The photographs are analyzed point by point in an optical diffractometer that is interfaced to a computer with a video camera and a video digitizer. By determining the precise locations of first-order diffraction peaks for deformed grids and comparing with the results for the undeformed grid, the authors obtain all four components of the in-plane deformation tensor: longitudinal and transverse strains, shear strain, and rigid-body rotation. The method is illustrated with results for a center-cracked aluminum tensile panel. Full-field images were obtained on a grid of 21 by 21 points, each corresponding to a 3-mm square on the specimen. Optically determined strains agreed well with electrical strain gage results.

700,975
PB88-141221 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Activities and Plans of the Time and Frequency Division of the National Bureau of Standards.
Final rept.,
D. B. Sullivan. 1986, 10p
Pub. in Proceedings of the Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting (18th), Washington, DC., December 2-4, 1986, p1-10.

Keywords: *Time standards, *Frequency standards, Calibrating, Measurement, Services, US NBS, Reprints.

In keeping with the other standards activities of the National Bureau of Standards, the Time and Frequency Division realizes and maintains the standards associated with its name, coordinates these standards nationally and internationally, provides access to the standards through a set of dissemination services, and develops new standards, measurement methods and dissemination methods in anticipation of future national requirements. The paper describes the current work of the division with emphasis on those activities which most directly concern the attendees of this conference. Projections for relevant future programs are also discussed.

700,976
PB88-147327 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.
Operation of a Bayard-Alpert Gauge in a Uniform 0-0.16 Tesla Magnetic Field.
Final rept.,
A. R. Filippelli. 1987, 6p
Pub. in Jnl. of Vacuum Science and Technology A-Vacuum Surfaces and Films 5, n2 p249-254 1987.

Keywords: Magnetic fields, Oscillations, Reprints, *Bayard-Alpert ionization gages.

The behavior of a widely-used Bayard-Alpert ionization gauge in a uniform magnetic field has been experimentally investigated for two cases: magnetic field orthogonal, and parallel to the axis of the grid. Filament emission, grid, and collector currents and, current to the wall surrounding the gauge, all at constant filament heating power, were measured as functions of field magnitude and direction for N2 in the pressure range 5 x 10 to the -8th power to 2 x 10 to the -4th power Pa. Gauge sensitivity was found to be strongly dependent on field magnitude and direction, but remained pressure independent.

700,977
PB88-147541 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Gas and Particulate Science Div.
Use of Simulation Data Sets for Assessing Interlaboratory Pattern Recognition Accuracy.
 Final rept.,
 L. A. Currie. 1985, 5p
 Pub. in *Optical Engineering* 24, n6 p1004-1008 Nov/Dec 85.

Keywords: Pattern recognition, Gamma ray spectroscopy, Aerosols, Linear regression, Multivariate analysis, Simulation, Accuracy, Reprints, *Interlaboratory comparisons, Reference materials.

Interlaboratory comparisons using common (reference) materials of known composition are an established means for assessing overall measurement precision and accuracy. Intercomparisons based on common data sets are equally important and revealing when one is dealing with complex chemical patterns or spectra requiring significant numerical modeling and manipulation for component identification and quantification. Two case studies of 'chemometric intercomparison' using simulation test data (STD) are presented; one comprising STD vectors as applied to nuclear spectrometry; and the other, STD data matrices as applied to aerosol source apportionment.

700,978
PB88-152228 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Chemical Process Metrology Div.
Electrical and Thermodynamic Characterization of Water Vapor/Polymeric Film System for Humidity Sensing.
 Final rept.,
 P. H. Huang. 1985, 6p
 Pub. in *Sensors and Actuators* 8, n1 p23-28 Sep 85.

Keywords: *Water vapor, Polymeric films, Membranes, Enthalpy, Entropy, Free energy, Reprints, *Humidity measurement, Electrical conductivity, Temperature dependence.

The electrical and thermodynamic characteristics of water vapor in pvc-styrene-sulfonate membranes have been investigated. The membrane is a cross-linked copolymer of styrenesulfonate with polyvinylchloride. Electrical conductance of the thin membrane is measured as a function of temperature at various relative humidities. Using the measured conductivity data, thermodynamic functions of free energy (ΔG), enthalpy (ΔH), and entropy (ΔS) are determined. The method of combined electrical and thermodynamic characterization of a gas/polymer system may be used to provide a means for designing suitable polymeric materials for humidity sensing and may provide a method to model improved gas sensor behavior.

700,979
PB88-152376 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Temperature and Pressure Div.
Another Step Toward an International Practical Pressure Scale (2nd AIRAPT IPPS Task Group Report).
 Final rept.,
 V. E. Bean, S. Akimoto, P. M. Bell, S. Block, W. B. Holzapfel, N. H. Manghanani, M. F. Nicol, and S. M. Stishov. 1986, 3p
 Pub. in *Physica* 139 and 140B, p52-54 1986.

Keywords: *Pressure measurement, *Scale(Ratio), Fixed points(Mathematics), Reprints.

The AIRAPT Task Group on the International Practical Pressure Scale recommends the best experimental values for several pressure fixed points.

700,980
PB88-152384 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Temperature and Pressure Div.
Elastic Distortion on Piston Gages.
 Final rept.,
 R. J. Lazos-Martinez, and V. E. Bean. 1986, 3p
 Pub. in *Physica B: Physics of Condensed Matter and C: Atomic, Molecular and Plasma Physics, Optics* 139-140, p785-787 May 86.

Keywords: Pressure gages, Pressure measurement, Elastic deformation, Distortion, Reprints, *Piston gages.

The authors report herein their progress toward the development of a rigorous method to calculate the elastic distortion of piston gages in order to test the effect of the assumptions upon which present methods are based. Preliminary results show the two methods to agree within 2 percent.

700,981
PB88-152392 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Temperature and Pressure Div.
Zero Stability and Calibration Results for a Group of Capacitance Diaphragm Gages.
 Final rept.,
 R. W. Hyland, and C. R. Tilford. 1985, 7p
 Pub. in *Jnl. of Vacuum Science and Technology A* 3, n3 pt2 p1731-1737 May/June 85.

Keywords: *Diaphragms(Mechanics), *Gages, Calibrating, Vacuum gages, Capacitance, Reprints.

The lowest pressure which may be measured by a capacitance diaphragm gage is established by instabilities in the gage zero. The calibration records for 17 gages, for which the authors have two or more calibrations separated by intervals on the order of one year, show shifts ranging from essentially no change to about 2% with an average value of 0.45%. With one exception, these do not appear as a steady drift with time, but as random shifts between calibrations.

700,982
PB88-152400 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Temperature and Pressure Div.
Pressure Metrology: Primary Standard Piston Gages.
 Final rept.,
 V. E. Bean. 1986, 4p
 Pub. in *Physica* 139 and 140B, p739-742 1986.

Keywords: Pressure gages, Pressure measurement, Elastic deformation, Distortion, Reprints, *Piston gages.

Elastic distortion is the leading cause of uncertainty in primary standard piston gages. Recent pressure measurement intercomparisons between national standards laboratories demonstrate the non-equivalence of the methods used to determine the effects of distortion. New research efforts on this fundamental pressure metrology problem are described.

Manufacturing Processes & Materials Handling

700,983
PB87-219234 Not available NTIS
 National Bureau of Standards (IMSE), Boulder, CO.
 Fracture and Deformation Div.
Effect of Power Supply Response Characteristics on Droplet Transfer of GMA Welds.
 Final rept.,
 G. Kohn, and T. A. Siewert. 1986, 4p
 Pub. in *Proceedings of International Conference on Trends in Welding Research*, Gatlinburg, TN., May 18-22, 1986, p299-302.

Keywords: *Gas metal-arc welding, *Droplets, Sputtering, Oscilloscopes, Lasers, Cameras, Fourier analysis, Power supplies, Control, Reprints.

The droplet transfer in gas metal arc welding was studied with a digital oscilloscope, laser backlighting, and a video camera. Fast Fourier transform of the digital current and voltage signals showed droplet transfer rates that were within 10% of the values determined with the video-tape record. A modified current controller with a variable upper current limit reduced the spatter in short circuiting welding by more than half.

700,984
PB88-113766 PC A03/MF A01
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Metallurgy Div.

Dynamic Microindentation of RDX (Cyclo-Trimethylene Trinitramine): Effect of Rate on Plasticity and Fracture.
 Technical rept. (Final),
 R. S. Polvani, A. W. Ruff, and J. C. Robbins. Jun 87,
 32p NBSIR-87/3634
 Contract N00014-86-F-0065
 Sponsored by Office of Naval Research, Arlington, VA.

Keywords: *RDX, Fracture, Mechanical, *Dynamic properties, Energetic material, Microindentation, Plasticity.

Microindentation measurements have been made on RDX crystals to determine the effect of load and time of loading on their mechanical response. A spherical indenter tip was used. The results are compared to those obtained earlier using pyramidal Vickers indenters. At the shortest loading periods a higher than expected plastic response was found which may indicate that local heating resulted from the indentation process.

Nondestructive Testing

700,985
PATENT-4 699 551 Not available NTIS
 Department of Commerce, Washington, DC.
Method and Apparatus for Measuring Machine Cutting Tool Positions.
 Patent,
 J. P. Peris. Filed 11 Mar 86, patented 13 Oct 87, 10p
 PB88-121397, PAT-APPL-6-838 726
 Supersedes PB86-199171.
 This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Patents, *Positioning devices(Machinery), *Machine tools, Measurement, Cutting tools, Lathes, Drilling machines(Tools), Boring machines.

An apparatus and method are provided for on-line measurement of a lathe cutting tool position using a measuring head with a rotatable square plate engaged with three cylindrical plungers and a positioning mechanism for pivoting the measuring head. The positioning mechanism includes a movable member mounted on a base on the lathe headstock and a rotating unit for rotating the movable member about an axis. A stop member is provided to stop the movable member at a locating position. The measuring head includes a square plate supported inside a housing and rotatable about a y-axis therein. The plungers extend into the housing to contact the plate near its corners.

700,986
PB87-152260 PC A05/MF A01
 National Bureau of Standards, Gaithersburg, MD.
Institute for Materials Science and Engineering, Nondestructive Evaluation: Technical Activities 1986.
 H. T. Yolken. Jan 87, 78p NBSIR-86/3434
 See also report for 1985, PB86-182375.

Keywords: *Nondestructive tests, Eddy current tests, Ultrasonic tests, Radiography, Thermal measurements, Acoustic emissions.

A review of the Nondestructive Evaluation Program at NBS, for fiscal year 1986, is presented in the annual report.

700,987
PB87-165734 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Metallurgy Div.
Determination of Inhomogeneities of Elastic Modulus and Density for One-Dimensional Structures Using Acoustic Dimensional Resonances.
 Final rept.,
 L. R. Testardi, S. J. Norton, and T. Hsieh. Nov 84, 5p
 Pub. in *Jnl. of Applied Physics* 56, n10 p2681-2685 Nov. 84.

Keywords: *Nondestructive tests, *Ultrasonic tests, Density(Mass/volume), Modulus of elasticity, Resonant frequency, Rods, Reprints, *Defects(Materials), One dimensional.

INDUSTRIAL & MECHANICAL ENGINEERING

Nondestructive Testing

The authors derive a simple relation which allows the reconstruction of the inhomogeneity of the elastic modulus and density along a rod based only on the measured fundamental and overtone frequencies. The technique, analogous to one-dimensional tomography in the frequency domain, permits the quantitative detection of both continuous and localized defects. Experimental tests using impressed temperature profiles and drilled holes are reported. Observed sensitivities are found to be better than 1C for the former and 0.0001 (of the rod volume) for the latter.

700,988
PB87-166435

(Order as PB87-166401, PC A05/MF A01)
National Bureau of Standards, Boulder, CO.
Detection and Sizing of Surface Flaws with a SQUID-Based Eddy Current Probe,
J. C. Moulder, and T. E. Capobianco. 24 Sep 86, 7p
Included in Jnl. of Research of the National Bureau of Standards, v92 n1 p27-33 Jan-Feb 87.

Keywords: *Eddy current tests, *Surfaces, SQUID devices, Aluminum alloy 6061, Defects(Materials).

In a new approach to eddy current detection and sizing of surface-breaking flaws, we have coupled a conventional reflection probe to a superconducting quantum interference device (SQUID) to produce an eddy current probe with increased sensitivity and signal to noise ratio. The new probe was used to obtain flaw signals from a number of electrical-discharge machined slots in aluminum alloy 6061. Results indicated that by scanning the probe along the length of the flaw, the length could be determined from the extent of the flaw signal. The peak amplitude of the flaw signal was found to be proportional to the cross-sectional area of the flaw.

700,989
PB88-122155

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Proposed Military Standard for Commercial Eddy Current Probes Based on Performance Characterization.
Final rept.,
T. E. Capobianco, and F. R. Fickett. 1986, 7p
Sponsored by Army Materials Technology Lab., Watertown, MA.
Pub. in Proceedings of the Defense Conference on Nondestructive Testing (35th), Hill Air Force Base, UT., October 28-30, 1986, p135-141.

Keywords: *Nondestructive tests, *Eddy current tests, *Standards, *Probes(Electromagnetic), Military standards.

The latest results of the work being done on a draft military standard for characterizing commercial eddy current probes are reported. The authors discuss measurement techniques that have been evaluated for suitability as a characterization test method, such as field mapping and various electrical parameter measurements and the reasons for selecting the method which has been incorporated in the present draft. The authors conclusion is that the measurement of impedance change of a probe over a range of frequencies on two metals of different conductivities offers the best indicator of eddy current probe sensitivity and proper operating range.

700,990
PB88-138722

Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Review of Eddy Current Research at the National Bureau of Standards in Boulder, Colorado.
Final rept.,
T. E. Capobianco. 1987, 10p
Pub. in Proceedings of Defense Conference on Nondestructive Testing (34th), Charleston, SC., October 29-31, 1985, p164-173 1987.

Keywords: *Eddy current tests, *Nondestructive tests, Cracking(Fracturing), Fatigue(Materials), Standards, Reviews, Probes(Electromagnetic), Artifacts, US NBS.

On going research in eddy current nondestructive evaluation at the National Bureau of Standards in Boulder, Colorado is reviewed. The most recent results and publications of experimental and theoretical studies are presented. This includes the areas of eddy current coil characterization and field mapping, experimental verification of eddy current-fatigue crack interaction, uniform field probe calibration, artifact stand-

ards, fatigue crack growth monitoring, and differential eddy current probe studies.

700,991
PB88-153622

PC A05/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Fracture and Deformation Div.
Institute for Materials Science and Engineering, Fracture and Deformation Division: Technical Activities 1987.
1987, 80p NBSIR-87/3613
See also report for 1986, PB87-136701.

Keywords: *Deformation, *Nondestructive tests, *Fractures(Materials), Fracture tests, Stress analysis, Fracture properties, Crack propagation, Welding, Cracking(Fatigue), Metallurgy, Composite materials, Grain boundaries, Mechanical properties.

The report summarizes the 1987 fiscal-year programs of the Fracture and Deformation Division of the Institute for Materials Science and Engineering. Its two major programs are Elastic-Plastic Fracture Mechanics and Fracture Mechanisms and Analysis. Elastic-Plastic Fracture Mechanics includes nondestructive evaluation, welding, and thermomechanical processing. Fracture Mechanisms and Analysis consists of physical properties, fracture physics, composite mechanics, cryogenic materials, and material performance. The report summarizes the principal accomplishments in these research areas, including wide-plate crack-arrest tests, a new model of plastic fracture, design and evaluation of a capacitive-array probe, measurement of the natural frequency for short-circuiting transfer in gas-metal-arc welding, and a model for prediction of the elastic properties of porous ceramics.

700,992
PB88-153655

PC A05/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD.
Institute for Materials Science and Engineering, Nondestructive Evaluation: Technical Activities 1987.
H. T. Yolken. 1987, 84p NBSIR-87/3611
See also report for 1986, PB87-136701.

Keywords: *Deformation, *Nondestructive tests, *Fractures(Materials), Fracture tests, Stress analysis, Fracture properties, Crack propagation, Welding, Cracking(Fatigue), Metallurgy, Composite materials, Grain boundaries, Mechanical properties.

A review of the Nondestructive Evaluation Program at NBS, for fiscal year 1987, is presented in the annual report.

Quality Control & Reliability

700,993
PB87-163713

Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD.
Nature of Repeatability and Reproducibility.
Final rept.,
J. Mandel, and T. W. Lashof. Jan 87, 8p
Pub. in Jnl. of Quality Technology 19, n1 p29-36 Jan 87.

Keywords: *Precision, *Reproducibility, Laboratories, Quality, Reprints, *Test methods, Repeatability.

Repeatability and reproducibility are usually defined by the relation $R = R(\text{square root of } 2) (S \text{ sub } R)$, where R stands for repeatability or reproducibility and (S Sub R) is the corresponding standard deviation. It is then stated that the probability is C that a difference between two test results will lie between (-R) and (+R). For $C = 0.95$, which is the usual choice, the values that have been proposed for the multiplier k are 1.96, 2, or Student's t. However, C is actually a random variable with a highly skewed distribution. It is shown that regardless of the above choice of k, the probability that C will lie in the vicinity of 0.95, such as for example 0.92 to 0.97, is very small, unless the number of participating laboratories is large (30 or more). Nevertheless, for any given interval defining a 'vicinity of 0.95,' a value of k exists that maximizes the probability that C lies in that interval. For a number of reasonable choices for 'vicinity of 0.95' the optimal k is close to 1.96.

700,994

PB87-210654
National Bureau of Standards (NML), Gaithersburg, MD. Office of Physical Measurement Services.
NBS (National Bureau of Standards) Calibration Services Users Guide: Fee Schedule.
Apr 87, 78p NBS/SP-250/A
See also PB87-174041.

Keywords: *Calibrating, Standards, Services, Quality assurance, *Fee schedules, National Bureau of Standards.

The physical measurement services of the National Bureau of Standards are designed to help the makers and users of precision instruments achieve the highest possible levels of measurement quality and productivity. The hundreds of individual services you will find listed in the Fee Schedule constitute the highest-order calibration services available in the United States. They directly link a customer's precision equipment or transfer standards to national measurement standards. These services are offered to public and private organizations and individuals alike. The Fee Schedule is a supplement to NBS Special Publication 250, Calibration Services Users Guide. These documents are designed to make the task of selecting and ordering an appropriate calibration service as quick and easy as possible.

700,995

PB88-110960
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Measurement Assurance Programs. Part 2: Development and Implementation.
Final rept.,
C. Croarkin. Apr 85, 128p NBS/SP-676-2
Also available from Supt. of Docs. as SN003-003-02654-9. Supersedes PB84-217876. See also PB84-217868.

Keywords: *Quality assurance, *Metrology, Standards, Random error, Statistical analysis, *Measurement assurance program, National Bureau of Standards, Calibration, Uncertainty.

The 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 the 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.

700,996

PB88-112347
National Bureau of Standards, Gaithersburg, MD.
Process and Quality Control and Calibration Programs of the National Bureau of Standards.
Final rept.,
Jun 87, 217p NBSIR-87/3596
Report to the Congress in Response to Public Law 99-574. Sponsored by Congress, Washington, DC.

Keywords: *Process control, *Quality control, *Calibration, US NBS, Standard reference materials.

The report responds to Public Law 99-574, which directed the NBS Director to ask the Bureau's major clients about their needs for research and services related to NBS' process and quality control and calibration programs; and to report findings and recommendations to the Bureau's Congressional authorizing committees. NBS found that American firms and government agencies believe that implementation of process control and quality assurance are and ought to be primarily the responsibility of the producers of the Nation's goods and services; and that to respond to global competitiveness, measurement services are needed at earlier stages in the product/program development process. Greater accuracies and broader coverage are needed for existing measurement services, and new technologies are creating demands for additional, often entirely new or different services. In general, customers are willing to pay costs directly related to the delivery of NBS services, but are opposed to subsidizing basic or generic research that might underlie several services. They see such research to be a

mandated NBS mission, they expect it to be funded by NBS appropriations, and they expect services to be available when needed. Finally, the report lists customers' specific measurement-related needs in a variety of technical areas.

700,997
PB88-113725 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD. Associate Director of Industry and Standards.
NVLAP (National Voluntary Laboratory Accreditation Program) Assessor Selection and Training, H. W. Berger. Sep 87, 12p NBSIR-87/3651

Keywords: Test facilities, *Laboratories, Selection, *Accreditation, *Training, National Voluntary Laboratory Accreditation Program, NVLAP program, Assessors.

The role and importance of 'peer' assessors in the National Voluntary Laboratory Accreditation Program (NVLAP) is discussed. Procedures for identification, evaluation, and selection of assessors are described, and the elements of assessor orientation and training are presented.

700,998
PB88-113733 PC A02/MF A01
National Bureau of Standards, Gaithersburg, MD. Associate Director of Industry and Standards.
Surveillance of Accredited Laboratories under Procedures of the National Voluntary Laboratory Accreditation Program (NVLAP), H. W. Berger. Sep 87, 9p NBSIR-87/3652

Keywords: *Test facilities, *Quality assurance, *Laboratories, Surveillance, *Accreditation, National Voluntary Laboratory Accreditation Program.

The paper describes mechanisms by which the National Voluntary Laboratory Accreditation Program (NVLAP) seeks to assure continuing competence of accredited laboratories to perform specific test methods or types of tests. Surveillance of laboratories (defined as actions taken after initial accreditation to ensure continued compliance with accreditation criteria) is achieved through proficiency testing, on-site assessments, and emphasis on the laboratory's own quality assurance system.

magnetoresistive array with sensor elements 2.5 mm apart (density can be increased an order of magnitude) covered by a sheet of rubber and a row of flat wires etched on a mylar film. The paper describes design, operation and expected performance of the skin.

701,001
PB87-162061 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Representing Workspace and Model Knowledge for a Robot with Mobile Sensors. Final rept., M. Shneider, E. Kent, and P. Mansbach. 1984, 4p. Pub. in Proceedings of International Conference on Pattern Recognition (7th), Montreal, Canada, July 30-August 2, 1984, p199-202.

Keywords: *Robots, *Manipulators, Pattern recognition, Models, *Robot vision, Representations, Workstations, Work environments, Scene analysis, Octal coding, Trees(Mathematics).

A representation is described for supplying a robot manipulator with information about its workspace. The information is obtained from sensors (primarily visual) that move with the manipulator, and is of two kinds, stored in two, linked, data structures. Spatial information is stored in an octree. This allows fast computation of which parts of the workspace are occupied, which are empty, and which are navigable. Information about properties of objects, their features, and relationships with other objects, is stored in a set of tables or attribute lists. This information is used to match objects in the world with stored models and to assign names to instances of objects and to features in the scene. Objects that have been recognized and objects that are unidentified are stored in the same way, so that all operations on the workspace model are uniform. The two representations are linked in a way that enables objects to be located in space by name, by description, or by position, and facilitates finding out what object occupies a particular volume in the workspace. The construction of the representations from model data and from successive sensor inputs is discussed, and their role in the total robot system is described.

Factory of the Future. Final rept., J. A. Simpson. 1982, 23p. See also AD-A124 104. Pub. in Proceedings of Manufacturing Technology and Productivity Conference (1982): The Revitalization of U.S. Manufacturing, Troy, NY., June 3-4, 1982, p191-213.

Keywords: *Management planning and control, Industrial plants, Manufacturing, Materials handling, Automation, Productivity, Robots, *Automated factories.

Despite uncertainty as to exact economic circumstances of the future, certain characteristics of the factory of the future can be predicted. It will be efficient in materials and energy, it will emphasize quality and it will be flexible towards product mix. Software costs will rise relative to hardware cost, and labor productivity will become less a matter of concern. These conclusions are discussed.

701,004
PB88-147277 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Future Directions for Reactor Based Research. Final rept., R. S. Carter. 1985, 2p. Pub. in Transactions of the American Nuclear Society 50, p196-197 1985.

Keywords: *Research, Nuclear reactors, Reprints, Condensed matter physics.

Reactor based research is moving in many directions with the development of a variety of new instruments and detectors. The development of intense sources of long wavelength neutrons (cold sources) has opened the way for advanced research in material science, condensed matter physics, chemistry, and structural biology. Other instrument developments are making it possible to explore new areas in trace analysis, crystal structure, and magnetic materials. These new research directions are illustrated by selected examples.

General

701,002
PB87-174041 PC A10/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Office of Physical Measurement Services.
NBS (National Bureau of Standards) Calibration Services Users Guide 1986-1988 Edition (Revised). Special pub., G. A. Urano, E. L. Garner, R. K. Kirby, and W. P. Reed. Jan 87, 205p NBS/SP-250-REV. Supersedes PB86-246162. Also available from Supt. of Docs as SN003-003-02789-8. Color illustrations reproduced in black and white.

Keywords: *Calibrating, *Measurement, Standards, Services, Quality assurance, National Bureau of Standards.

The NBS Calibration Service Users Guide provides detailed descriptions of the currently available NBS calibration services, special test services, and measurement assurance programs. The document is a revised edition of NBS Special Publication 250. It describes the NBS services available as of the second quarter of 1986 and reflects a number of important changes since the 1982 edition was published. A detailed description is given of each measurement service. A new numbering system is used to uniquely identify each of the services. Addendum I to the document is a cross-reference index that links the new NBS test numbers to those used previously to identify the services. Also cited are a large number of NBS technical experts (including addresses and telephone numbers) who may be contacted for further information concerning services or measurement problems. Future editions will be published periodically as NBS services change. The document also presents a detailed description of a number of Measurement Assurance Program (MAP) services.

701,003
PB87-233763 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Mfg. Engineering.

Tooling, Machinery, & Tools

700,999
PB87-152831 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Visualization of Machine Tool Vibratory Motion. Final rept., E. B. Magrab. 1984, 13p. Pub. in Proceedings of Conference Some Perspectives on CAD/CAM in Mechanical Engineering, San Antonio, TX., June 17-21, 1984, p117-129.

Keywords: *Machine tools, Drill bits, *Vibration mode.

The improvement in the understanding of the complicated modal characteristics of machine tools with the proper visualization of the results is demonstrated with two examples: (i) a drill bit and (ii) a milling machine. The application of the results to machine tool diagnostics and design is indicated.

701,000
PB87-161113 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Magnetoresistive Skin for Robots. Final rept., J. M. Vranish. 1984, 16p. See also report dated 17 May 84, PB84-114658.

Pub. in Proceedings of International Conference on Robot Vision and Sensory Controls (4th), London, England, October 9-11, 1984, p269-284.

Keywords: *Magnetoresistivity, *Thin films, *Skin(Structural member), *Manipulators, *Detectors, Touch, *Robots, *Robot vision, Tactile perception.

A tactile imaging skin for robot grippers based on magnetoresistive technology is proposed. In the design considered here, the skin would consist of a thin film

LIBRARY & INFORMATION SCIENCES

Information Systems

701,005
PB87-156725 PC A09/MF A01
National Bureau of Standards, Gaithersburg, MD. Center for Programming Science and Technology.
Data Base Directions: Information Resource Management - Making It Work. Proceedings of a Workshop on Information Resource Management (IRM) Held at Fort Lauderdale, Florida on October 21-23, 1985. Final rept., E. N. Fong, and A. H. Goldfine. Jun 86, 187p NBS/SP-500/139. See also PB83-115634. Library of Congress catalog card no. 86-600559. Also available from Supt. of Docs as SN003-003-02738-3.

Keywords: *Meetings, Resource allocation, Information systems, Management methods, *Information resource management, *Data management, Data base management, Data directories.

The report constitutes the results of a three-day workshop on how to make information resource management work, held in Fort Lauderdale, Florida, on October 21-23, 1985. The workshop was sponsored by the Institute for Computer Sciences and Technology (ICST) of the National Bureau of Standards (NBS), in cooperation with the Association for Computing Machinery, the IEEE Computer Society, and the Federal Data Management Users Group. Patterned after the three previous Data Base Directions workshops, this workshop, Data Base Directions: Information Re-

Information Systems

source Management -- Making it Work, evaluated current practice to identify problem areas, reviewed important technologies and tools and when to apply them to information resource management, and explored the motivation and inhibitors to decentralized and distributed environments. The approximately seventy workshop participants were organized into four working panels, which met to discuss IRM in the 1990s, IRM and the System Life Cycle, Technologies for IRM, and IRM in a Decentralized and Distributed Environment.

701,006
PB87-163978 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.
FIREDOC: An Automated Bibliographic Database. Final rept., N. H. Jason. 1986, 8p
Pub. in Proceedings of 1986 SFPE Fire Protection Engineering Seminars, Atlanta, GA., May 19-22, 1986, p1-8.

Keywords: *Fires, Research, *Data bases, *FIREDOC data base.

The creation of an automated fire research bibliographic database, FIREDOC, is discussed in this paper. FIREDOC is the automated 'card catalog' to the Fire Research Information Services collection at the Center for Fire Research. In the report, a sample reference question in answered by using different search techniques to illustrate how the user can obtain an answer.

Reference Materials

701,007
FIPS PUB 55-2 PC A03/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD.
Guideline: Codes for Named Populated Places, Primary County Divisions, and Other Locational Entities of the United States and Outlying Areas. Category: Data Standards and Guidelines. Subcategory: Representations and Codes.
Federal information processing standards (Final), R. G. Saltman. Feb 87, 34p
Supersedes FIPS PUB 55-1.
Three ring vinyl 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.

The guideline implements ANSI X3.47-1977 and provides a two-character FIPS State Code and a five-character FIPS numeric place code to uniquely identify each listed entity. An exhaustive list is carried of names of incorporated places, census designated places (CDPs), primary county divisions (such as townships, New England towns, and census county divisions), counties, and recognized Indian reservations and Alaska Native villages. The listing also includes names of all populated places in the files of the Geographic Names Information System of the U.S. Geological Survey, as well as names of airports, military bases, national parks, and U.S. Post Offices. A two-character class code distinguishes over fifty entity types.

701,008
PB87-133377 MF E06
National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.
KWIC Index of U.S. Voluntary Engineering Standards. Mar 87, 3007p
Supersedes PB86-154408.
Microfiche copies only (twelve sheets of 48X reduction).

Keywords: *Engineering, *Standards, Indexes(Documentation), Subject index terms, Specifications, Tests, United States, Engineering standards, Product standards.

The index contains the permuted titles of more than 28,000 standards, specifications, test methods, and recommended practices published by approximately

400 U.S. standards-developing organizations. Each title can be found under all the significant key words which it contains. These key words are arranged alphabetically down the center of each page together with their surrounding context. The date of publication or last revision, the standard number and an acronym designating the standards-issuing organization appear as part of each entry.

701,009
PB87-166401 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 92, Number 1, January-February 1987. Feb 87, 84p
See also PB87-166419 through PB87-166476, and PB87-137154. Also available from Supt. of Docs as SN703-027-00014-8.

Keywords: *Research, Temperature measurement, Eddy current tests, Surfaces, Water vapor, Steam, Thermodynamic properties, Units of measurement, Data processing security, Fiber optics, Optical communication, Standards, Light speed, SQUID devices, Computer security, Optical fibers.

Contents: The continuity of the meter--The redefinition of the meter and the speed of visible light; The NBS scale of radiance temperature; Detection and sizing of surface flaws with a SQUID-based eddy current probe; Ideal gas thermodynamic functions for water; Report on the 17th session of the consultative committee on electricity; Computer security for today...and for tomorrow; Symposium on optical fiber measurements.

701,010
PB87-181251 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 92, Number 2, March-April 1987. Apr 87, 85p
See also PB87-181269 through PB87-181293, and PB87-166401. Also available from Supt. of Docs as SN703-027-00015-6.

Keywords: *Research, Fundamental constants, Ultraviolet detectors, Far ultraviolet radiation, Standards, Microphones, Acoustic measurement, Phase transformations, Membranes, Raman spectroscopy.

Articles included within this Journal include the following: The 1986 CODATA Recommended Values Of the Fundamental Physical Constants; Far Ultraviolet Detector Standards; Description of the Thermotropic Behavior Of Membrane Bilayers In Terms of Raman Spectral Parameters: A Two-State Model; Free-Field Reciprocity Calibration Of Microphones.

701,011
PB87-181988 PC A06/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
FIREDOC Vocabulary List, 2nd Edition. N. H. Jason. Apr 87, 116p NBSIR-87/3545
See also report dated Sep 85, PB86-165354.

Keywords: *Terminology, *Fire safety, Fires, Indexes(Documentation), Information retrieval, *FIREDOC vocabulary.

The second edition of the FIREDOC Vocabulary List contains over 4000 entries and reflects the subject matter of published reports, articles and documents comprising the Fire Research Information Services (FRIS) collection. As the database becomes more retrospective, the keywords will reflect the addition of these references from the collection.

701,012
PB87-210258 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
NBS (National Bureau of Standards) Research Reports (April 1987). Special pub.
Apr 87, 37p NBS/SP-721
Library of Congress catalog card no. 86-600603.

Keywords: *Research projects, Surface properties, Microstructure, Malignant neoplasms, Prevention, Manufacturing, Physical properties, Hotels, Fire prevention, Air pollution, Documents, Meetings, US NBS, Parallel processing(Computers).

The table of contents includes: Research update; Surface science: Thin is in; Mapping microstructures: A

quest for the 'smoking gun'; Parallel processing research: Turning supercomputing promise into practice; Cancer prevention research examines micronutrient levels in the body; Manufacturing technology for the second industrial revolution; New values recommended for the fundamental physical constants; Equations and models used to investigate hotel fire; Atmospheric contaminants targets in NBS version of 'dating' game; New publications; and Conference calendar.

701,013
PB88-113774 PC A11/MF A01
National Bureau of Standards, Gaithersburg, MD. Information Resources and Services Div.
NBS (National Bureau of Standards) Serial Holdings 1987. M. L. Kingston. Sep 87, 235p NBSIR-87/3590
Supersedes PB83-132704.

Keywords: *Periodicals, *Bibliographies, Libraries, Collection, National government, Library collections, National Bureau of Standards.

The publication contains holdings information for approximately 5,000 titles held in the NBS Research Information Center, representing current and noncurrent journals, periodicals, annuals, memoirs, proceedings and transactions.

701,014
PB88-124409 PC A04/MF A01
National Bureau of Standards, Gaithersburg, MD.
Journal of Research of the National Bureau of Standards, Volume 92, Number 5, September-October 1987. 1987, 58p
Also available from Supt. of Docs. as SN703-027-00018-1. See also PB88-124417 through PB88-124441.

Keywords: *Research, Hall effect, Potentiometers(Instruments), Alpha particle detectors, Radiation counters, Mossbauer effect, Photometry, Quantum Hall effect, Image reconstruction, Tomography, Luminous intensity, Candelas.

Articles include the following: An automated potentiometric system for precision measurement of the quantized hall resistance; The NBS large-area alpha-particle counting system; Mossbauer imaging; International intercomparisons of photometric base units.

701,015
PB88-153754 PC A07/MF A01
National Bureau of Standards, Gaithersburg, MD. Information Resources and Services Div.
Data Bases Available at the National Bureau of Standards Research Information Center (Sixth Edition). D. Cunningham, and C. Kline. Jul 87, 147p NBSIR-87/3658
Supersedes PB86-247616.

Keywords: *Information systems, *Directories, Information centers, *Bibliographic data bases, *Data bases, *National Bureau of Standards.

Data bases available online at the National Bureau of Standards (NBS) Research Information Center are listed by acronym and by full title. In addition, descriptions of the data bases, periods of coverage, producers, corresponding hard copy titles and principal sources and vendors are listed. A general subject index and a cross reference index are also supplied.

MANUFACTURING TECHNOLOGY

Computer Aided Design (CAD)

701,016
PB87-224515 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Using Available Curve-Shaped Information with a Non-Uniform B-Spline.

Final rept.,
M. Roche, and S. Beusan. 1987, 7p
Pub. in Computers in Mechanical Engineering 6, n1
p63-69 Jul/Aug 87.

Keywords: Reprints, *Computer aided design, Approximation, *B spline, Continuity conditions, Curve shape, Defining polygon, Interpolate.

The B-spline is a commonly used tool for solving problems in computer-aided design. A procedure for describing the curve shape and discontinuity conditions at input coordinate locations is outlined for non-uniform B-splines.

701,017
PB88-157680 PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Strategies for Implementing IGES (Initial Graphics Exchange Specification) for the Operations of NAVFAC (Naval Facilities Engineering Command).
Final rept.,
M. E. Palmer. Jan 88, 44p NBSIR-88/3693
Sponsored by Naval Facilities Engineering Command, Alexandria, VA.

Keywords: *Drafting(Drawing), Digital data, Information management, Computer graphics, Translators, Construction, Civil engineering, Specifications, *Computer aided design, IGES(Initial Graphics Exchange Specification), NAVFAC(Naval Facilities Engineering Command).

As part of the transition from the current paper-intensive processes to a highly automated and integrated mode of operation, the Navy is adopting the Initial Graphics Exchange Specification (IGES) for certain digital data exchanges among elements of the Navy and Navy contractors. The report provides strategies and recommendations for implementing IGES for exchanging and archiving digital representations of Naval Facilities Engineering Command (NAVFAC) projects. NAVFAC plans to benefit from the use of computer-aided design and drafting (CADD) by encouraging outside architecture, engineering, and construction (AEC) firms to acquire CADD capabilities and by requiring the delivery of certain project documentation in digital form. The ability to transmit drawings and specifications between different CADD systems is expected to reduce the time (and resources) that NAVFAC and outside personnel spend reviewing, changing, and managing projects and also to improve the quality of the projects.

Computer Aided Manufacturing (CAM)

701,018
PB87-161121 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Workstation Control in a Computer Integrated Manufacturing System.
Final rept.,
H. Scott, and K. Strouse. 1984, 22p
Pub. in SME Technical Paper MS84-786, 22p 1984.

Keywords: *Manufacturing, *Automatic control, *Machining, *Robots, Automation, Numerical control, Controllers, *Computer aided control systems, *Computer aided manufacturing, Control systems, Real time, National Bureau of Standards.

Computer control of an automated machining workstation is one area of research being performed at the Automated Manufacturing Research Facility (AMRF) of the National Bureau of Standards (NBS). A finite state machine controller has been developed to provide the required real-time control. The architecture of the workstation control system was developed in particular to address the problems of system integration in a machining workstation containing components with greatly differing interface characteristics and capabilities. Such components include an advanced industrial robot system, a numerically controlled machining center, an automated fixturing system, a material and tool delivery and retrieval system, various sensor systems, a higher level of control (cell control), a distributed data base system, and an off-line programming system. The flexibility and extensibility of the controller

architecture have allowed such integrations to be performed. The software, hardware, and user interfaces are described.

701,019
PB87-165189 PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Using the AMRF (Automated Manufacturing Research Facility) Part Model Report.
S. Ressler. Feb 87, 26p NBSIR-87/3531

Keywords: *Manufacturing, *Components, Characteristics, Automation, *Computer aided manufacturing, *AMRF data base, *Data bases.

One mechanism used in the AMRF (Automated Manufacturing Research Facility) to facilitate the communication of information about the parts to be manufactured is the AMRF Part Model. This is a description of a variety of characteristics of a part which may be obtained by making a request to the AMRF Data Base. The part model report serves as the primary mechanism for obtaining information about the part. The paper describes the uses of a parser which interprets the part model report and transforms it into a set of data structures for use in a variety of applications.

701,020
PB87-165809 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Knowledge Representation Scheme for Processes in an Automated Manufacturing Environment.
Final rept.,
S. Ray. 1986, 5p
Pub. in Proceedings of Institute of Electrical and Electronics Engineers International Conference on Systems, Man, and Cybernetics, Atlanta, GA, October 14-17, 1986, p1169-1173.

Keywords: *Process control, *Manufacturing, *Machining, *Automation, *Artificial intelligence, Subroutines, *Computer aided manufacturing, *Knowledge representation, *Computerized control systems, Programming, Expert systems, Hierarchies, National Bureau of Standards, Work measurement.

A key factor in applying advanced programming concepts to an industrial manufacturing environment is the establishment of a language to specify the process steps involved. In the Automated Manufacturing Research Facility at NBS, these process steps are described in terms of 'work elements'. Work elements are specified in process plans which are passed to controllers throughout the facility. The paper describes the properties which were considered in the definition of work elements from the perspective of automated process planning and the control system implementation at NBS. The control system is based upon a philosophy of hierarchical control, where high level goals are decomposed through a succession of levels, each producing sequences of simpler goals to the next lower level, with the lowest level generating drive signals to robots, grippers and other actuators. The work elements are implemented with different software at each stage in the manufacturing sequence: process planning, communication, and execution.

701,021
PB87-172961 PC A02/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Hierarchical Decision-Making in the Factory of the Future.
R. H. F. Jackson, and A. W. T. Jones. Feb 87, 25p
NBSIR-87/3511

Keywords: *Manufacturing, *Automatic control, *Scheduling, Facilities, Decision making, Planning, Hierarchies, Standards, Measurement, Research projects, Optimization, *Factory automation, *Flexible manufacturing, Computer aided manufacturing, National Bureau of Standards.

A major manufacturing research facility is being established at the National Bureau of Standards. The Automated Manufacturing Research Facility will address the standards and measurement needs for the factory of the future. A five-layer hierarchical control architecture is under development to manage all production and support activities within the facility. The proper execution of many of these activities requires the solution to one or more optimization problems. The paper describes a hierarchical planning architecture and the decision-making problems that exist at each level within that architecture.

701,022
PB87-174298 PC A02/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
AMPLE (Automated Manufacturing Programming Language Environment) Project.
J. C. Boudreaux. Mar 87, 17p NBSIR-86/3496

Keywords: Automatic control, Programming languages, Economic analysis, *Computer aided manufacturing, *Flexible manufacturing, *Manufacturing automation control, *AMPLE system, National Bureau of Standards.

The report describes the Automated Manufacturing Programming Language Environment (AMPLE) system, being developed within the Center for Manufacturing Engineering of the National Bureau of Standards. The development of this system is being undertaken to provide a precise, conceptually transparent medium for the construction of control interfaces to industrial processes; and to address the technical and economic requirements of small-batch flexible manufacturing systems.

701,023
PB87-200382 PC A03/MF A01

National Bureau of Standards, Gaithersburg, MD.
National Forum on the Future of Automated Materials Processing in U.S. Industry. The Role of Process Models, Artificial Intelligence and Computer Integration. Report of a Workshop (2nd) Held at Gaithersburg, Maryland on May 19-20, 1986.
H. M. Bloom, and N. R. Kuchar. Apr 87, 50p NBSIR-87/3544

See also report dated Dec 85, PB86-212040. Prepared in cooperation with General Electric Co., Schenectady, NY. Sponsored by Industrial Research Inst., Inc., New York, and Office of Science and Technology Policy, Washington, DC.

Keywords: *Materials handling, *Artificial intelligence, Automation, Competitiveness, Models, Detectors, Computer integration, Process models.

The workshop was the second of two workshops sponsored by the Industrial Research Institute and the White House Office of Science and Technology Policy, Committee on Materials, Working Group on Automation of Materials Processing. The first workshop, held in December, 1985 was devoted to the role of process sensors. Together, the workshops addressed several technologies which can play important roles in improving the competitiveness of U.S. process industries through automation. The goals of the workshops were threefold: to assess the state of the art in key technologies needed for process automation, including sensors, process modeling, artificial intelligence and computer integration; to identify broad issues and generic needs for advancing these technologies and applying them in U.S. industry; and to develop information and recommendations for National direction aimed at enhancing the competitiveness of U.S. process industries.

701,024
PB87-201877 PC A02/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Part Geometry Data in the AMRF (Automated Manufacturing Research Facility).
J. S. Tu, and T. H. Hopp. Apr 87, 19p NBSIR-87/3551

Keywords: Manufacturing, Automation, Components, Geometric forms, *Computer aided manufacturing, Computer aided design, AMRF(Automated Manufacturing Research Facility).

The paper is an overview of the approach being taken toward the modeling and management of part geometry data in the NBS Automated Manufacturing Research Facility (AMRF). It describes the Geometry Data System, that achieves the objectives of having a uniform representation of part geometry data to allow data sharing and data exchange with the AMRF. The paper describes the approach to the implementation of the Geometry Data System, the applications supported by the system, and how the geometry data flow through the AMRF.

701,025
PB87-202933 Not available NTIS

MANUFACTURING TECHNOLOGY

Computer Aided Manufacturing (CAM)

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Integration of Material Buffering Devices in an Automated Factory.

Final rept.,
D. Fishman, H. Scott, and R. Bunch. 1987, 35p
Pub. in Proceedings of International Conference on Robotics and Factories of the Future (2nd), San Diego, CA., July 18-31, 1987, p1-35.

Keywords: *Industrial plants, *Automatic control, Machining, Materials handling, Reprints, Hierarchical control.

A generic control architecture for integrating material buffering devices (MBDs) in an automated factory is described. The architecture is designed to support material buffering devices that serve as interfaces between workstations and a facility-wide material transport system. The architecture developed for a Material Buffering Controller (MBC) is based on the observation that MBDs are in a class of equipment different from any other device already on the shop floor. Since an MBD serves as an interface to equipment-level components of both machining and material transport workstations, it is considered a shared resource between those workstations (like a data base), rather than as an equipment-level component of either workstation. The shared resource method of integrating a Material Buffering Controller into an automated factory provides independence between the activities of a factory-wide transport system and those of a machining workstation. An application of this architecture in the Automated Manufacturing Research Facility (AMRF) at the National Bureau of Standards (NBS) is presented. Included is a description of the data files and the command and status interfaces that will be used in the integration of a Material Buffering Controller into the AMRF. Specific examples of typical operations involving an MBC are also given.

701,026
PB87-202974 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Data-Driven Automation. A Computer Architecture for Small-Batch Manufacturing.
Final rept.,
C. R. McLean, M. J. Mitchell, and E. J. Barkmeyer. 1983, 6p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Spectrum 20, n5 p59-64 May 83.

Keywords: Data management systems, Communications systems, Artificial intelligence, Expert systems, User interfaces, Reprints, *Computing architectures, *Manufacturing control systems.

The development of fully automated small batch manufacturing systems has been slowed by a number of technical and economic problems. The most significant problem is the lack of a standard information processing systems architecture that addresses consumer and vendor needs. The National Bureau of Standards has a project underway to construct a testbed manufacturing systems, the Automated Manufacturing Research Facility (AMRF), to investigate these problems. The paper discusses four major component technologies of the AMRF information processing architecture: Manufacturing Systems Control, Distributed Data Administration, Communications Systems, and Task-Oriented User Interfaces.

701,027
PB87-218277 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Interactive Process Planning in the AMRF (Automated Manufacturing Research Facility).
Final rept.,
P. F. Brown, and C. R. McLean. 1986, 18p
Pub. in Knowledge-Based Expert Systems for Manufacturing, PED-v24 p245-262 1986.

Keywords: *Artificial intelligence, *Machining, Reprints, *Automated machining, Expert systems, Process planning.

As more intelligent automated control systems are introduced into discrete parts manufacturing facilities, it will become increasingly difficult to maintain the centralized process planning systems in use today. A new approach is required that will permit distributed manufacturing operations planning via a network of cooperating, intelligent, process engineering systems. Expert planning modules should be developed for each con-

troller or class of controllers that are or will be used in manufacturing installation. To accomplish this goal of distributed, intelligent planning modules, work has started with the development of a semi-automatic interactive process planning system. This system has several unique features. First, a hierarchical planning system has been developed for multi-level factory architecture. Second, all activities within the factory are described by work elements. Third, standard interfaces have been defined to allow the passing of information between planning and modules and controllers. Fourth- a semi-intelligent editor for the manipulation of these process planning data structures.

701,028
PB87-218350 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Cell Control Architecture for Flexible Manufacturing.
Final rept.,
C. R. McLean. 1987, 14p
Pub. in Proceedings of 1987 Advanced Manufacturing Systems Exposition and Conference, Chicago, IL., June 23-25, 1987, p622-635.

Keywords: *Manufacturing automation, Architectures, *Cell control systems, Interface standards.

The software architecture of the cell control system in the Automated Manufacturing Research Facility (AMRF) at the National Bureau of Standards is presented. The cell control system manages production and support operations for an automated small batch manufacturing system that produces machined parts. The cell is the highest level of control that is currently implemented within the AMRF. It is programmed in the C language and runs on IBM (tm) personal computer systems and compatibles. The cell is comprised of modules which decompose and sequence manufacturing work orders and which provide interfaces to communications, global databases, process planning and other control systems. The architecture of the cell is generic. It is designed to be applicable for control system implementations at any level in the AMRF hierarchy.

701,029
PB87-218368 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Vertical Machining Workstation of the AMRF (Automated Manufacturing Research Facility): Software Integration.
Final rept.,
C. R. McLean. 1986, 16p
Pub. in Integrated and Intelligent Manufacturing, PED-v21 p101-116 1986.

Keywords: *Manufacturing automation, Architectures, Reprints, *Vertical machining, Process planning, Interface standards.

The software architecture of the Vertical Machining Workstation (VWS) in the Automated Manufacturing Research Facility (AMRF) at the National Bureau of Standards is presented. The prototype system demonstrates flexible computer-integrated manufacturing for a family of prismatic parts. The workstation software components include: a feature-based design system for defining part geometries, an automatic process planning and NC code generation system, a state machine-based hierarchical control system which executes process plans, a diagnostic tools package, and mailbox communications software. The mechanical components of the workstation, described in a companion paper (1), include: a CNC vertical machining center, a robot and locally implemented gripper system, a pneumatic vise, a vacuum chip removal system, local part storage, and tray roller tables for a robot cart materials delivery system. The system is capable of running in stand-alone mode as a single station computer-integrated manufacturing system, or remotely under the AMRF cell controller.

701,030
PB87-232039 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Automated Manufacturing Research Facility at the National Bureau of Standards.
Final rept.,
C. R. McLean, and P. F. Brown. 1987, 27p
See also PB83-139022. Sponsored by International Federation for Information Processing, Geneva (Switzerland).

Pub. in New Technologies for Production Management Systems, Chapter 9 p177-203 1987.

Keywords: *Facilities, *Automation, Manufacturing, Machining, Research, Automatic control, Reprints, Computer aided manufacturing.

The Automated Manufacturing Research Facility (AMRF) at the U.S. National Bureau of Standards (NBS) is a major government laboratory for research in computer integrated manufacturing. The AMRF is designed to support the NBS role of providing measurement standards for American industry. The facility, located at Gaithersburg, Maryland, has close ties with industry, university, and government engineers and scientists.

701,031
PB87-234050 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Process Planning in the AMRF (Automated Manufacturing Research Facility).
Final rept.,
C. R. McLean, and P. F. Brown. Aug 87, 4p
Sponsored by Society of Manufacturing Engineers, Dearborn, MI.
Pub. in CIM Technology, pCT-23--CT-26 Aug 87.

Keywords: Process control, Reprints, *Automated Manufacturing Research facility, AMRF project, Computerized control systems.

As more intelligent automated control systems are introduced into discrete parts manufacturing facilities, it will become increasingly difficult to maintain the centralized process planning systems in use today. A new approach is required that will permit distributed manufacturing operations planning via a network of cooperating, intelligent, process engineering systems. Research on such systems is underway as a part of the Automated Manufacturing Research Facility (AMRF) project at the National Bureau of Standards (NBS). The article discusses: (1) the role of process planning in manufacturing facilities, (2) system architectures for planning and control, (3) the work element concept, (4) process plan data exchange formats, (5) feature-based manufacturing and (6) the current implementation of the planning system.

701,032
PB88-122015 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.
Research Issues in Process Planning at the National Bureau of Standards.
Final rept.,
P. F. Brown, and S. R. Ray. 1987, 9p
Pub. in Proceedings of CIRP International Seminar on Manufacturing Systems (19th), Pennsylvania State University, PA., June 1-2, 1987, p111-119.

Keywords: *Process control, *Manufacturing, *Robots, *Machine tools, Automation, *Computer aided manufacturing, Expert systems, National Bureau of Standards, Factory automation.

Several years ago, the Automated Manufacturing Research Facility (AMRF) project was established at the Gaithersburg site of the National Bureau of Standards (NBS). The facility is unique in several ways: first, all manufacturing activities are under direct computer control; second, all manufacturing data preparation systems and control systems are linked through a complex data administration and communication system; third, all manufacturing operations are carried out by robots and machine tools with a minimum of human intervention. This last constraint requires that all manufacturing data be complete and unambiguous. It was necessary to develop a process planning system which was capable of supporting the particular requirements and manufacturing capabilities of the AMRF. The paper describes the research agenda of NBS and its cooperative efforts over the past few years in the area of Automated Process Planning.

701,033
PB88-152731 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.

Production Control Module for the AMRF (Automated Manufacturing Research Facility).

Final rept.,
A. T. Jones, and C. R. McLean. 1985, 6p
Pub. in Proceedings of the International Computers in Engineering Conference and Exhibit, Boston, MA., August 4-8, 1985, p445-450.

Keywords: Computer aided manufacturing, Automation, Research and development, Industrial plants, Production control, Process control, Reprints, *Flexible manufacturing systems, Hierarchical control, US NBS, AMRF(Automated Manufacturing Research Facility).

The Automated Manufacturing Research Facility (AMRF) is being established at the National Bureau of Standards. The manufacturing testbed provides a means for conducting research in automated metrology and interface standards for the factory of the future. A five layer control hierarchy has been proposed to manage the real-time control of the facility. A careful examination of the functions performed at each level within the hierarchy indicates that a standard internal structure for control modules is possible. The paper describes the internal structure, external interfaces, and implementation techniques for such a production control module which can be utilized at each level in the hierarchy.

701,034

PB88-152749 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Factory Automation Systems Div.

Proposed Hierarchical Control Model for Automated Manufacturing Systems.

Final rept.,
A. T. Jones, and C. R. McLean. 1986, 11p
Pub. in Jnl. of Manufacturing Systems 5, n1 p15-25 1986.

Keywords: Computer aided manufacturing, Automation, Research and development, Industrial plants, Production control, Process control, Reprints, *Flexible manufacturing systems, Hierarchical control, US NBS, AMRF(Automated Manufacturing Research Facility).

The Automated Manufacturing Research Facility is being constructed at the National Bureau of Standards. This small, integrated, flexible manufacturing system will serve as a research testbed to aid in the identification, design, and testing of standards for the automated factory of the future. The paper describes the five layer hierarchical production control model proposed to manage these factories. It includes a discussion of the philosophy behind the model, the functional requirements of each layer within the model, a brief description of the data services needed to support the approach, and an overview of the techniques used to implement existing subsystems.

701,035

PB88-155742 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.

AMRF (Automated Manufacturing Research Facility) Database Report Format: Part Model,
T. H. Hopp. Nov 87, 77p NBSIR-87/3672

Keywords: *Report generators, Computer systems programs, Specifications, Programmers, AMRF(Automated Manufacturing Research Facility), Computer aided manufacturing, AMRF data base, Application programs(Computers), Format, User manuals(Computer programs).

The document specifies the format of Part Model database reports. These reports are used throughout the AMRF to communicate part model data between application processes and the global AMRF database. Part model data consists of basic shape data (topology and geometry), features, and functionality (tolerances). This document is organized in five sections. This document is intended for use by programmers implementing systems that make use of AMRF part model data. It is also intended as an introduction to the capabilities of the part model for systems analysts who must decide what applications can be supported by the AMRF part model.

Job Environment

701,036

PB87-232070 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.
Some Tools for Fire Model Validation.

Final rept.,
A. D. Davies. 1987, 20p
Pub. in Fire Technology 23, n2 p95-114 May 87.

Keywords: *Fire tests, Models, Errors, Graphic methods, Reprints, *Foreign technology.

General ideas are offered for describing fire model validity prior to starting product design. Validation of independent test results is part of the phase. Differences between comparable results, graphical methods, and distinctions between random and systematic errors are discussed.

701,037

PB88-129648 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

Quantitative Fire Hazards Analysis: An Overview of Needs, Methods and Limitations.

Final rept.,
E. K. Budnick. 1986, 12p
Pub. in Fire Safety Jnl. 11, n1-2 p3-14 Jul-Sep 86.

Keywords: *Fire hazards, *Safety engineering, Mathematical models, Computerized simulation, Reprints.

This year's SFPE symposium Techniques for Quantitative Fire Hazard Analysis focuses on available analytical techniques for fire hazard prediction. Topics include damageability factors, calculations for discrete fire hazards, prediction of fire effects in enclosures, applications of computer models and the basics of probabilistic and statistical methods for addressing uncertainty. The introductory paper provides an overview addressing such issues as the need for quantitative methods, the technical basis for development of these methods, and a review of the more popular methods available to the fire protection community.

Joining

701,038

PB87-199345 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Fracture Toughness of Weldments: Elastic-Plastic Fracture Analysis.

Final rept.,
D. T. Read. 1984, 15p
Sponsored by Metal Properties Council, Inc., New York.
Pub. in Proceedings of 1984 Pressure Vessels and Piping Conference and Exhibition, San Antonio, TX, June 17-21, 1984, p75-89.

Keywords: *Weldments, *Fracture(Materials), Toughness, Elastic properties, Plastic properties, Welding, Metal plates, Stresses, Failure, Reprints.

Elastic-plastic fracture mechanics (EPFM) analysis of the results of tests of four welded wide plate specimens of one size with one surface crack geometry was attempted on three levels; simple correlation of wide plate results with small-specimen EPFM toughness; comparison of predicted and measured wide plate crack mouth opening displacement (CMOD) and J-integral; and comparison of EPFM-predicted wide plate failure stresses with experimental results. The failure loads of the three as-welded plates were correlated with both critical J-integral and critical crack tip opening displacement (CTOD). The stress-relieved specimen had a higher failure load than expected from both J and CTOD.

701,039

PB87-219200 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Compressive Stress Effects on the Ultrasonic Detection of Cracks in Welds.

Interim rept.,
T. A. Siewert, and R. E. Schramm. 1987, 8p
Contract N00167-86-WR6-0038
Sponsored by David W. Taylor Naval Ship Research and Development Center, Bethesda, MD.
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6B p1593-1600 1987.

Keywords: *Ultrasonic tests, *Welding, Weld defects, Residual stress, Compressing, Cracks, Reprints.

Ultrasonic inspection techniques are often used to search for cracks and other flaws in welds. These inspections are dependent on an impedance mismatch giving rise to reflection and scatter of ultrasound in the vicinity of the defect. The study investigates the effect of varying compressive stress across a flaw face on ultrasound of both very high frequency (from a piezoelectric transducer) and low frequency (from an electromagnetic-acoustic transducer, or EMAT). The test specimen had a shallow weld to serve as a hinge and specially machined faces between the two plates. Varying the bending force through this hinge changed the compressive loading across the flaw face. As this contact pressure increased, both reflected amplitudes decreased but there were marked differences between the two frequencies. The nature of these differences depended on the transducer location along the weld, possibly due to changes in the nature of the bearing surfaces.

701,040

PB88-129697 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Sizing Canted Flaws in Weldments Using Low-Frequency EMATs (Electromagnetic-Acoustic Transducers).

Final rept.,
R. E. Schramm, and T. A. Siewert. 1987, 6p
Sponsored by David W. Taylor Naval Ship Research and Development Center, Bethesda, MD.
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6B p1731-1736 1987.

Keywords: *Weldments, *Nondestructive tests, Ultrasonic frequencies, Reprints, EMAT(Electromagnetic acoustic transducer).

Techniques for detecting and sizing flaws with electromagnetic-acoustic transducers (EMATs), previously used successfully for normal planar flaws, were applied to canted flaws in steel plates. Comparisons were made between metallographic and ultrasonic measurements on specially prepared welds. Results indicated a high probability of detecting canted flaws (> 0.5-mm deep) with EMATs. The EMAT sizing was highly repeatable and, for the most part, very accurate. Some, as yet unexplained, inaccuracies did show up, however, in some weld sections. There is a possibility that the calibration curve may be more complex for canted flaws than for normal flaws.

701,041

PB88-139175 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Effects of Deoxidation Practice on the Transformation Behavior and Toughness of Steel Welds.

Final rept.,
O. Grong, T. A. Siewert, and G. R. Edwards. 1986, 19p
Pub. in Welding Jnl. 65, n11 p279s-288s Nov 86.

Keywords: *Weldments, *Microstructure, Deoxidizing, Toughness, Steels, Manganese, Gas metal arc welding, Silicon, Reprints.

The fundamental factors controlling the development of microstructures in C-Mn steel weldments were studied, with particular emphasis on gas metal arc (GMA) welding. The authors conclude that the major role of manganese in the weld metal transformation kinetics is to restrict the growth rate of the grain boundary ferrite allotriomorphs (and indirectly Widmanstätten ferrite) until the degree of undercooling reaches the point where intergranular nucleation of acicular ferrite is energetically feasible. Silicon, on the other hand, increases the growth rate of grain boundary ferrite and promotes the formation of proeutectoid ferrite.

701,042

PB88-141171 Not available NTIS

MANUFACTURING TECHNOLOGY

Joining

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.

Sensors for Batch Manufacturing of Metal Parts.

Final rept.,

D. S. Blomquist. 1985, 4p

Pub. in Proceedings of Conference on High Productivity Machining: Materials and Processes, New Orleans, LA., May 7-9, 1985, p277-280.

Keywords: *Sensors, *Manufacturing, *Metal products, *Monitors, Detectors, Transducers, Microcomputers, Computer aided manufacturing, Reprints.

Reliable and effective sensors are important elements of both manned and unmanned batch manufacturing of metal parts. The increased speed in microcomputers and the decreased costs of memory have allowed significant changes to be made in the type of sensors that can be considered. By the proper application of microcomputers, transducer mechanisms that were previously discarded can now be used because the microcomputer can process information in a short enough time to influence the process being monitored and can provide increased accuracy by data analysis or linearization.

Manufacturing, Planning, Processing & Control

701,043

PB87-153060

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Design of a Conformal Tactile Sensing Array.

Final rept.,

I. McCammon. 1984, 6p

Pub. in Proceedings of Conference on Intelligent Robots and Computer Vision, Cambridge, MA., November 5-8, 1984, p296-301.

Keywords: *Pneumatic control, *Manufacturing, Arrays, Matrix methods, Displacement, Pins, Air flow, Stiffness, Measurement, Standards, Hysteresis, *Tactile sensation, *Robotics, *Optoelectronic sensors.

In the course of the National Bureau of Standards' program in measurements and standards for automated manufacturing and robotics, a tactile sensing array with a high degree of conformability has been developed. The array consists of a pneumatically controlled matrix of displacement pins which provides a deformable grasping surface, and a corresponding array of optoelectronic proximity sensors which determine workpiece orientation and geometry. Regulation of air flow into the finger to control grasping stiffness permits the sensing and handling of very delicate of complex objects. Additional features of the design include programmable array rigidity, zero mechanical hysteresis, and gripper mounted packaging.

701,044

PB87-161196

PC A02/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Mfg. Engineering.

Hierarchical Control and Real-Time Optimization in Automated Manufacturing Systems.

R. H. F. Jackson, and A. W. T. Jones. Feb 87, 22p

NBSIR-86/3503

Keywords: *Pilot plants, *Manufacturing, *Production management, *Industrial plants, Scheduling, Routing, Standards, Measurement, Optimization, Models, Research, Facilities, Prototypes, *Factory automation, *Hierarchical control, *Flexible manufacturing, *Technology innovation, Real time, National Bureau of Standards.

A major manufacturing research facility is being established at the National Bureau of Standards. The Automated Manufacturing Research Facility will address the standards and measurement needs for the factory of the future. A five-layer hierarchical control architecture is under development to manage all production and support activities within the facility. The proper execution of many of these activities requires the solution to one or more optimization problems. The paper partitions these problems into levels consistent with the control architecture and reports on early work undertaken to solve some of them.

701,045

PB87-161881

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Measurement of the Separation Distance in Contact and Proximity Lithography.

Final rept.,

D. B. Novotny. Dec 86, 6p

Pub. in Jnl. of the Electrochemical Society 133, n12 p2600-2605 Dec 86.

Keywords: *Lithography, Substrates, Separation, Masking, Diffraction, Reprints.

A method is presented for measuring the separation distance between the substrate surface and the mask surface in contact and proximity optical lithography. The method uses the analysis of the Fresnel diffraction pattern produced by a slit aperture in the mask and physically replicated in the photoresist. From the analysis, the image distance producing the observed Fresnel diffraction pattern is obtained and is used to calculate the separation distance. The conditions for the application of this method are presented, and an easy method for computer-generation of the Fresnel diffraction patterns is described. A simplified method for estimating the separation distance from the number of diffraction pattern peaks and valleys is also given. Results are presented showing that a finite separation distance may exist in hard 'contact' lithography, and that this measurement method is applicable from separation distance from near zero to 20 or more micrometers.

701,046

PB87-191045

Not available NTIS

National Bureau of Standards, Gaithersburg, MD. Office of Product Standards Policy.

Need for a Standard in Package Inspection.

Final rept.,

C. S. Brickenkamp. 1984, 7p

Pub. in Transactions of the Annual Quality Congress (38th), Chicago, IL., p420-426, May 14-16, 1984.

Keywords: *Packaging, *Standards, Quality control, Labels, Reprints, Content.

The National Bureau of Standards (NBS) Handbook 133 'Checking the Net contents of Packaged Goods' is a procedural manual on package testing for State and local weights and measures officials. The context within which the handbook was developed, including the legal requirements, definitions of acceptable lot, and traditional compliance testing approaches are presented. Intercomparisons are made among the Handbook 133 compliance testing procedures (including individual package limits), older methods in the United States, and the directives issued by the European Economic Community (EEC). Recommendations that could significantly increase the productivity of regulatory agencies along with opportunities for cost savings in the packaging industries are outlined.

701,047

PB87-218376

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.

Advances Toward the Standardization of Residual Stress Measurements.

Final rept.,

L. Mordfin. 1987, 5p

Pub. in Advances in Surface Treatments, v4 p341-345 1987.

Keywords: *Surface finishing, *Residual stress, *Standards, Reprints, US NBS, American Society for Testing and Materials (ASTM).

Advance toward the standardization of residual stress measurements since 1982 are described. Most of the advances in standard methods have been achieved through the American Society for Testing and Materials (ASTM) -- notably in its Subcommittee E28.13 -- while research at the US National Bureau of Standards (NBS) has been directed toward physical measurement standards. Current activities in these organizations and plans for the near future are also discussed. Additional participants for this work are solicited.

701,048

PB87-233615

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Effect of Electrode Weave Procedure on HY-80 GMA (Gas Metal Arc) Welds.

Final rept.,

T. A. Siewert, R. E. Trevisan, and P. T. Purtscher. Jul 87, 7p

Sponsored by David W. Taylor Naval Ship Research and Development Center, Bethesda, MD.

Pub. in Welding Jnl. 66, n7 p203-s-209-s Jul 87.

Keywords: *Gas metal arc welding, Fracture tests, Toughness, Reprints, *Foreign technology, Steel HY-80.

The report describes the effect of electrode weave procedure on both the weld interface shape and the toughness of gas metal arc (GMA) welds on HY-80 steel. To evaluate the variation in weld interface shape, the HY-80 welds were simulated by substituting a Type 309 stainless steel electrode for the HY-80 electrode, while reproducing the weave pattern and the weld pool dimensions. When the HY-80 base material was dissolved from around the weld, the entire fusion surface could be examined. This technique revealed the two-dimensional weld interface surface rather than the one-dimensional weld interface normally seen by metallographic techniques. The weld interface surface in the direction of welding was smooth for conventional (stringer bead) welds and convoluted for welds with a transverse weave pattern. Only small differences were observed in welds that were deposited using three different weave patterns.

701,049

PB88-122064

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Standardization Suggested by the AMRF - A Research Testbed for the Factory of the Future.

Final rept.,

H. M. Bloom, and C. R. McLean. 1985, 23p

Pub. in Automated Manufacturing, Chapter 4, 23p 1985.

Keywords: *Factory automation, *Manufacturing, Computer systems hardware, Interfaces, Standardization, Research, Test facilities, *Computer aided manufacturing, Computer software, Computer aided design, Hierarchical control.

A research effort has been initiated at the National Bureau of Standards to develop a small batch manufacturing system to support study and experimentation in automated metrology and interface standards for the computer integrated factory of the future. When completed, the resulting testbed system will be made available for fundamental studies in manufacturing technology by scientists and engineers from government, industry, and universities. The paper will report on the progress of major software and hardware sub-projects that are being carried out in support of the construction of the AMRF.

701,050

PB88-140975

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Some Observations on Tool Sharpness and Sub-Surface Damage in Single Point Diamond Turning.

Final rept.,

C. Evans, R. Polvani, M. Postek, and R. R. Rhorer.

1987, 15p

Pub. in SPIE (Society of Photo-Optical Instrumentation Engineers)-in-Process Optical Metrology for Precision Machining, v802 p52-66 1987.

Keywords: *Precision finishing, *Machining, Electron microscopy, Damage assessment, Reprints.

Simple techniques for an assessment of the depth and intensity of plastic work, or subsurface damage, in single point diamond turned components are described. Based on microhardness measurement techniques, the approach outlined here gives good qualitative correlation with conventional metallographic approaches for sub-surface damage assessment.

701,051

PB88-153358

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.

Study of Die Polishing for United States Mint Phase 3.
Final rept.,
K. Ousterhout. Oct 87, 35p NBSIR-87/3664

Keywords: *Dies, *Polishing, Automation, *United States Mint.

The research was undertaken to determine the feasibility of automating the polishing process of proof dies at the United States Mint. The dies polished during the research endeavor were the obverse Kennedy half-dollar dies. The main goals of the research are: (1) Develop a method of mechanically polishing proof dies which results in a quality level equal to or better than that now achieved by current manual methods; (2) Develop the optimum production rate that can be achieved in mechanically polishing proof dies; (3) Utilize a machine tool with at least 4 axes of motion; and, (4) Exercise initiative and ingenuity in the use of conventional and computer technologies, and develop through experimentation the best polishing compounds and materials, tooling, tool paths, speeds, masking techniques or other methods of protecting areas not to be polished.

Plant Design & Maintenance

701,052
PB88-110747 Not available NTIS
National Bureau of Standards (ICST), Gaithersburg, MD. Systems Components Div.
Multi-Microprocessor Guard Control Station.

Final rept.,
A. Mink, G. Nacht, A. Holt, A. Koenig, and R. Moore. 1983, 11p
Sponsored by Defense Nuclear Agency, Washington, DC.
Pub. in Proceedings of Annual Technical Symposium of the Washington, DC. Chapter of the ACM (Association for Computing Machinery) (22nd), 'Microcomputer Systems: Tools or Toys', Gaithersburg, MD., June 23, 1983, pF.2.1-F.2.11.

Keywords: *Security, *Internal security, *Guards(Personnel), Facilities management, Control equipment, *Area security, *Multiprocessors, Interactive systems, Real time operations.

The implementation and evaluation of a Guard Control Station that is part of a Computerized Site Security Monitor and Response System is described. The implementation used three microprocessors interconnected via communication channels in an arrangement that permitted simulation of physical security scenarios in a real-time, interactive mode.

Quality Control & Reliability

701,053
PB87-151593 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Three Dimensional Strain Measurements with X-ray Energy Dispersive Spectroscopy.

Final rept.,
D. R. Black, C. J. Bechtoldt, R. C. Placious, and M. Kuriyama. 1985, 5p
Pub. in Jnl. of Nondestructive Evaluation 5, n1 p21-25 1985.

Keywords: *Nondestructive tests, *Strain measurement, *X ray diffraction, Gradients, Curve fitting, Steels, Residual stress, Bars, Reprints, Three dimensional.

A feasibility study was performed to show the ability of energy dispersive x-ray diffraction (EDXRD) to measure three dimensional strain distributions in thick industrial materials. Photon energies up to 130 keV were used to guarantee penetration through the sample and curve fitting techniques applied to peak position determination. The system was used to measure the strain gradient through the thickness of a 9.5 mm thick cantilevered steel bar.

701,054
PB87-201406 PC A03/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.
NDE (Non-Destructive Evaluation) Publications, 1984.
L. Mordfin. Apr 87, 32p NBSIR-87/3552
See also report for 1982, PB85-244069.

Keywords: *Nondestructive tests, *Bibliographies, Abstracts, National Bureau of Standards.

This is the eighth in a series of bibliographies of NBS publications on nondestructive evaluation (NDE). It provides bibliographic citations, with selected abstracts, for 103 publications that appeared in the open literature, primarily during calendar year 1984. A detailed subject index is included as well as information on how copies of many of the publications may be obtained.

701,055
PB87-219226 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.
Plate Modes Generated by EMATs for NDE of Planar Flaws.
Interim rept.,
S. K. Datta, R. E. Schramm, and Z. Abduljabbar. 1987, 8p
Contract N00167-86-WR6-0038
Sponsored by David W. Taylor Naval Ship Research and Development Center, Bethesda, MD., National Science Foundation, Washington, DC., and Office of Naval Research, Arlington, VA.
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6A p101-108 1987.

Keywords: *Nondestructive tests, Waveforms, Diffraction, Plates, Ultrasonic tests, Transducers, Reprints.

In recent years several investigators have reported on the propagation and scattering of SH waves in a plate. The theory of SH wave generation by EMATs and the representation of the waveform in propagating plate modes is well understood. Scattering of SH waves by planar flaws has also been studied theoretically and experimentally. In the paper, the authors have examined how the various plate modes form as a function of frequency, geometry, and transducer configuration, then combine into a waveform. Careful selection of the parameters simplifies subsequent analysis and determines optimal positions for the transducers relative to each other and any reflector. Calculations based on a hybrid finite element and model expansion technique are presented for scattering by canted cracks that might be expected in a plate. Experimental comparisons have been made on slotted plates.

701,056
PB87-232062 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Digital Image Processing for Improved Detection and Diagnosis of Hidden Flaws.
Final rept.,
R. C. Placious, D. Polansky, and J. H. Sparrow. 1983, 9p
Pub. in Technology Advances in Engineering and Their Impact on Detection, Diagnosis and Prognosis Methods, p100-108 1983.

Keywords: *Nondestructive tests, *Radiography, Digital systems, *Image processing, *Flaw detection.

The conversion of a radiographic image to a digitized form is discussed. The transformation permits one to perform mathematical operations on the digital data by use of a microprocessor or a computer. A transformed image can then be displayed on a suitable video monitor for viewing or analysis. A sophisticated technology has been developed by the image processing industry for the enhancement of images. Many of these techniques are useful in NDT work for the detection of material or fabrication flaws which could result in mechanical failures.

701,057
PB87-233847 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Field Mapping and Performance Characterization of Commercial Eddy Current Probes.
Final rept.,
T. E. Capobianco. 1987, 8p
Sponsored by Army Materials Technology Lab., Watertown, MA.
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6A p687-694 1987.

Keywords: *Eddy current tests, Magnetic fields, Mapping, Performance, Sensitivity, Reprints, *Probes(Electromagnetic), US NBS.

Variations in the sensitivity of commercial eddy current probes are common, and this fact can cause reliability problems for those using eddy current inspection techniques. The National Bureau of Standards in Boulder, Colorado, is conducting research to characterize eddy current probe performance. The authors have developed a unique capability to map the near magnetic field of these probes, and results are presented comparing field maps to measurements of electrical and other performance parameters. They show that the magnetic field intensity per unit of excitation current has a direct relationship to the strength of the probe response to a simulated defect (electrical discharge machined notches) when probe/coil misalignments are corrected for. Performance tests are reported which can account for coil misalignments as well as other factors affecting the strength of the defect response. The inclusion of these tests in a proposed military standard for eddy current probe characterization is also discussed.

701,058
PB87-233854 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Pickup Coil Spacing Effects on Eddy Current Reflection Probe Sensitivity.
Final rept.,
T. E. Capobianco, and K. Yu. 1987, 5p
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6A p721-725 1987.

Keywords: *Eddy current tests, Performance, Sensitivity, Reprints, *Probes(Electromagnetic).

The authors report the results of an experiment investigating the effect of pickup coil spacing on differential probe sensitivity. The probe configuration for these experiments consists of an air core excitation coil surrounding two air core pickup coils. All three coils have vertical axes with respect to the flat plate test piece. Measurements were taken for three different pickup coil spacings on an aluminum test piece with four electrical discharge machined (EDM) notches. The effect of pickup coil unbalance on probe response is also reported.

701,059
PB87-233987 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Calibration of Acoustic Emission Transducers: Comparison of Two Methods.
Final rept.,
F. R. Breckenridge, T. Watanabe, and H. Hatano. 1982, 11p
Sponsored by Nippon Steel Corp., Tokyo, Japan Welding Engineering Society, Tokyo, Electric Power Research Inst., Palo Alto, CA., and Office of Naval Research, Arlington, VA.
Pub. in Proceedings of International Acoustic Emission Symposium (6th), Susono, Japan, October 31-November 3, 1982, p448-458.

Keywords: *Calibrating, *Transducers, Reprints, *Foreign technology, Acoustic emission.

An endeavor to compare two types of calibration of acoustic emission transducers was undertaken jointly by the Nippon Steel Corporation in Japan and the National Bureau of Standards in the United States. For the purpose of comparison, six transducers, of two very different types, were calibrated each three times by the surface-pulse method of the National Bureau of Standards and each three times by the reciprocity method of the Nippon Steel Corporation. They were then recalibrated at NBS to assure that no changes had occurred. A brief discussion of the two methods is given and the frequency response curves are compared.

701,060
PB88-117551 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

MANUFACTURING TECHNOLOGY

Quality Control & Reliability

Design and Characterization of Uniform Field Eddy Current Probes.

Final rept.,
P. J. Shull, T. E. Capobianco, and J. C. Moulder.
1987, 9p
Sponsored by Ames Lab., IA., and Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH. Materials Lab.
Pub. in Quantitative Nondestructive Evaluation, v6A p695-703 1987.

Keywords: *Nondestructive tests, *Eddy current tests, Performance, Reprints, *Probes(Electromagnetic).

Uniform field eddy current probes operate by interrogating flaws with a spatially uniform electromagnetic field. Their use in quantitative NDE is particularly attractive because theoretical models of the field-flaw interaction are greatly simplified by the assumption of a uniform field. This leads to much simpler inversion protocols for determining flaw sizes from measurements. Yet, most eddy current probes in use today have highly nonuniform field distributions: the design of probes to produce a uniform field distribution while retaining high sensitivity to flaws remains a relatively unexplored area. The report here recent progress at NBS in the design, fabrication, and characterization of uniform field eddy current probes. Factors that were considered and evaluated include sensitivity, field uniformity, operating frequency, size and shape, ferrite properties, electrical characteristics, and noise. They also evaluated the sensitivity of the probes to liftoff, tilt, and proximity to edges. To evaluate field uniformity, the magnetic fields of some probes were mapped in three dimensions.

701,061
PB88-117668 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Uniform Field Eddy Current Probe: Experiments and Inversion for Realistic Flaws.
Final rept.,
J. C. Moulder, P. J. Shull, and T. E. Capobianco.
1987, 10p
Sponsored by Ames Lab., IA., and Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH. Materials Lab.
Pub. in Quantitative Nondestructive Evaluation, v6A p601-610 1987.

Keywords: *Nondestructive tests, *Eddy current tests, *Titanium alloys, Electromagnetic fields, Surface defects, Reprints, *Foreign technology, Titanium alloy 6Al 4V.

The analysis of the interaction of electromagnetic fields with surface-connected flaws is greatly simplified when the magnetic field of the interrogating probe is spatially uniform. This has led to the development of uniform field eddy current probes for quantitative NDE applications. The probes were calibrated with shallow cylindrical and spherical recesses formed by electrical-discharge machining (EDM). Both fatigue cracks and semi-elliptical EDM slots in Ti-6Al-4V were studied. Flaws ranged in length from 0.5 to 3.0 mm and in depth from 0.25 to 1.5 mm. All measurements and calibrations were performed with an automatic network analyzer.

701,062
PB88-122312 CP T05
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
STAT2: A Fortran Program for Analysis of Data from Microelectronic Test Structures.
Software,
R. L. Mattis. Mar 86, mag tape NBS/SW/MT-88/002
See also PB86-182490.
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 NITS Computer Products if you have questions. Price includes documentation, PB84-127455, PB86-22861, and PB83-263764.

Keywords: *Software, Computer programs, Wafers, Computer systems programs, STAT2 computer program, Automatic test equipment, L=Fortran, H=VAX-11/785.

STAT2 is a computer program which performs the following functions: reads data as a two-dimensional array; calculates mean, sample standard deviation, and median; identifies outliers using statistically sound algorithms; calculates replacement values for outliers;

makes gray-tone, numerical and contour data maps on a line printer; makes a numerical map on the user's terminal; makes a histogram on a line printer; constructs a data base for examining correlations among various data sets; searches the data base for correlations using several selective keys; makes a vector map, scatter plot and trend chart.

701,063
PB88-123724 PC A09/MF A01
National Bureau of Standards, Gaithersburg, MD.
Uniform Laws and Regulations as Adopted by the National Conference on Weights and Measures (72nd), 1987.
Final rept.,
C. S. Brickenkamp. Sep 87, 193p NBS/HB-130-1988
Also available from Supt. of Docs. as SN003-003-02814-2. Supersedes PB87-103248.

Keywords: *Weight measurement, *Regulations, Standardization, Handbooks, Units of measurement, Packaging, Labels, Commodities, Sales, Prices, Consumer affairs, Automotive fuels, *Weights and measures, Open dating, Unit pricing.

The 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 Conference at its annual meeting in 1987. The edition also contains a new motor fuel inspection law and regulation. The NCWM recommends adoption and promulgation by the states of these uniform laws and regulations as updated in the handbook.

701,064
PB88-141213 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Comparison of Several Ultrasonic Techniques for Absolute Stress Determination in the Presence of Texture.
Final rept.,
A. V. Clark, J. C. Moulder, R. B. Mignogna, and P. P. DelSanto. 1987, 16p
In Proceedings of ONR Symposium on Solid Mechanics Research for QNDE, Evanston, IL., September 18-20, 1985, p345-360 1987.

Keywords: *Stress analysis, *Ultrasonic tests, Nondestructive tests, Acoustic measurement, Texture, Reprints.

Most ultrasonic stress measurement techniques measure some combination of stresses, such as the sum or difference of principal stresses, relative to some (possibly unknown) stress state. In order to apply fracture mechanics methods to failure/life assessment of flawed structures, stresses must be determined absolutely. Ultrasonic stress measurement methods rely on the acoustoelastic effect (stress induced change in phase velocity). Unfortunately, texture also has a comparable effect. This has limited most application to measurement of applied (as opposed to residual) stress. The authors consider several methods of eliminating texture and develop criteria which must be met to achieve a desired (absolute) stress resolution. Illustrations will be given for several techniques by using data from acoustoelastic experiments.

701,065
PB88-147459 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Energetics of AE (Acoustic Emission) Source Characterization.
Final rept.,
R. B. Clough. May 87, 8p
Pub. in Materials Evaluation 45, n5 p556-563 May 87.

Keywords: *Nondestructive tests, *Acoustic emission, Calibrating, Materials tests, Reprints.

An acoustic emission system is modeled as an energy flow process. An examination of the energy method is made which permits system calibration so that the source may be characterized in terms of joules or watts. The entire acoustic emission system--source, specimen, sensor, and instrumentation--is calibrated using an energy source such as a dropped ball or pulsed infrared laser. Over the 63 to 200 kHz band-pass, the system is linear in power and the measured energy is found to be approximately independent of

specimen size and shape, as well as source and sensor positions. The technique appears to have a wide variety of possible applications in materials processing, structural monitoring, and materials science studies.

701,066
PB88-153705 PC A05/MF A01
CD Metrology, Inc., Germantown, MD.
Computer Software for the Computation of the Scattered Field and the Optical Microscope Image of Line Objects Patterned in Thick Layers.
D. Nyyssonen. Dec 87, 89p NBSIR-87/3618
Sponsored by National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Keywords: *Dimensional measurement, *Integrated circuits, *Line width, Optical microscopes, Optical measurement, Metrology, Computation, Computer programs, Wafers, Algorithms, THKIMAG computer program, Fortran 77 programming language.

The report contains computer software for calculating optical microscope images of line objects patterned in thick layers ($> \lambda/4$ thick). The algorithms used are based on a monochromatic, waveguide model which can predict the images of line objects with arbitrary edge geometry including multilayer structures with sloped, curved, asymmetric, and undercut edges. Along with the computer software listing, the mathematics of the model, a short description of its structure and use, and test cases for help in implementation are given. The computer software described in the report was written in conjunction with the NBS project to develop fundamentally accurate optical measurement techniques for the width of micrometer and submicrometer lines patterned on integrated circuit wafers.

Robotics/Robots

701,067
PATENT-4 694 230 Not available NTIS
Department of Commerce, Washington, DC.
Micromanipulator System.
Patent,
A. H. Slocum, and J. P. Peris. Filed 11 Mar 86,
patented 15 Sep 87, 13p PB88-110275, PAT-APPL-6-838 748
Supersedes PB86-234382.
This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Patents, *Robots, Manipulators, Positioning.

The invention is a micromanipulator system for precisely positioning an object in an xz plane and then grossly moving the object in the y direction into a hole z. The micro-manipulator system includes a base and a platform mounted to the base having five different degrees of movement (in the x direction, y direction, z direction, about the x axis, and about the z axis). Suitable moving mechanisms are provided for reversibly moving the platform in the five degrees of movement. Four of the degrees of movement being for fine or precise positioning of the platform and the fifth degree of movement in the y direction being a coarse positioning movement.

701,068
PB87-161105 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Quick Change System for Robots.
Final rept. 1 Aug 82-1 Dec 85,
J. M. Vranish. 1984, 24p
Pub. in Proceedings of Conference on Robots 8, Detroit, MI, June 4-7, 1984, v2 p17.74-17.97.

Keywords: *Robots, Automations, Hydraulics, Pneumatics, Manufacturing, Facilities, *Robotics, Robot vision, National Bureau of Standards.

The National Bureau of Standards has developed and conducted preliminary tests of a versatile robot quick change system for use in its Automated Manufacturing Research Facility. These tests indicate: the quick change is capable of interfacing multiple hydraulic as well as multiple pneumatic lines; it has mating repeatability

bility sufficient to facilitate the use of a sophisticated vision sensor; it can pass multiple electronics and fiber optics channels; it can store grippers at the robot wrist in holsters by using a unique compliance technique. Modified commercial components are used throughout and the device is suitable for industrial use. The paper discusses technical details of the system.

701,069
PB87-161824 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Mfg. Engineering.
Update - NBS (National Bureau of Standards) Research Facility Addresses Problems in Set-Ups for Small Batch Manufacturing.
Final rept.,
P. Nanzetta. 1984, 6p
Pub. in Industrial Engineering 16, n6 p68-73 1984.

Keywords: *Manufacturing, *Automation, *Robots, *Machining, *Materials handling equipment, Inspection, Deburring, Cleaning, Automation, Research, Facilities, *Computer aided manufacturing, Hierarchical control, Data base management systems, Computer networks, National Bureau of Standards.

The AMRF consists of 5 basic workstations, 3 machining, 1 cleaning and deburring, and 1 inspection; an automated materials handling system; a cell level of control; a network manager; and a database manager. Almost all of the major equipment is in place on the floor of the NBS Instrument Shop; the first major integration stage within the AMRF has been publicly tested; and the authors are finding that the fundamental approach described in the beginning of the project appears to be rich enough to support development of the complete system.

701,070
PB88-134523 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Split Rail Parallel Gripper.
Final rept.,
W. R. Bunch, and J. M. Vranish. 1985, 14p
See also PB86-220316.
Pub. in Proceedings of Conference on Robots 9, Detroit, MI., June 2-6, 1985, p6-11-6-14.

Keywords: *Robots, Clamps, Holders, Clamps, Servomechanisms, *Grippers, Stepper motors.

A wide throw parallel action gripper is described. The gripper uses a unique 'split rail' design concept in conjunction with a pair of preloaded commercial recirculating ball bearing linear slides. The prototype is compact enough to be used on small payload robots, 4.5 Kg (10 lbs), yet was found to have the strength, rigidity and immunity to jamming from side torques necessary for use on large payload robots 90 Kg (200 lbs). It can be used as a simple open/close air actuated gripper; yet has repeatability and responsiveness that make it ideal for use with stepping motors and D.C. servo motors. It cannot be fouled by oil or chips when used in a material cutting environment. The paper describes the design and operation of the gripper and discusses the results of initial tests.

701,071
PB88-139019 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Programming a Hierarchical Robot Control System.
Final rept.,
J. S. Albus, A. J. Barbera, and M. L. Fitzgerald. 1982, 13p
Pub. in Proceedings of International Symposium on Industrial Robots (12th), Paris, France, June 1982, p505-517.

Keywords: *Robots, *Computer programming, Real time operations, Algorithms, *Control systems, Finite state machines, Hierarchical control.

A hierarchical architecture for real-time sensory-interactive robot control system provides a method for partitioning the control problem into modules so that each module can be implemented as a finite-state automation. Programs in each module can be expressed as state-transition tables. The paper describes several advantages and disadvantages of the representation, particularly in regards to the issue of error recovery. A algorithm is given by which programs written in a conventional robot programming language can be translated into the state-table representation.

701,072
PB88-141239 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Low-Level Control Interface for Robot Manipulators.
Final rept.,
M. L. Fitzgerald, and A. J. Barbera. 1985, 13p
Pub. in Robotics and Comput.-Integrated Manuf. 2, n3-4 p201-213 1985.

Keywords: *Manipulators, *Robots, Control, Interfaces, Reprints.

The paper will discuss a possible low-level control interface for a robot manipulator. The first section will present background information describing a proposed system modularization and the capabilities and limitations afforded by the use of interfaces. The next section presents three possible low-level robot control interfaces within the system. These will be elaborated on including a specification of the interface information and its use, timing considerations, and potential limitations. The paper concludes with a summary discussion and recommendation.

701,073
PB88-141247 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Hierarchical Control for Robots and Teleoperators.
Final rept.,
J. S. Albus, C. R. McLean, A. J. Barbera, and M. L. Fitzgerald. 1986, 11p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) Workshop on Intelligent Control, Troy, NY., August 26, 1985, p39-49 1986.

Keywords: *Robots, *Control systems design, Computer aided manufacturing, Reprints, Hierarchical control.

The basic structure of a hierarchical control system is a tree, wherein each computational module has a single superior, and one or more subordinate modules. The top module is where the highest level decisions are made and the longest planning horizon exists. Goals and plans generated at this highest level are transmitted to the next lower level where they are decomposed into sequences of subgoals. In general, the decomposition at each level takes into account information derived from: (a) processed input data from sensors that measure the state of the environment, (b) reports from lower control levels as to the state of the control hierarchy itself, and (c) predictions (or expectations) generated by models, knowledge bases, or inference engines.

701,074
PB88-152038 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Automatic Laser Tracking Interferometer System for Robot Metrology.
Final rept.,
K. Lau, R. J. Hocken, and W. Haight. 1986, 6p
Pub. in Precision Engineering 8, n1 p3-8 Jan 86.

Keywords: *Robots, *Robotics, *Metrology, *Laser tracking, Laser applications, Tracking(Position), Standards, Performance tests, Reprints.

The growing utilization of robots in manufacturing has created the need for standard procedures, instruments and terminologies to measure and describe robot performance. In response to this, a research group has recently been formed at the National Bureau of Standards (NBS) whose function is to devise methodologies, instruments, and standard test procedures for characterizing the accuracy, repeatability and dynamic performance of robots. The paper describes the concept of the automatic laser tracking system and presents preliminary results obtained from an experimental version of the system.

701,075
PB88-152046 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Robot Performance Measurements Using Automatic Laser Tracking Techniques.
Final rept.,
K. Lau, R. Hocken, and L. Haynes. 1985, 10p
Pub. in Robotics and Computer-Integrated Manufacturing 2, n3-4 p227-236 1985.

Keywords: *Robots, *Laser tracking, Position(Location), Interferometers, Performance evaluation, Precision, Reprints.

The paper describes a robot end point position sensing laser tracking system currently under development at the National Bureau of Standards. Testing thus far indicates that the final system should be able to determine the position of the end effector of a robot to better than 1 part in 100,000 (i.e., .0002 inch to .0005 inch for a medium to large size robot) in X-, Y-, and Z-axes, and the pitch and yaw to within a few seconds of arc. The laser tracking system is simple enough that it would be economically feasible to exploit as an integral part of a robot, providing robot position independent of the robot members and joint encoders.

701,076
PB88-152905 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Incrementally Constructing a Spatial Representation Using a Moving Camera.
Final rept.,
T. H. Hong, and M. O. Shneider. 1985, 6p
Pub. in Proceedings of the IEEE (Institute of Electrical and Electronic Engineers) Computer Society Conference on Computer Vision and Pattern Recognition (1985), San Francisco, CA., June 19-23, 1985, p591-596.

Keywords: *Manipulators, Trajectories, *Robot vision, Spatial representation, Image reconstruction, Three dimensional motion, Octrees.

A method is described for using a sequence of views of a scene to construct a representation of the world in terms of space occupied by objects and space that is empty. The world is represented by an octree, and it is assumed that each view is taken from an arbitrary, but known, location. The spatial representation is part of the description of the world required for sensory-interactive control of a robot manipulator. It is useful for trajectory planning and provides a spatial index of the objects in the world.

701,077
PB88-152913 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Real-Time Cooperative Interaction between Structured-Light and Reflectance Ranging for Robot Guidance.
Final rept.,
E. W. Kent, T. E. Wheatley, and M. Nashman. 1985, 5p
Pub. in Robotica 3, pt1 p7-11 Jan-Mar 85.

Keywords: *Manipulators, Target acquisition, Range finding, Real time operations, Reprints, *Robot vision.

When applied to rapidly moving objects with complex trajectories, the information-rate limitation imposed by video-camera frame rates impairs the effectiveness of structured-light techniques in real-time robot servoing. To improve the performance of such systems, the use of fast infrared proximity detectors to augment visual guidance in the final phase of target acquisition was explored. It was found that the approach was limited by the necessity of employing a different range/intensity calibration curve for the proximity detectors for every object and for every angle of approach to complex objects. A technique was devised for cooperative interaction between modalities, in which the vision sense provided on-the-fly determination of calibration parameters for the proximity detectors, for every approach to a target, before passing control of the system to the other modality. The technique provided a three hundred percent increase in useful manipulator velocity, and improved performance during the transition of control from one modality to the other.

701,078
PB88-152921 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
Rotation and Translation of Objects Represented by Octrees.
Final rept.,
T. H. Hong, and M. O. Shneider. 1987, 6p
Pub. in Proceedings of the IEEE (Institute of Electrical and Electronic Engineers) International Conference on Robotics and Automation (1987), Raleigh, NC., March 31-April 3, 1987, v2 p947-952.

MANUFACTURING TECHNOLOGY

Robotics/Robots

Keywords: *Rotation, Algorithms, *Translational motion, Spatial representation, Octrees.

The paper describes an algorithm for performing arbitrary translations and rotations of objects represented by octrees. Given an octree in a standard position and a transformation, the algorithm builds a new tree in a top down fashion, visiting each node in the new tree only once, and constructing only those nodes that appear in the final tree. It works by projecting the transformed space over the original tree, and labeling the new nodes according to the labels of the nodes in the underlying untransformed tree.

701,079

PB88-152939 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Repeatability Measurements of a Vision Servoed Manipulator Using an Optoelectronic Remote 3D Tracking System.

Final rept.,

M. Juberts. 1985, 8p

Pub. in Proceedings of the IEEE (Institute of Electrical and Electronic Engineers) International Conference on Cybernetics and Society (1985), Tucson, AZ., November 12-15, 1985, p948-955.

Keywords: *Manipulators, Robots, Workplace layout, Real time operations, Position finding, Orientation, Reproducibility, Robotics, Light emitting diodes, Control systems, Three dimensional, Calibration.

The paper presents an application of a two camera optoelectronic three dimensional remote measuring system, developed by the National Bureau of Standards (NBS), for precisely measuring the position and orientation of a robots end-effector. The measurements were used to evaluate the repeatability performance of a vision served industrial manipulator whose task was to automatically insert a peg into a hole with .127 mm (.005 inch) clearance. Vision camera data is processed to find the position and orientation of the end-effector (peg) with respect to the hole, and control signals are sent to the robot controller to orient and position the peg at a selected distance above the hole. The remote measuring system was also used to measure the industrial manipulators repeatability. An NBS developed Real-Time Control System was used for robot control. A brief description of the opto electronic remote measurement system is given, along with the 3D calibration procedure for establishing a calibrated work volume.

701,080

PB88-153051 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Accurate Remote Measurement of Robot Trajectory Motion.

Final rept.,

A. Dainis, and M. Juberts. 1985, 8p

Sponsored by Office of Naval Research, Arlington, VA. Pub. in Proceedings of the IEEE (Institute of Electrical and Electronic Engineers) International Conference on Robotics and Automation (1985), St. Louis, MO., March 25-28, 1985, p92-99.

Keywords: *Robots, Workplace layouts, Position finding, Trajectories, Photodiodes, Measurement, Robotics, Three dimensional motion, Light emitting diodes, Calibration, Remote systems.

The paper discusses a two camera electronic remote measuring system, developed by the National Bureau of Standards, for accurately measuring robot trajectory motion and position in three dimensions. An approach being developed by NBS uses a remote measuring system to measure robot trajectory motion and position within a calibrated work volume and to compare these values against the robots programmed trajectories and positions. The measuring system precisely tracks, in three dimensions, the location of infrared emitting LEDs, attached to points on the robot. The system, which uses two tetra-lateral photodiode cameras, has a resolution of approximately 0.01 percent and absolute accuracy of 0.1 percent along each of the three dimensions of a work volume as measured on a coordinate positioning and measurement machine. Data collection rate is 3.3 KHz for one data point (LED) location measurement. Implementation and analysis procedures are also discussed.

701,081

PB88-153077 Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Describing a Robot's Workspace Using a Sequence of Views from a Moving Camera.

Final rept.,

T. H. Hong, and M. O. Shneider. 1985, 6p

Pub. in IEEE (Institute of Electrical and Electronic Engineers) Transactions on Pattern Analysis and Machine Intelligence PAMI-7, n6 p721-726 Nov 85.

Keywords: Workplace layout, Trajectories, Reprints, *Robotics, *Robot vision, Spatial representation, Three dimensional, Octrees.

A method is described of building and maintaining a spatial representation for the workspace of a robot, using a sensor that moves about in the world. From the known camera position at which an image is obtained and two-dimensional silhouettes of the objects in the image, a series of cones are projected to describe the possible positions of the objects in the space. When an object is seen from several viewpoints, the intersections of the cones constrain the position and size of the object. After several views have been processed, the object begins to resemble its true shape. At all times, the spatial representation contains the best guess of the true situation in the world, with uncertainties in position and shape explicitly represented. An octree is used as the data structure for the representation. It provides a relatively compact representation, and allows fast access to information. The purpose of constructing the representation is to describe the volumes in the workspace that are occupied, and those that are empty. This enables trajectory planning to be carried out, and also provides a means of spatially indexing objects.

701,082

PB88-153085 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

Fast, Three-Dimensional, Collision-Free Motion Planning.

Final rept.,

M. Herman. 1986, 8p

Pub. in Proceedings of the IEEE (Institute of Electrical and Electronic Engineers) International Conference on Robotics and Automation (1986), San Francisco, CA., April 7-10, 1986, p1056-1063.

Keywords: *Robots, Collision avoidance, Search theory, Algorithms, *Robotics, *Obstacle avoidance, Three dimensional motion, Octrees.

Issues dealing with fast, 3-D, collision-free motion planning are discussed, and a fast path planning system under development at NBS is described. The components of a general motion planner are outlined, and some of their computational aspects are discussed. It is argued that an octree representation of the obstacles in the world leads to fast path planning algorithms. The system they are developing uses such an octree representation. The robot and its swept-volume paths are approximated by primitive shapes so as to result in fast collision detection algorithms. The search for a path is performed in the octree space, and combines hypothesize and test, hill climbing, and A*.

701,083

PB88-153762 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.

National Bureau of Standards Programmers Guide for the Field Material-Handling Robot (FMR),

S. Szabo. Sep 87, 59p NBSIR-87/3624

Sponsored by Human Engineering Lab., Aberdeen Proving Ground, MD.

Keywords: *Robots, *Materials handling, *Material, Forklift vehicles, User manuals(Computer programs).

The document is a programmers guide for the NBS Real-Time Control System (RCS) used in the Field Material Handling Robot (FMR). The FMR is sponsored by the U.S. Army Human Engineering Laboratory. The RCS (version 2) is a high level, sensory interactive controller which enables the robot to perform automatically as a stationary fork lift. The Robot Sensor Language (RSL) provides the RCS a mechanism for sensor integration and task planning.

Tooling, Machinery, & Tools

701,084

PATENT-4 685 661 Not available NTIS
Department of Commerce, Washington, DC.

Method and Mechanism for Fixturing Objects.
Patent,

A. H. Slocum, and J. P. Peris. Filed 21 Jun 85, patented 11 Aug 87, 15p PB87-230652, PAT-APPL-6-747 486

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, Robots, *Vises, Pat-CI-269-20.

A programmably controllable vise has mechanisms for automatic adjustment of workpiece position relative to three orthogonal axes. The positions of the vise jaws (during clamping) establish workpiece position along a first axis, and stop members (e.g., piston actuated stops) selectively extendable from the jaws establish workpiece position along a second axis. Two levelling bars supported adjacent the jaws by respective servo-actuators (e.g., double-acting piston type actuators) which adjust the bars along the jaws establish workpiece position along the third axis, as well as workpiece tilt about the first and second axes. Because the adjustments may be made automatically, the vise may operate unattended, with workpieces being loaded and unloaded by a robot. The vise jaws preferably incorporate replaceable jaw elements which are constructed for attachment and removal by a robot and which may be machined to accommodate non-prismatic workpieces. One of the jaws may be fixed to a housing of the vise, with the other jaw being supported on a movable carriage driven by a feedback-controlled linear drive. An open side of the housing adjacent the jaws is protectively covered by a sheet metal band wrapped around the housing and having opposite ends respectively attached to the front and rear of the carriage. The band circulates around the housing with movement of the carriage, and the open side of the housing thus remains covered to avoid the entry of contaminants.

701,085

PATENT-4 707 013 Not available NTIS
Department of Commerce, Washington, DC.

Split Rail Parallel Gripper.

Patent,

J. M. Vranish, W. R. Bunch, and W. L. Johns. Filed 30 May 86, patented 17 Nov 87, 10p PB88-166848, PAT-APPL-6-868 485
Supersedes PB86-220316.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Patents, *Machine tools, Pneumatic servomechanisms, Holders, Clamps, PAT-CL-294-119.

A wide-throw parallel-action gripper of the split-rail design is disclosed. The gripper includes a pair of pre-loaded linear bearings which engage the outward surfaces of each rail and two roller bearings spaced on either side of a pinion, all mounted onto a pinion shaft, which engage the inward sides of each rail. A single finger is mounted at opposed ends of each rail and an actuator is connected either to one of the rails or to the central pinion. The actuators can include a pneumatic cylinder of electrical stepping motors or D.C. servo motors.

701,086

PB87-161097 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.

Drill-Up, an Alternative for On-Line Determination of End-Mill Wear.

Final rept.,

K. W. Yee, and L. Evans. 1985, 6p

Pub. in Proceedings of North American Manufacturing Research Conference (13th), Berkeley, CA, May 19-22, 1985, p304-309.

Keywords: *Tools, *Wear, *Milling(Machining), Cutting machines(Tools), Spindles.

The use of Drill-Up, an instrument for detecting tool wear by applying time-domain analysis to vibration signals sensed by an accelerometer coupled to the work-

piece, as an alternative to spindle power consumption and axis-feed force measurements for determining end-mill wear, has been investigated for three hardness levels of steel. The potential of Drill-Up as a wear-out sensor for end mills has been shown. Some significant reasons for choosing spindle-power consumption rather than feed force as an end-mill wear-out indicator have been identified. For any given application, Drill-Up or spindle cutting-power consumption measurements may be suitable for wear-out detection.

701,087

PB87-230918

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

Accurate Positional Servo for Use with Pneumatically Supported Masses and Vibrationally Isolated Tables.

Final rept.,

G. L. Greene. 1987, 3p

Pub. in Review of Scientific Instruments 58, n7 p1303-1305 Jul 87.

Keywords: *Pneumatic servomechanisms, *Vibration isolators, Positioning, Reprints, *Foreign technology.

A noncontacting electropneumatic servosystem for the positional control of vibrationally isolated tables is described. Employing a 'live zero', integrating servo, the system has been used to position an 'air spring' supported optical table to within a few microns and a few seconds of arc for a period of several months. If needed, the system can be extended to provide for control of all six degrees of freedom. The system provides an improvement in positional stability of between 2 and 3 orders of magnitude over typical commercial systems.

701,088

PB88-138938

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Automated Production Technology Div.

Alternatives for Sensing Tool Wear in Peripheral and Slot End-Milling.

Final rept.,

L. Evans, and K. W. Yee. 1985, 18p

Pub. in Tech. Pap. Soc. Manuf. Eng., MS85-1001, 18p 1985.

Keywords: *Tools, *Wear, *Milling machines, Steels, Monitors, Vibration, Reprints.

Cutting power, feed force, and Drill-Up, an instrument based on time-domain vibration analysis, are examined as three alternatives for sensing tool wear during peripheral and slot milling for heavy cuts in two steels of different hardnesses using 1/2-inch diameter high-speed steel end mills.

Tribology

701,089

PB87-218285

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Real-Time Evaluation of Wear Particles Using Electromagnetic Forced Rotation and Laser Scattering.

Final rept.,

T. Sato, O. Ikeda, T. Hatsuzawa, and M. Linzer.

1987, 12p

Pub. in Wear 115, n3 p273-284 1987.

Keywords: *Oils, *Metals, *Particles, *Wear, Particle size, Evaluation, Reprints, *Electromagnetic rotation, *Laser scattering.

A real-time method has been developed to measure the size, shape and number of metallic wear particles in oil.

701,090

PB87-224556

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Automated Production Technology Div.

Design to Limit Thermal Effects on Linear Motion Bearing Performance.

Final rept.,

A. H. Slocum. 1987, 7p

Pub. in Int. Jnl. Mach. Tools Manufact. 27, n2 p239-245 1987.

Keywords: *Roller bearings, Thermal stresses, Design standards, Reprints.

By tuning the geometry of a linear motion bearing to the metallurgical and geometric properties of a structure, the effects of temperature changes on bearing geometry and performance can be minimized. This is illustrated in the design of a recirculating-roller, linear motion bearing that was designed for use on a flexible automated fixturing system. The main structure of the fixturing system was made of aluminum and steel and powered by hydraulics. Due to temperature rise caused by the hydraulics, thermal growth effects on bearing preload had to be controlled in order to maintain accuracy of the system.

701,091

PB88-152251

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Descriptive Lubrication Model for Concentrated Contacts under Boundary Conditions.

Final rept.,

S. M. Hsu. 1985, 10p

Sponsored by Department of Energy, Washington, DC. Pub. in Proceedings of the Symposium on Energy Engineering Sciences (3rd): Thermofluids and Solid Mechanics, University Park, PA., October 8, 1985, p213-222.

Keywords: *Lubrication, Wear, Probability theory, Contacting, Models, Reprints.

The processes of lubrication are systematically analyzed and explained with the aid of recent experimental discoveries. Effective lubrication often involves surface chemical reactions which are dependent on contact geometry, load, speed, and environmental influences. Materials properties such as hardness, elasticity and others also affect the wear outcome. Fluid mechanics under the influence of interfacial pressures and temperatures also control a significant portion of the wearing processes. A conceptual model is proposed to link all these factors in a line of defense framework, and to discuss how wear can be predicted based on a probabilistic model.

General

701,092

PB87-209961

PC A17/MF A01

National Bureau of Standards, Gaithersburg, MD. Information Resources and Services Div.

Publications of the National Bureau of Standards, 1986 Catalog.

Rept. for Jan-Dec 86,

R. J. Pardee. Jun 87, 389p NBS/SP-305-SUPPL-18

See also PB87-145272. Also available from Supt. of Docs as SN003-003-02798-7.

Keywords: *Catalogs(Publications), *Bibliographies, Aeronautics, Astronomy, Astrophysics, Atmospheric, Electronics, Electrical engineering, Physics, Mechanical engineering, *National Bureau of Standards, US NBS.

The 18th Supplement to Special Publication 305 contains full bibliographic citations including keywords and abstracts for National Bureau of Standards (NBS) 1986 papers published and entered into the National Technical Information Service (NTIS) collection. (Also included are NBS papers published prior to 1986 but not reported in previous supplements of this annual catalog.) Four indexes are included to allow the user to identify NBS papers by personal author, keywords, title, and NTIS order/report number.

701,093

PB87-219101

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Slit Pulsed Valve for Generation of Long-Path-Length Supersonic Expansions.

Final rept.,

C. M. Lovejoy, and D. J. Nesbitt. 1987, 5p

Grant NSF-PHY86-04504

Sponsored by National Science Foundation, Washington, DC.

Pub. in Review of Scientific Instruments 58, n5 p807-811 May 87.

Keywords: *Values, Reprints, *Long path length absorption, *Pulsed valve, *Slit expansion.

The authors describe a valve for production of jet-cooled species in a pulsed, long-path-length (1.2-cm) supersonic expansion. The valve produces 150 600-microsec-duration pulses at repetition rates up to 60 Hz from a nozzle with variable slit width, and is suitable for use with corrosive gases and vapors.

701,094

PB87-230827

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Indicating Rupture Disk for Gas Cylinders.

Final rept.,

T. J. Bruno. 1987, 1p

Pub. in Jnl. of Chemical Education 64, n6 p557 Jun 87.

Keywords: *Gas cylinders, *Relief valves, Failure, Corrosion.

The failure of a frangible rupture disk (in the safety head of a gas cylinder), and resulting rapid venting of the contents of the cylinder, can be extremely destructive to laboratories and dangerous to personnel. The most common cause of spontaneous disk failure is the development of corrosion stresses in the disk itself. In this note, a device is suggested that will allow the tracking of corrosion in rupture disk, and may help to prevent their failure.

MATERIALS SCIENCES

Adhesives & Sealants

701,095

PB87-196895

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Effect of Volume Fraction of Dispersed Rubbery Phase on the Toughness of Rubber-Toughened Epoxy Polymers.

Final rept.,

A. J. Kinloch, and D. L. Hunston. 1987, 9p

Pub. in Jnl. of Materials Science Letters 6, p131-139 1987.

Keywords: *Adhesion, *Composite materials, Adhesives, Epoxy, Fracture, Morphology, Temperature dependence, Reprints.

Rubber-modified epoxy polymers are increasingly utilized in structural adhesives and composites because they combine high fracture energy with other important properties, such as good modulus and high temperature behavior. The properties of these materials depend on their two phase morphologies which consist of rubber particles dispersed in and bonded to an epoxy matrix. In this work the relationship between the morphologies of four model systems and their fracture behaviors was studied. Previous publications have suggested that the volume fraction of phase separated rubber determines the material's behavior. In the present study, however, it is shown that no unique relationship can exist between these two parameters because the fracture behavior depends on the temperature and loading rate. In addition, the particle size distribution is found to influence the fracture properties. More detailed work is needed therefore before quantitative relationships between morphology and performance can be established.

Carbon & Graphite

701,096

PB87-201380

PC A03/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

MATERIALS SCIENCES

Carbon & Graphite

Thermochemistry of Materials by Laser Vaporization Mass Spectrometry, Part 2 - Graphite.

Final rept.,
J. W. Hastie, D. W. Bonnell, and P. K. Schenck. Jun 87, 45p NBSIR-87/3561

Keywords: *Graphite, *High temperature, *Lasers, Thermochemistry.

In an earlier study (Part I of this series) an experimental approach which couples laser heating of refractory materials under vacuum with mass spectrometric detection of the vapor plume, for thermochemical determinations, of 2900 K was demonstrated using the BN refractory system at 2900 K. The paper describes the results of a similar study on graphite at temperatures around 4100 K and total species pressures in the vicinity of an atmosphere ($1 \text{ atm} = 1.01325 \times 10^5$ to the 5th power Nm⁻²). A Nd/YAG laser system, focused to power densities in the range of 10 to the 9th power - 10 to the 10th power W/sq. cm., was found to be a convenient energy source for producing controlled vapor plumes and with negligible post-vaporization perturbation of the neutral species identity and concentration. The principal vapor species were found to be Cn ($n = 1 - 9$) and their relative intensities were found to be more consistent with the JANAF Thermochemical Tables than more recent literature assessments and results.

Ceramics, Refractories, & Glass

701,097

PB87-15980 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Summary of Ellipsometric and Electrochemical Studies of the Delamination of Organic Coatings from Iron and Steel.

Final rept.,
R. Ritter. 1985, 8p
Pub. in Proceedings of a Conference on Technical Symposia - Corrosion 85, held at Boston, MA, March 25-29, 1985, p56.1-56.8 1985.

Keywords: *Coatings, *Delaminating, *Iron, *Steels, Corrosion resistance, Electrochemistry.

Ellipsometric and electrochemical techniques for the in situ study of the corrosion of coated iron and steel is described. The results of these studies, an interpretation of the data and the extension of the technique to the study of inhibited coatings systems are summarized. It is concluded that interfacial oxide dissolution constitutes an important mechanism of coating delamination.

701,098

PB87-162319 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Effect of Overaging on the Room Temperature Strength of Partially Stabilized Zirconia.

Final rept.,
L. J. Schioler, R. N. Katz, A.C. Gonzalez, and B. R. Lawn. 1985, 2p
Pub. in American Ceramic Society Bulletin 64, n2 p326-327 1985.

Keywords: *Zirconium oxides, Aging tests(Materials), Toughness, Ceramics, Heat treatment, Reprints.

Commercially available partially stabilized zirconias were tested in their as-received state and after heat treatment at 1000 degrees C for 100 and 500 hr. The strengths of specimens with and without controlled flaws showed marked variations with time-at-temperature. The changes in the strength are linked to the changes in the phase content due to heat treatment. It is concluded that in-service aging effects could jeopardize long-lifetime applications of these materials at intermediate temperatures.

701,099

PB87-163739 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Corrosion and Crack Growth in 33% Na2O-67% SiO2 and 33% Li2O-67% SiO2 Glasses.

Final rept.,
G. S. White, D. C. Greenspan, and S. W. Freiman. 1986, 7p
Contract N00014-79-F-0030
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Jnl. of the American Ceramic Society 69, n1 p38-44 1986.

Keywords: *Silica glass, *Crack propagation, *Corrosion, Spectroscopic analysis, Glass, Reprints.

Environmentally enhanced crack growth data in 33% Na2O-67% SiO2 and 33% Li2O-67% SiO2 have been correlated with corrosion data of the same glasses as determined by infrared reflection spectroscopy and atomic absorption spectroscopy. It was determined that, of the tested environments, those environments and only those environments which caused surface corrosion also enhanced crack growth. Crack growth curves were more complicated in these materials than in fused silica and water dominated regions occurred even in some environments which are known to enhance crack growth.

701,100

PB87-164166 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Nucleation and Growth of Cracks in Vitreous-Bonded Aluminum Oxide at Elevated Temperatures.

Final rept.,
K. Jakus, S. M. Wiederhorn, and B. J. Hockey. Oct 86, 7p
Sponsored by Department of Energy, Oak Ridge, TN. Fossil Energy Program.
Pub. in Jnl. of the American Ceramic Society 69, n10 p725-731 Oct 86.

Keywords: *Ceramics, *Aluminum oxide, *Crack propagation, Fractures(Materials), Creep rupture strength, Reprints.

The nucleation and growth of cracks was studied at elevated temperatures on a grade of vitreous-bonded aluminum oxide that contained approx. 8% vol glass at the grain boundaries. Cracks were observed to nucleate within the vitreous phase, close to the tensile surface of the flexural test specimens used in these experiments. Crack nucleation occurred at a strain of approx. 0.08% to 0.12% which corresponded to a crack nucleation time of approx. 35% of the time to failure by creep rupture. Once nucleated, cracks propagated along grain boundaries, as long as the stress for crack propagation was maintained.

701,101

PB87-191003 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Creep Rupture of Siliconized Silicon Carbide.

Final rept.,
S. M. Wiederhorn, L. Chuck, E. R. Fuller, and N. J. Tighe. 1986, 19p
Sponsored by Department of Energy, Oak Ridge, TN. Fossil Energy Program.
Pub. in Tailoring Multiphase and Composite Ceramics, p755-773 1986.

Keywords: *Silicon carbides, *Creep rupture strength, Fracture properties, Deformation, Reprints.

Creep and creep-rupture of siliconized silicon carbide were studied in flexure as a function of temperature and applied stress. Cavity formation during creep caused a significant reduction in the room temperature strength. By contrast, the strength at elevated temperatures did not decrease until extensive cavity linkage occurred at creep times that approached the creep-rupture life.

701,102

PB87-193595 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Inorganic Materials Div.

Estimation of Power-Law Creep Parameters from Bend Test Data.

Final rept.,
T. J. Chuang. 1986, 11p
Contract DE-AL05-800R206799
See also report dated Feb 85, PB85-183408. Sponsored by Department of Energy, Washington, DC., and Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Jnl. of Materials Science 21, p165-175 1986.

Keywords: *Ceramics, *Creep properties, Creep tests, Aluminium oxide, Applications of mathematics, Reprints.

Power-law creep parameters of brittle ceramic materials are commonly deduced from load-point displacement data generated by four-point bend experiments, under the assumption that tensile and compressive behaviors obey the same constitutive law. However, because of microcracking and cavitation, it is now well recognized that this premise may not always be valid. The paper presents an analysis which takes the differences into account.

701,103

PB87-197752 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Characterization of Active Sites at Chemically Modified Glass Surfaces.

Final rept.,
D. Cukman, J. Jednacak-Biscan, Z. Vekseli, and W. Haller. 1987, 5p
Pub. in Jnl. of Colloid and Interface Science 115, n2 p357-361 Feb 87.

Keywords: *Adsorption, *Glass, Silanization, Surfaces, Reprints.

Chemically modified surfaces of silica glass samples of controlled pore size (CPG) were studied by gas (argon, H2O) adsorption, and by adsorption of organic amino and hydroxyl functional compounds having ESR active nitroxide groups. Chemical modification of surfaces was achieved using triethoxy or trichloro alkyl, allyl, and phenyl silanes. The results allow the quantitative and qualitative estimation of the number of active sites on modified surfaces of CPG.

701,104

PB87-201554 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Toughness and Flaw Responses in Nontransforming Ceramics: Implications for NDE.

Final rept.,
B. R. Lawn, and C. J. Fairbanks. 1987, 10p
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6B p1023-1032 1987.

Keywords: *Ceramics, *Microstructure, *Toughness, Nondestructive tests, Fracture mechanics.

The relationship between toughness and microstructure of ceramics is described. A bridging mechanism was found responsible for rising T-curve behavior, and a model has been developed. The implications of this work to the NDE field are discussed.

701,105

PB87-201562 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Development of a Ceramic Phase Diagram and Thermodynamic Data Bank.

Final rept.,
J. W. Hastie, H. Ondik, and D. W. Bonnell. 1987, 11p
Pub. in Proceedings of the Int. Conference on User Applications of Alloy Phase Diagrams, Lake Buena Vista, FL, October 4-9, 1986, p1-11 1987.

Keywords: *Ceramics, *Phase diagrams, *Thermodynamics, *Data bases, Computer applications, US NBS.

Ceramic phase diagrams are indispensable summaries of multiphase, multicomponent materials thermochemistry. A large body of experimental data exists for ceramic phase equilibria but its utility is limited by the difficulty of accessing the data and by the lack of reliability assessments for the data. The paper describes recent progress at the National Bureau of Standards (NBS) towards development of a comprehensive, evaluated, computer-accessible data bank of ceramic phase diagram information—bibliographic, graphic, and thermodynamic. Examples of applications of the partially complete data bank are also given.

701,106

PB87-201570 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Transient Behavior of Structural Ceramics under Flexural Creep.

Final rept.,
T. J. Chuang, S. M. Wiederhorn, and C. F. Chen.
1987, 17p

Contract DE-AI05-85OR21569

Sponsored by Department of Energy, Oak Ridge, TN. Pub. in Proceedings of the Int. Conference on Creep and Fracture of Engineering Materials and Structures (3rd), Swansea, UK, April 5-10, 1987, p957-973 1987.

Keywords: *Ceramics, *Creep properties, Silicon carbides, Transient response, Stresses, Strains.

The transient creep of a ceramic bend bar under constant load is analyzed using a scheme developed earlier by Cohrt et al. The methodology assumes that the beam is formed by an infinite number of parallel fibers, each modelled as a Maxwell fluid consisting of an elastic spring and a dashpot connected in series. The numerical solution produces a time history of stress along the beam depth, ranging from a linear (elastic) distribution at initial loading to a nonlinear distribution at steady state. Also available from the solutions are the transient periods and the time-dependent migration of the neutral planes in stress and strain, the latter being measurable and thus experimentally verifiable. Qualitative agreement is obtained when the analysis is compared to a set of experimental data on siliconized silicon carbide.

701,107

PB87-203899

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Effect of Surface Tension on the Toughness of Glass.

Final rept.,

T. J. Chuang. 1987, 5p

Pub. in Jnl. of the American Ceramic Society 70, n3 p160-164 Mar 87.

Keywords: *Glass, *Interfacial tension, Cracks, Toughness, Silica glass, Mechanical properties, Reprints, Surface tension.

Mechanical stresses (i.e., surface tension) inherently exist on a general free surface because its atomic structure differs from its bulk counterpart. The effect of surface tension is amplified at a crack tip because of curvature enhancement. An integral equation describing this effect on the toughness of glass is derived and first-order approximations using a weight function technique were made. The qualitative results indicate that the geometry-induced toughening is linearly proportional to surface tension and crack tip curvature and to the square root of crack tip zone size. An illustrative example of a recently observed crack tip in SiO₂ glass is given which shows that toughness is enhanced by approximately 3 times the intrinsic K_{1c} value.

701,108

PB87-203907

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Crack-Interface Grain Bridging as a Fracture Resistance Mechanism in Ceramics: 2. Theoretical Fracture Mechanics Model.

Final rept.,

Y. W. Mai, and B. R. Lawn. 1987, 6p

See also PB87-203915. Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Jnl. of the American Ceramic Society 70, n4 p289-294 Apr 87.

Keywords: *Ceramics, *Aluminum oxide, Toughness, Cracking(Fracturing), Models, Bridging, Reprints.

A fracture mechanics models is developed for non-transforming ceramics that show an increasing toughness with crack extension (R-curve, or T-curve, behavior). The model derives from the observations in Part I, treating the increased crack resistance as the cumulative effect of grain bridging restraints operating behind the advancing tip. An element of discreteness is incorporated into the formal distribution function for the crack-plane restraining stresses, to account for the primary discontinuities in the observed crack growth. A trial force-separation function for the local bridge microcrack process is adopted, such that an expression for the microstructure-associated crack driving (or rather, crack closing) force may be obtained in analytical form. The description can be made to fit the main trends in the measured toughness curve for a coarse-grained alumina.

701,109

PB87-203915

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Crack-Interface Grain Bridging as a Fracture Resistance Mechanism in Ceramics: 1. Experimental Study on Alumina.

Final rept.,

P. L. Swanson, C. J. Fairbanks, B. R. Lawn, Y. W. Mai, and B. J. Hockey. 1987, 11p

See also PB87-203907. Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Jnl. of the American Ceramic Society 70, n4 p279-289 Apr 87.

Keywords: *Aluminum oxide, *Ceramics, Bridging, Toughness, Reprints, Interfacial energy.

Direct microscopic evidence is presented in support of an explanation of R-curve behavior in monophase ceramics by grain-localized bridging across the newly formed crack interface. In situ observations are made of crack growth in tapered cantilever beam and indented flexure specimens of a coarse-grained alumina. The fractures are observed to be highly stable, typical of a material with a strongly increasing resistance characteristic, but are discontinuous at the microstructural level. Associated with this discontinuity is the appearance of overlapping segments in the surface fracture trace around bridging grains; the mean spacing of such 'activity sites' along the trace is about 2 to 5 grain diameters. These segments link up with the primary crack beneath the specimen surface, and continue to evolve toward rupture of the bridge as fracture proceeds.

701,110

PB87-224226

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Microstructural Effects on Grinding of Alumina and Glass-Ceramics.

Final rept.,

D. B. Marshall, B. R. Lawn, and R. F. Cook. Jun 87, 2p

Sponsored by Army Research Office, Research Triangle Park, NC.

Pub. in Jnl. of the American Ceramic Society 70, No. 6 pC-139 - C-140 Jun 87.

Keywords: *Devitrified glass, *Aluminum oxide, Grinding(Comminution), Machinability, Cracks, Reprints.

Grinding forces were measured in aluminas and glass-ceramics with various microstructures. The microstructures were found to exert a profound influence on the machinability. In particular, the controlling toughness variable is that which pertains to small cracks, not that conventionally measured in a large-scale fracture specimen.

701,111

PB87-225447

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.

Development of a Test Method to Evaluate the Penetration Resistance of High-Security Glazing Subjected to Mechanical Impact and Heat.

Final rept.,

L. I. Knab, S. Fischler, J. R. Clifton, and N. E. Waters. Nov 86, 44p

Pub. in NII Report 300-85, p1-44 Nov 86.

Keywords: *Glazing, Penetration, Impact, Heat, Tests, Glass, Laminated glass, Polycarbonates, Reprints, High security glazing.

The report describes the development of a laboratory test method for transparent, high-security glazing. The test method was developed to evaluate the penetration resistance of glazing materials subjected to a simultaneous attack of mechanical impact with a sharp-nosed tool and heat application. The rationale for the determination of the test parameters and realistic parameter levels is given. Glazing panels, measuring 12 X 12 in, are simultaneously subjected to repeated impacts by a pendulum with a chisel-nosed impactor and a continuous diffusion (yellow) flame delivered by propane gas torches until the chisel nose penetrates the panel. Test results indicated a wide range in the number of impacts (1 to 116) required to penetrate the glazing. Increases in polycarbonate thickness resulted in increases in the number of impacts required for penetration. It was concluded that (a) the test method can

be used to evaluate the penetration resistance of glazing materials when they are subjected to the specified test conditions, and (b) the test results can be used to rank the penetration resistance of the glazing materials, provided the variability of the test results is incorporated in the ranking.

701,112

PB87-230884

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Microstructure and the Strength of Ceramics.

Final rept.,

C. J. Fairbanks, B. R. Lawn, R. F. Cook, and Y. W. Mai. 1986, 15p

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Fracture Mechanics of Ceramics, v8 p23-37 1986.

Keywords: *Ceramics, *Fracture properties, Microstructure, Cracks, Fatigue(Materials), Reprints, *Foreign technology.

Microstructural influences on ceramic strength become significant at small flaw sizes. These influences are readily quantified by strength testing with controlled indentation flaws. Data are presented here for alumina and glass-ceramic specimens broken under both inert and fatigue conditions. As the flaw size is systematically reduced there is a tendency to a reduction in strength relative to that predicted from macroscopic toughness measurements, reflecting R-curve behavior. This tendency is critically dependent on the microstructural detail, e.g. presence of glassy phases at the grain boundaries in the aluminas. However, the fatigue susceptibility is found to be relatively insensitive to the microstructural influence over the same flaw-size range. A fracture mechanics framework for incorporating a 'microstructural stress intensity factor' is outlined.

701,113

PB87-233664

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Effect of a Liquid Phase on the Morphology of Grain Growth in Alumina.

Final rept.,

W. A. Kaysser, M. Sprissler, C. A. Handwerker, and J. E. Blendell. May 87, 5p

Pub. in Jnl. of the American Ceramic Society 70, n5 p339-343 May 87.

Keywords: *Aluminum oxides, Sintering, Grain refinement, Reprints, *Foreign technology.

In the investigation the authors have studied how the presence of a liquid phase affects the grain morphology and grain growth kinetics in Al₂O₃ at 1800 deg C using the growth of both matrix grains and large spherical single-crystal seeds growing into the matrix. The growth rates of the matrix grains were found to decrease in the following order: undoped Al₂O₃, Al₂O₃ with anorthite, Al₂O₃ with anorthite and MgO, and Al₂O₃ with MgO. Except for the samples doped with MgO alone, the matrix grains were faceted and appeared tabular in polished sections. In samples containing anorthite both with and without MgO, the single-crystal seeds exhibit basal facets with continuous liquid films and slow growth in the (0001) relative to all other crystallographic directions. When only MgO is added, the growth of the single-crystal seeds was not isotropic; however, no faceting was observed. The authors discuss how anisotropic growth rates caused by the anorthite additions can stimulate discontinuous grain growth in Al₂O₃.

701,114

PB88-111166

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Examination of Thin Films in the ZrO₂-SiO₂ System by Transmission Electron Microscopy and X-ray Diffraction Techniques.

Final rept.,

E. N. Farabaugh, A. Feldman, J. Sun, and Y. N. Sun. 1987, 4p

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Jnl. of Vacuum Science and Technology A 5, n4 p1671-1674 Jul/Aug 87.

MATERIALS SCIENCES

Ceramics, Refractories, & Glass

Keywords: *Zirconium oxides, *Silicon dioxide, X ray diffraction, Surface roughness, Thin films, Microstructure, Reprints, Transmission electron microscopy.

The microstructure of thin films of ZrO_2 and ZrO_2-SiO_2 formed by electron-beam coevaporation have been examined by x-ray diffraction and transmission electron microscopy. Results of these examinations suggest that films composed of 100% ZrO_2 grow by the formation of tapered polycrystalline columns. Near the substrate the columns are of small diameter and contain a single crystalline phase, but at increasing distances from the substrate the column diameters increase and material with two crystalline phases occurs. Small additions of SiO_2 to the film composition result in a smaller column diameter at a given distance from the substrate. Films with greater than 30% SiO_2 by volume, which earlier had been shown to display an amorphous x-ray diffraction pattern, have been shown to display an amorphous electron diffraction pattern as well. The surfaces of the amorphous films are nearly featureless and are significantly smoother than the surfaces of 100% ZrO_2 films.

701,115
PB88-121066 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Metastable Retention of a High-Pressure Phase of Zirconia.
Final rept.,
J. A. H. da Jornada, G. J. Piermarini, and S. Block. 1987, 3p
Pub. in Jnl. of the American Ceramic Society 70, n9 p628-630 1987.

Keywords: *Zirconium oxides, Metastable state, Nucleation, Reprints, Phase studies, High pressure.

A high-pressure phase of zirconia, stable above 3.3 GPa at room temperature, can be retained metastably, at ambient room conditions of pressure and temperature by appropriate thermal/pressure treatments. The amount of high-pressure phase retained depends on the thermal treatment, hydrostatic environment, and particle size of the starting powder. The results support the idea that the high-pressure transformation in zirconia is initiated at nucleation centers whose population can be minimized by appropriate thermal treatments. The results also point out the importance of high pressure as a source of controllable driving force to induce the transformation in zirconia, thus permitting the use of annealing treatments to change the population of defects involved in nucleating the transition.

701,116
PB88-141098 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Role of Surface Forces in Fracture.
Final rept.,
D. R. Clarke, B. R. Lawn, and D. H. Roach. 1986, 10p
Pub. in Proceedings of the International Symposium on Fracture Mechanics of Ceramics (4th), Blacksburg, VA., June 19-21, 1985, v8 p341-350 1986.

Keywords: *Ceramics, *Fractures(Materials), Cracking(Fracturing), Surfaces, Force, Crack propagation, Stresses, Reprints.

The role of surface forces in fracture is considered by specifically including the contribution of the surface forces acting between the walls of the crack in the overall force balance on a crack and then evaluating the net driving force. It is shown that attractive surface forces will lead to a threshold stress intensity below which a crack will heal. In addition, as surface forces modify the overall crack driving force they will affect the kinetics of slow crack growth. Of fundamental significance is that crack growth may provide an alternative experimental method for measuring surface forces.

701,117
PB88-141114 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Fracture Mechanisms in Lead Zirconate Titanate Ceramics.
Final rept.,
S. W. Freiman, L. Chuck, J. J. Mecholsky, D. L. Shellenman, and L. J. Storz. 1986, 11p
Pub. in Proceedings of the International Symposium on Fracture Mechanics of Ceramics (4th), Blacksburg, VA., June 19-21, 1985, p175-185 1986.

Keywords: *Fracture strength, Ferroelectric crystals, Microstructure, *Lead titanate zirconates, *Lead zirconate titanates.

Lead Zirconate Titanate (PZT) ceramics can be formed over a wide range of $PbTiO_3/PbZrO_3$ ratios and exist in a number of crystal structures. The study involved the use of various fracture mechanics techniques to determine critical fracture toughness, K_{IC} as a function of composition, microstructure, temperature, and electrical and thermal history. The results of these experiments indicate that variations in K_{IC} are related to phase transformations in the material as well as to other toughening mechanisms such as twinning and microcracking. In addition, the strength and fracture toughness of selected PZT ceramics were determined using specimens in which a crack was introduced by a Vicker's hardness indenter.

701,118
PB88-147632 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Effect of Microstructure on Reliability Predictions for Glass-Ceramics.
Final rept.,
R. F. Cook, S. W. Freiman, and T. L. Baker. 1986, 14p
Sponsored by Sandia National Labs., Albuquerque, NM.
Pub. in Materials Science and Engineering 77, p199-212 Jan 86.

Keywords: *Devitrified glass, Microstructure, Reliability, Indentation, Fracture properties, Crack propagation, Grain size, Reprints.

A study is made of the fracture properties of a range of three lithia-silica glass-ceramics with different grain sizes. Both equilibrium and kinetic crack-propagation parameters are evaluated using the controlled flaw indentation technique with a view to making reliability predictions. Fracture toughness in the well-behaved, large contact flaw range is found to increase with increasing grain-size. The results suggest that caution must be exercised when reliability predictions are made for materials showing the effects of crack/microstructure interaction, especially in extrapolations to low contact loads.

701,119
PB88-147640 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
High Temperature Mechanical Properties SiAlON Ceramic: Creep Characterization.
Final rept.,
C. F. Chen, and T. J. Chuang. 1987, 9p
Pub. in Ceramic Engineering and Science Proceedings 8, n7-8 p796-804 Jul/Aug 87.

Keywords: *Ceramics, *Mechanical properties, High temperature tests, Creep strength, Tension, Reprints, Sialon.

Creep resistance of an annealed Beta sub 10-7G SiAlON at 1170 deg C was characterized as a function of applied stress. By using a statistical least-square method to minimize the differences between predicted and measured creep rates, different power law creep parameters for simple tension and simple compression were obtained. The agreements between measured migration of neutral axes and theoretical predictions further confirm the estimated values.

701,120
PB88-152244 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Applications of Multiple Small Angle Neutron Scattering to Studies of Ceramic Processing.
Final rept.,
K. A. Hardman-Rhyne, K. G. Frase, and N. F. Berk. 1986, 3p
Pub. in Physica B and C 136, n1-3 p223-225 Jan/Feb 86.

Keywords: *Sintering, *Ceramics, *Processing, Neutron scattering, Porosity, Reprints.

The sintering process for ceramic materials including unfired compacted powder samples ('green' state ceramics) with 50% porosity can be studied non-destructively by small angle neutron scattering techniques. These volume fractions and pore sizes (~1.0 micrometer) are much larger than can be seen with traditional

single particle diffraction techniques in small angle scattering. The authors have employed multiple scattering methods to elucidate microstructural information including pore size, size distribution, porosity, and surface areas.

701,121
PB88-152269 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Laser Induced Vaporization Mass Spectrometry of Refractories.
Final rept.,
D. W. Bonnell, P. K. Schenck, and J. W. Hastie. 1986, 2p
Pub. in AIP (American Institute of Physics) Conference Proceedings, n146 p728-729 1986.

Keywords: *Refractory materials, *Mass spectroscopy, Boron nitrides, Graphite, Vaporizing, Molecular beams, Temperature measurement, Reprints, *Laser heating, High temperature.

Many of the measurement problems inherent in the study of refractory materials at very high temperatures can be overcome with the use of lasers as heat sources. The paper reports the development of a Laser Induced Vaporization (LIV) system with very high speed pumping in the vaporization region, coupled to a mass spectrometer by multiple differential pumping regions to minimize sampling artifacts. The system can mass analyze the molecular beam which result from vaporization caused by laser energy absorption in refractory substrates. The technique is demonstrated here for the BN and graphite systems. Results include species identification for boron- and carbon-containing molecules, evidence for local thermodynamic equilibrium in the vaporization process and a comprehensive analysis of system temperatures.

701,122
PB88-152277 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Predictive Thermodynamic Model of Oxide and Halide Glass Phase-Equilibria.
Final rept.,
J. W. Hastie, and D. W. Bonnell. 1986, 8p
Pub. in Jnl. of Non-Crystalline Solids 84, n1-3 p151-158 1986.

Keywords: *Glass, Thermodynamics, Vapor pressure, Lithium oxides, Sodium oxides, Potassium oxides, Calcium oxides, Magnesium oxides, Aluminum oxide, Iron oxides, Silicon dioxide, Fused salts, Sodium bromide, Potassium bromide, Reprints, Molten salts, Lead bromides.

Basic information on the processing and performance of silicate, borate, and halide glass systems is relatively sparse, owing to the adverse experimental conditions of high temperature, chemical reactivity, and complex multiphase interactions. A thermodynamic model is described for the prediction of phase equilibria and vapor pressures for a wide variety of glass systems. Systems tested to date include mixtures of Li_2O , Na_2O , K_2O , CaO , MgO , Al_2O_3 , Fe_2O_3 , and SiO_2 , in addition to molten salts. The model is based on the formation of actual, or hypothetical chemical complexes in the liquid and solid phases. As such, it is similar, though not identical, to the associate liquid model used successfully for alloys. The model and its thermodynamic data base have been validated by comparison with experimental activity data for well-characterized solid and liquid glass systems.

701,123
PB88-152285 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Ultrasonic Evaluation of Spray-Dried Ceramic Powders during Compaction.
Final rept.,
M. P. Jones, and G. V. Blessing. 1987, 9p
Pub. in Nondestructive Characterization of Materials 2, p139-147 1987.

Keywords: *Ceramics, *Powder(Particles), Nondestructive tests, Compacting, Ultrasonic tests, Reprints.

A new technique has been developed that enables ultrasonic wave speed measurements (shear and longitudinal) to be made on spray-dried ceramic powders while they are being compacted into shape. Ultrasonic velocity data is used together with independent density

measurements to calculate the shear, bulk, and Young's moduli, and Poisson's ratio of the powders during their compaction. The goal of the study is to gauge the quality of the powder by its elasticity as measured during compaction. Spray-dried ceramic powders contain polymers that allow ceramic particles to flow more evenly during compaction than those without the polymers. The extent to which the polymer affects particle-particle contact will be studied.

701,124
PB88-152301 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.

Simulation of Microstructure Development during the Hydration of a Cement Compound.

Final rept.,
H. M. Jennings, and S. K. Johnson. 1986, 6p
Pub. in Jnl. of the American Ceramic Society 69, n11
p790-795 Nov 86.

Keywords: *Ceramics, *Calcium silicates, *Hydration, Cements, Microstructure, Computerized simulation, Reprints.

A mathematical model which simulates the development of microstructure during the hydration of tricalcium silicate (C3S) is described. It is part of a program to develop a model which will quantitatively connect variables associated with different observable characteristics in cement-based systems, from the time of mixing onwards. It might also serve as a prototype for other materials which are formed through reaction bonding of powder compacts, including fired ceramics, chemically bonded ceramics, and products of powder metallurgy.

701,125
PB88-152319 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.

Aqueous Solubility Relationships for Two Types of Calcium Silicate Hydrate.

Final rept.,
H. Jennings. 1986, 5p
Pub. in Jnl. of the American Ceramic Society 69, n8
p614-618 Aug 86.

Keywords: *Calcium silicates, *Hydration, Ceramics, Lime cements, Equilibrium, Phase diagrams, Reprints.

There are many published values for the concentrations of lime and silica in the aqueous phase which is in contact with calcium silicate hydrate. These have been collected, carefully analysed, and found often to be apparently inconsistent. When, however, they are interpreted as having come from an aqueous phase which is in near equilibrium with one or another of two possible modifications of calcium silicate hydrate, almost all the data are rationalized. Some important insights emerge for the understanding of the complex processes which occur during the hydration of tricalcium silicate.

701,126
PB88-157706 PC A05/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Institute for Materials Science and Engineering, Ceramics: Technical Activities 1987.

Nov 87, 86p NBSIR-87/3612
See also report for 1985, PB86-196771.

Keywords: *Ceramics, Physical properties, Performance, Glass, Chemistry, Processing, Stability, Superconductivity, Optical materials, Mechanical properties, Powder(Particles), Tribology.

Current programs of the Ceramics Division are reviewed. Among the significant accomplishments by the Division in 1987 are: The phase diagram for the superconducting YBaCuO system was determined and published. A diamond film deposition apparatus was constructed and successful deposition of diamond films demonstrated. A theoretical model of the role of surface forces in subcritical crack growth was developed. A time-resolved micro-Raman test system to analyze reactions at tribological contacts was developed. The interrelationships between processing, microstructure, and properties of superconducting YBaCuO were determined. A novel technique for measurement of sintering stress in ceramics was invented. Low temperature 'sintering' through the application of high pressure was demonstrated, with the potential for enhanced toughness through pressure induced phase transformation. As part of the Interna-

tional Energy Agency (IEA) international powder characterization round-robin, 2000 silicon nitride reference powder samples were prepared, certified and distributed. Standard Reference Material 6406, silicon powder, was certified for calibration of x-ray line positions in x-ray powder diffraction. Techniques to predict the effect of filaments on crack growth retardation in ceramic matrix components were developed. The first data on the fracture behavior of superconducting ceramics as a function of sintering and annealing conditions were obtained. Volume 6 of Phase Diagrams for Ceramics was completed.

Coatings, Colorants, & Finishes

701,127
PB87-151528 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.

Laboratory Scale Electrodeposition.

Final rept.,
T. J. Bruno. 1986, 4p
Sponsored by Gas Research Inst., Chicago, IL., and Department of Energy, Washington, DC.
Pub. in Jnl. of Chemical Education 63, n10 p883-886 Oct 86.

Keywords: *Electrodeposition, Pilot plants, Electroplating, Reprints.

In the paper, some of the practical aspects of electrodeposition or electroplating are discussed. Special emphasis is given to the techniques required to make electrodeposition work reliably in the laboratory. The author will then discuss some of the problem-solving applications that have been of value in the author's laboratory.

701,128
PB87-224218 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Measurement of Residual Stresses in Coatings on Brittle Substrates by Indentation Fracture.

Final rept.,
M. F. Gruninger, B. R. Lawn, E. N. Farabaugh, and J. B. Wachtman. May 87, 5p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Jnl. of the American Ceramic Society 70, n5
p344-348 May 87.

Keywords: *Coatings, *Cracking(Fracturing), Indentation, Substrates, Reprints.

A method for evaluating stresses in coatings on brittle substrates by indentation is described. The basis for evaluation is a fracture mechanics model of the radial crack system in the Vickers geometry, incorporating the effects of a thin surface stress layer. Experiments on coated glass substrates are used to demonstrate the methodology. The crack sizes on these coated specimens are found to be considerably smaller than those on uncoated controls, indicating substantial (about 50 MPa) in-plane stresses. Substrate tensile stresses, as reflected in the crack expansions observed after applying the coatings to already indented surfaces, are found to make an unexpectedly large contribution to the fracture susceptibility. The procedure offers a simple means for quantifying the mechanical integrity of coating configurations for ceramic components.

701,129
PB88-141304 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Microindentation Hardness Testing of Coatings: Techniques and Interpretation of Data.

Final rept.,
P. J. Blau. 1986, 21p
See also PB86-132644.
Pub. in AIP (American Institute of Physics) Conference Proceedings Phys. Chem. Prot. Coat. 149, p1-21 1986.

Keywords: *Coatings, *Hardness tests, Thin films, Indentation, Mechanical properties, Penetration tests, Reprints.

The paper addresses the problems and promises of microindentation testing of thin solid films. It has discussed basic penetration hardness testing philosophy,

the peculiarities of low load-shallow penetration tests of uncoated metals, and it has compared coated with uncoated behavior so that some of the unique responses of coatings can be distinguished from typical hardness versus load behavior. As the uses of thin solid coatings with technological interest continue to proliferate, microindentation testing methodology will increasingly be challenged to provide useful tools for their characterization. The understanding of microindentation response must go hand-in-hand with machine design so that the capability of measurement precision does not outstrip the ability to interpret test results in a meaningful way.

Composite Materials

701,130
PB87-150801 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Cure Monitoring for Polymer Matrix Composites.

Final rept.,
B. Fanconi, F. Wang, D. Hunston, and F. Mopsik. 1986, 17p
Pub. in Materials Characterization for Systems Performance and Reliability, p275-291 1986.

Keywords: *Curing, Reprints, *Polymer matrix composites, Process monitoring.

Polymer matrix composites are desirable materials owing to their high specific strength and modulus and corrosion resistance. Wider application of these materials is limited by product variability and the labor intensive, time consuming manufacturing processes. The development of suitable means of process monitoring and control is the key to improved processing. A central thrust of the polymer matrix composites program at the National Bureau of Standards is cure monitoring for the purpose of process control. Four techniques have been explored, or are currently under development for cure monitoring. Fourier transform infrared spectroscopy has been used to follow the extent of chemical reactions forming the three dimensional network. Molecular mobility and ionic transport has been measured by dielectric spectroscopy. The mechanical properties of a curing matrix resin has been monitored using an ultrasonics method, and the microviscosity of a resin has been examined by an optical waveguide-fluorescence microprobe technique. Results of measurements conducted by these techniques are presented and their potential is explored.

701,131
PB87-182937 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Effective Elastic Properties of Materials with Inclusions.

Final rept.,
H. M. Ledbetter, and S. K. Datta. 1986, 16p
Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in Proceedings Rheology of Anisotropic Materials, Paris, France, November 28-30, 1984, p291-306 1986.

Keywords: *Elastic properties, *Composite materials, Anisotropy, Inclusions, Poisson ratio, Modulus of elasticity, Approximation, Aluminum alloys.

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. As a particular example, the authors consider an SiC-particle-reinforced aluminum-alloy composite. They give results also for a porous rock, where the authors consider both prolate-spheroid and oblate-spheroid voids. For SiC/Al the authors first consider the homogeneous-particle-distribution case where SiC particles represented as prolate spheroids (aspect ratio-3) are oriented randomly.

701,132
PB87-200309 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

MATERIALS SCIENCES

Composite Materials

Process Monitoring of Polymer Matrix Composites Using Fluorescence Probes.

Final rept.,
B. Fanconi, F. Wang, and R. Lowry. 1987, 9p
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v6B p1287-1295 1987.

Keywords: *Polymers, *Composite materials, Viscosity, Fluorescence, Spectroscopy, Reprints.

A fluorescence technique has been developed to monitor the viscosity of polymer resins. The technique has application to cure monitoring of polymer matrix composites. Optic fibers are used to bring the excitation light into the polymer, or composite specimen, as well as to collect fluorescence light for detection.

701,133
PB87-201547 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Microstructures of SiC and Si₃N₄ with Fibrous Inclusions.

Final rept.,
N. J. Tighe, J. Sun, and R. M. Hu. 1986, 2p
Sponsored by Department of Energy, Oak Ridge, TN., and United Nations Industrial Development Organization, Vienna (Austria).
Pub. in Proceedings of the Annual Meeting of the Electron Microscopy Society of America (44th), Albuquerque, NM, April 4-6, 1986, p492-493 1986.

Keywords: *Ceramic composites, Silicon nitrides, Silicon carbides, Boron nitrides, Microstructure, Silicon nitride matrix composites, Silicon carbide matrix composites, Boron nitride matrix composites.

The paper describes morphology, structure, and chemistry of a silicon nitride/boron nitride composite, and a silicon carbide/carbon composite ceramic.

701,134
PB87-208310 PC A03/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Structural Reliability and Damage Tolerance of Ceramic Composites for High-Temperature Applications.

E. R. Fuller, T. W. Coyle, R. F. Krause, and T. J. Chuang. Jun 87, 31p NBSIR-87/3564
Sponsored by Department of Energy, Oak Ridge, TN. Advanced Research and Technology Fossil Energy Materials Program.

Keywords: *Ceramic composites, *Ceramics, Silicon carbides, Whisker composites, Heat recovery, *Heat engines.

The achievement of higher efficiency heat engines and heat recovery systems requires the availability of high temperature, high performance structural materials. Structural ceramics, and more recently, ceramic matrix composites have received particular attention for these applications due to their high strength, and corrosion and thermal shock resistance. Even with these positive attributes, improved reliability and extended lifetime under service conditions are necessary for structural ceramics to gain industrial acceptance. The problems with these materials are mechanical and chemical in nature and are enhanced by the fact that they are subjected to high temperatures, reactive environments and extreme thermal gradients. With an objective of improved performance for heat engine/heat recovery applications, the NBS program on structural ceramics and ceramic composites addresses these problems through the determination of the critical factors which influence mechanical and microstructural behavior. The activities of the program are grouped under two major subtasks, each designed to develop key data, associated test methods and companion predictive models. The status of the subtasks are detailed in the following sections.

701,135
PB87-231999 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Matrix Resin Effects in Composite Delamination: Mode I Fracture Aspects.

Final rept.,
D. L. Hunston, R. J. Moulton, N. J. Johnston, and W. D. Bascom. 1987, 21p
Sponsored by National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
Pub. in ASTM (American Society for Testing and Materials) Special Technical Publication 937, p74-94 1987.

Keywords: *Polymers, *Composite materials, Polycarbonate resins, Polyamide resins, Delaminating, Thermoplastic resins, Fracture properties, Reprints, *Foreign technology.

A variety of thermoset, toughened-thermoset, and thermoplastic polymers were characterized for Mode I critical strain energy release rates, and their composites were tested for interlaminar strain energy release rates using the double-cantilever beam specimen. A clear correlation between the data from the two types of experiments was found. With brittle polymers, the composite strain energy release rates varied from slightly greater than to three times greater than the resin values. Although the resin toughness may represent the lower limit for the composite, the increased strain release rate value usually found in the composite was attributed to the fiber breakage and pullout that generally accompany composite crack growth.

701,136
PB88-122189 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Ductility Improvement in Particle-Reinforced Aluminum Composites: A Ductile-Fracture Model Based on Void Nucleation and Growth.

Final rept.,
I. H. Lin. 1987, 4p
Pub. in Proceedings of the International Conference on Mechanical Behaviour of Materials (5th), Beijing, China, June 3-6, 1987, p1261-1264.

Keywords: *Aluminum, *Ductility, *Composite materials, Failure, Mathematical models, Tension tests, Strain, Fracture properties.

The authors studied theoretically the effect of SiC particles on the ductility of SiC/A1 composites. The authors developed a failure model with the assumptions that voids nucleate at the particle-matrix interface and grow to a critical size at fracture. One adjustable parameter, the critical void size, was fit to results of uniaxial tensile tests. The model predicts quantitatively the tensile strain at fracture as a function of the SiC volume fraction.

701,137
PB88-122197 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Elastic-Wave Surfaces in Anisotropic Media.

Final rept.,
R. D. Kriz, and H. M. Ledbetter. 1986, 13p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Proceedings of Annual Colloquium on Rheology of Anisotropic Materials, Paris, France, November 28-30, 1984, p79-91 1986.

Keywords: *Fiber composites, *Reinforcing materials, Acoustics, Surfaces, Sound transmission, Reprints.

Based on Christoffel-equation solutions, some interesting wave-surface topological features are described for anisotropic media. These features include crossovers of transverse-longitudinal surfaces and continuous transverse-longitudinal mode conversion over a single surface. For orthorhombic symmetry (mmm), crossovers of transverse-transverse surfaces occur for all known cases: the transverse surfaces interconnect and form a single surface. Beyond this, some orthorhombic crystals exhibit a longitudinal-transverse crossover that causes all three surfaces to interconnect into a single surface. The authors consider several real cases, including wood and reinforced composites.

701,138
PB88-122205 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Elastic Representation Surfaces of Unidirectional Graphite-Magnesium Composites.

Final rept.,
R. D. Kriz, and H. M. Ledbetter. 1987, 14p
Pub. in Proceedings of Nondestructive Testing and Evaluation of Advanced Materials and Composites Conference, Colorado Springs, CO., August 19-21, 1986, p63-76 1987.

Keywords: *Magnesium, *Composite materials, *Elasticity, Graphite, Stiffness, Mathematical models, Anisotropy, Modulus of elasticity, Reprints.

Unidirectional graphite-magnesium composites show high elastic anisotropy and unusual geometrical fea-

tures in their elastic-property polar diagrams. From the five-component transverse-isotropic elastic-stiffness tensor the authors compute and display representation surfaces for Young's modulus, torsional modulus, linear compressibility, and Poisson's ratios. The authors emphasize the importance of obtaining the complete elastic-stiffness tensor. They give examples of errors resulting from popular elastic-constant approximations.

701,139
PB88-122221 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Determination of Whole-Field Strain in a Composite Panel Using Coherent Optical Processing.

Final rept.,
J. F. Cardenas-Garcia, J. C. Moulder, and R. D. Kriz. 1986, 10p
Pub. in Proceedings of SEM (Society for Experimental Mechanics) Fall Conference on Experimental Mechanics, 'Optical Methods in Composites', Keystone, CO., November 2-5, 1986, p48-57.

Keywords: *Stresses, *Composite materials, *Panels, Glass, Deformation, Epoxy compounds, Cracks, Mathematical models, Strains, Tension, Reprints, Finite element analysis.

A newly devised video-optical experimental technique allows for the automated determination of the in-plane, plane stress components of the infinitesimal deformation tensor at discrete locations over an area of interest in a loaded specimen. It was used to evaluate a square area enclosing the central crack in a G10CR woven glass epoxy panel loaded in tension. A finite element analysis was performed to model the strain tensor field surrounding the central crack. The experimental and FEM results show an equivalence and the localized effect of high strains close to the crack tip is observed.

701,140
PB88-152087 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Fractographic Analysis of Interlaminar Fracture.

Final rept.,
W. D. Bascom, D. J. Boll, D. L. Hunston, B. Fuller, and P. J. Phillips. 1987, 19p
Sponsored by National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
Pub. in ASTM (American Society for Testing and Materials) Special Technical Publication 937, p131-149 1987.

Keywords: *Carbon fibre reinforced plastics, *Epoxy laminates, Polyphenyl compounds, Fractography, Failure, Yield strength, Thermoplastic resins, Electron microscopy, Reprints.

The failed surfaces of interlaminar fracture (Mode I) specimens were examined using scanning electron microscopy. The matrix resins were Hercules 3501-6 and 2502 epoxies and Phillips Petroleum polyphenylene sulfide (PPS) and the reinforcing carbon fibers were Hercules AS4 and AS6G. The epoxy matrix composites exhibited fiber pull-out, hackle markings and regions of smooth resin fracture. Considerable (up to 30-50%) relaxation of the deformed resin occurred when the epoxy matrix specimens were heated above the matrix T_g. Some of the fractography features are discussed in terms of the tensile stresses acting at the surface of the fibers.

701,141
PB88-152525 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Effect of Interface Properties on Wave Propagation in a Medium with Inclusions.

Final rept.,
S. K. Datta, and H. M. Ledbetter. 1986, 11p
Pub. in Mechanics of Materials Interfaces, p131-141 1986.

Keywords: *Composite materials, Secondary waves, Longitudinal waves, Attenuation, Inclusions, Interfaces, Ultrasonic frequencies, Reprints.

The study considers propagation of effective plane longitudinal and shear waves through a medium with a random distribution of spherical inclusions. The authors assume that inclusions and matrix possess different elastic properties and that a thin layer of elastic

material with still different properties separates the inclusions from the matrix. Also, the authors assume same-size inclusions same-thickness layers. The authors find that the layers substantially affect the phase velocities and attenuation of coherent plane waves propagating through the composite medium.

701,142

PB88-153937

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Monitoring Elastic Stiffness Degradation in Graphite/Epoxy Composites.

Final rept.,

R. D. Kriz, 1987, 7p

See also PB86-111812.

Pub. in Solid Mechanics Research for Quantitative Non-Destructive Evaluation, p389-395 1987.

Keywords: *Graphite composites, *Epoxy resins, *Stiffness methods, Nondestructive testing, Composite materials, Elastic analysis, Degradation, Moisture, Reprints.

Many stiffness-critical aerospace structures exploit the high specific stiffness of graphite/epoxy composites. Elastic-stiffness degradation of these materials is therefore important. Here a nondestructive technique is described that measures stiffness degradation of the graphite-fibers and epoxy-matrix. The technique monitors variations in the direction of stress-wave propagation (energy-flux) corresponding to a change in composite stiffness.

701,143

PB88-153798

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Fracture Mechanics Characterization of Crack/Fiber Interactions in Ceramic Matrix Composites.

Final rept.,

T. W. Coyle, E. R. Fuller, P. Swanson, and T. Palamides, 1987, 6p

Sponsored by Department of Energy, Washington, DC. Pub. in Ceramic Engineering and Science Proceedings 8, n7/8 p630-635 Jul/Aug 87.

Keywords: *Ceramic matrix composites, *Fracture properties, Cracking(Fracturing), Ceramic fibers, Bonding, Stress waves, Delaminating, Fractography, Reprints.

A crucial factor in the structural performance of ceramic matrix composites is the influence of the fiber/matrix bond on the interaction of a matrix crack with the reinforcing fibers. To elucidate the character of this interaction under controlled fracture conditions, glass fracture mechanics specimens were fabricated in the double-cleavage, drilled compression (CDC) configuration with simple arrays of fibers. Propagating cracks were observed in cross-polarized illumination to characterize delamination of the fiber ahead of the crack and bridging interactions behind the crack tip. Stress wave fractography was employed to analyze the shape and relative velocity of the crack front.

Corrosion & Corrosion Inhibition

701,144

PB87-153615

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Thermodynamic and Kinetic Corrosion Data: The NACE-NBS (National Association of Corrosion Engineers - National Bureau of Standards) Corrosion Data Program.

Final rept.,

M. J. Rodriguez, A. C. Van Orden, and G. M. Ugiansky, 1984, 9p

Pub. in Proceedings of Electrochem. Soc., n84-9 p325-333 1984.

Keywords: *Corrosion, Reaction kinetics, Thermodynamics, Alloy steels, Corrosion Data Center.

Corrosion costs can be reduced by improving known practices or implementing new practices through the use of kinetic and thermodynamic data. These corrosion data are not available now to designers and engineers, and are scattered throughout the literature. It is important to establish a central facility dedicated to

data collection, evaluation and effective dissemination. Such a facility is being developed, the Corrosion Data Center. The Center is the core of a joint program between the National Association of Corrosion Engineers (NACE) and the National Bureau of Standards (NBS). Several projects have been initiated in the areas of kinetic and thermodynamic corrosion data. In the kinetic area, the projects include atmospheric corrosion of structural alloys, localized corrosion of austenitic stainless steels and uniform corrosion of steels. In the thermodynamic area, most of the efforts are directed toward the establishment of a facility of computer generated Pourbaix (E-pH) diagrams for multicomponent systems.

701,145

PB87-161592

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Computer Assisted Corrosion Data Evaluation and Dissemination.

Final rept.,

A. C. Van Orden, G. M. Ugiansky, M. J. Rodriguez,

and E. Escalante, 1985, 10p

Pub. in Proceedings of Symposium on Computer Aided Acquisition and Analysis of Corrosion Data, New Orleans, LA., October 7-12, 1984, p180-189 1985.

Keywords: Corrosion, Data analysis, *Corrosion data center, Computer applications.

There is a great need to collect, evaluate, and disseminate the corrosion data which is presently scattered throughout the open literature and in the proprietary files of many companies and trade associations. The NBS facility, the Corrosion Data Center, will be dedicated to data collection, evaluation, and dissemination. The computer is an integral part and effective tool in this effort. The Corrosion Data Center has initiated several pilot projects in the areas of thermodynamic and kinetic data. These projects include atmospheric corrosion of structural alloys, localized corrosion of austenitic stainless steels, and the uniform corrosion of steels in acids, in the kinetic area. In the thermodynamic area, the efforts involve establishment of a facility for computer generated Pourbaix (E-pH) diagrams for multicomponent systems.

701,146

PB87-172763

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Role of Phosphorus and Hydrogen Sulfide in the Anaerobic Corrosion of Iron and the Possible Detection of This Corrosion by an Electrochemical Noise Technique.

Final rept.,

W. P. Iverson, G. J. Olson, and L. F. Heverly, 1986,

8p

Sponsored by Office of Naval Research, Arlington, VA. Pub. in Biologically Induced Corrosion, p154-161 1986.

Keywords: *Phosphorus, *Hydrogen sulfide, Iron, Microorganisms, Reprints, *Anaerobic corrosion, *Desulfovibrio, Electrochemical noise.

Anaerobic corrosion has been postulated as a process which results from the removal of hydrogen from the surface of iron by sulfate-reducing bacteria. Evidence is presented that this type of corrosion is induced instead by a volatile, water soluble, corrosive, phosphorus-containing compound produced by these organisms which also produce hydrogen sulfide. The chemical production of a similarly acting compound, by the action of hydrogen sulfide on certain inorganic phosphorus compounds, is also described. Anaerobic corrosion is stimulated both by the addition of ferrous ions to the anaerobic environment as well as the breakdown of the partially protective films of iron sulfide on the iron which permits the phosphorus compound to initiate the corrosion process in both cases.

701,147

PB88-129846

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Statistical Analysis of the Fluctuations of the Passive Current.

Final rept.,

U. Bertocchi, M. Koike, S. Leigh, F. Qiu, and G. Yang,

1986, 5p

Pub. in Jnl. of the Electrochemical Society 133, n9 p1782-1786 Sep 86.

Keywords: *Iron containing alloys, *Corrosion, Pitting, Statistical analysis, Reprints, *Foreign technology.

From recordings of fluctuations in the passive current of Fe-Cr alloys in chloride-containing solutions, the statistical properties of sequences of intervals between current spikes and sequences of decay constants for the spikes were obtained. The interval time sequences were examined for independence and stationarity, and decay constant sequences for time trends. The results show that the interval times cannot be modeled by renewal processes or homogeneous Markov chains, but more complicated stochastic models have to be employed.

701,148

PB88-153788

PC A06/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Corrosion Evaluation of Underground Telephone Cable Shielding Materials.

J. L. Fink, D. Mathews, G. Hessler, and E. Speed.

Jan 88, 115p NBSIR-87/3546

Sponsored by Rural Electrification Administration, Washington, DC.

Keywords: *Telephone cables, *Coatings, *Underground corrosion, Plastics.

Corrosion data are given on the performance of base and plastic-coated metals intended for use as cable shields for buried telephone cable. The materials investigated on specially prepared specimens were buried for periods up to seven years in six different soil environments. Metals tested included homogeneous plastic-bonded and metallurgically bonded laminates. Some specimens were exposed bare (uncoated), while others had plastic coatings or other types of coatings on either one or both sides. Metals studied included aluminum, copper, low carbon steel, and stainless steel alloys.

701,149

PB88-153796

PC A05/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Model for Molten Salt Corrosion of (Co,Cr)-Based Superalloys.

Final rept.,

L. P. Cook, and D. W. Bonnell, Dec 87, 94p NBSIR-

87/3628

Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.

Keywords: *Heat resistant alloys, *Hot corrosion, Cobalt alloys, Chromium alloys, Fused salts, Hydrocarbons, Fuels, Impurities.

An integrated equilibrium kinetic model is described for treating the chemical solution component of corrosion of (Co, Cr)-based superalloys by the (Na, S, V)-molten salts originating from impurities present in hydrocarbon fuels. Gas phase chemistry and gas phase/condensed phase precipitate interactions are modeled using the NASA-Lewis multicomponent free energy minimization program (CEG).

Elastomers

701,150

PB87-153292

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Strain-Energy Function for Rubber-Like Materials.

Final rept.,

L. J. Zapas, 1981, 11p

Pub. in IUTAM (International Union of Theoretical and Applied Mechanics) Symposium on Finite Elasticity, Lehigh University, August 10-15, 1980, P445-455 1981.

Keywords: *Elastomers, *Strains, Deformation, Mechanical tests.

Some results are presented on theories which attempt to describe the relation between force and deformation of rubbers where the linear laws of the classical theories of elasticity are not applicable. A few experimental results are presented in order to show the present status of the form of the strain-energy function of rubber-like materials.

MATERIALS SCIENCES

Elastomers

701,151
PB88-110358 PC A04/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
In-situ Characterization of the Interface of Glass Reinforced Composites.
Final rept.,
F. W. Wang, and B. M. Fanconi. Jun 87, 66p NBSIR-87/3581
Sponsored by Army Research Office, Research Triangle Park, NC.

Keywords: *Curing agents, *Viscosity, Epoxy compounds, Fluorescence, Composite materials, Remote sensing, Polyimide resins, Fiber optics.

A technique has been developed to monitor the viscosity of curing epoxies. Fluorescence spectroscopy of viscosity-sensitive organic dyes is used together with optic fibers as a means of delivering the probing light to the measurement site and retrieving the modulated light for detection. The technique is adaptable to remote sensing through the use of optic fibers. The evanescent wave of the guided radiation is used to excite probe molecules lying at the interface between the fiber and surrounding matrix. Therefore, the technique is adaptable to in-situ characterization of the interface of glass reinforced composites.

701,152
PB88-134622 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Non-Equilibrium Mechanical Response of a Cross-Linked Network.
Final rept.,
R. J. Gaylord, G. H. Weiss, and E. A. DiMarzio. 1986, 3p
Pub. in *Macromolecules* 19, n3 p927-929 1986.

Keywords: *Polymers, *Elastomers, Polymerization, Networks, Barriers, Crosslinking, Reprints, *Foreign technology.

The reptation and retracing mechanisms of chain relaxation in cross-linked polymer networks are viewed as multiple barrier passage processes and their properties are calculated in terms of the model of a continuous-time random walk with a pausing-time distribution having a long-time tail.

701,153
PB88-134648 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Continuous-Time Random Walk Description of the Non-Equilibrium Mechanical Response of Cross-Linked Elastomers.
Final rept.,
R. J. Gaylord, B. Joss, J. T. Bendler, and E. A. DiMarzio. 1985, 3p
Pub. in *British Polymer Jnl.* 17, n2 p126-128 Jun 85.
Keywords: *Natural rubber, *Elastomers, *Crosslinking, Networks, Stress relaxation, Polymers, Reprints, *Foreign technology, CTRW model.

The application of the continuous-time random walk model to the description non-equilibrium stress response of a cross-linked network is discussed. Different versions of the CTRW model lead to the prediction of a stress relaxation function having either a fractional-power law form or a fractional-exponential law form. Both forms are tested against experimental data on the stress relaxation and loss modulus behaviors of cross-linked natural rubber.

Fibers & Textiles

701,154
PB87-153813 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Physics Div.
Apparent Thermal Conductivity Characterization of Low-Density, Glass-Fiber Insulation Material.
Final rept.,
B. Rennex, and T. A. Somers. 1985, 23p
Sponsored by Department of Energy, Washington, DC. Pub. in *Jnl. of Thermal Insulation* 8, p175-197 Jan 85.

Keywords: *Thermal insulation, Glass fibers, Thermal conductivity, Standards, Reprints, Standard reference materials.

The work describes the procedure, results, and error analysis of a study to characterize the apparent thermal conductivity values of a lot of low-density, glass-fiber insulation material. The uncertainty of these values of the 75 samples measured is estimated to be plus or minus 1.4 percent. The data was taken at a mean temperature of 24C, and the sample thickness was 25mm. It is recommended that this lot be made available as a Standard Reference Material from the Office of Standard Reference Materials of the National Bureau of Standards.

Iron & Iron Alloys

701,155
AD-A176 497/6 PC A02/MF A01
Colorado School of Mines, Golden.
Model for the Silicon-Manganese Deoxidation of Steel Weld Metals,
O. Grong, T. A. Siewert, G. P. Martins, and D. L. Olson. Oct 86, 7p ARO-23474.7-MS
Contract DAAL03-86-K-0064
Pub. in *Metallurgical Transactions A*, v17A p1797-1807 Oct 86.

Keywords: *Welding, *Liquid metals, *Manganese, *Oxides, *Silicon, *Steel, *Weld metal, *Deoxidation(Metallurgy), Buoyancy, Flow fields, Fluid flow, High temperature, High velocity, Interactions, Low temperature, Models, Parameters, Particles, Rates, Separation, Surfaces, Reprints.

From an analytical and theoretical study of flat and out-of-position gas metal arc (GMA) C-Mn steel welds containing varying additions of silicon and manganese, it is concluded that the buoyancy effect (flotation obeying Stokes' law) does not play a significant role in the separation of oxide inclusions during weld metal deoxidation. The separation rate of the particles is controlled solely by the fluid flow pattern in the weld pool. A proposed two-step model for the weld metal deoxidation reactions suggests that inclusions formed in the hot, turbulent-flow region of the weld pool are rapidly brought to the upper surface behind the arc because of the high-velocity flow fields set up within the liquid metal. In contrast, those formed in the cooler, less-turbulent flow regions of the weld pool are to a large extent trapped in the weld metal as finely dispersed particles as a result of inadequate melt stirring. The boundary between 'hot' and 'cold' parts for possible inclusion removal is not well defined, but depends on the applied welding parameters, flux, and shielding gas composition. As a result of the intricate mechanism of inclusion separation, the final weld metal oxygen content depends on complex interactions among the following three main factors: 1) the operational conditions applied, 2) the total amount of silicon and manganese present, and 3) the resulting manganese-to-silicon ratio.

701,156
PB87-151494 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Fracture and Deformation Div.
Statistical Observations of Creep Cavitation in AISI Type 304 Stainless Steel.
Final rept.,
T. S. Liu, R. J. Fields, D. G. Harlow, and T. J. Delph. Mar 85, 6p
Pub. in *Scripta Metallurgica* 19, n3 p299-304 Mar 85.

Keywords: *Stainless steels, *Creep properties, Reprints, *Steel 304, Computer applications.

It is well known from experimental observations that many of the characteristic features of intergranular creep cavitation are highly nonuniform. In specimens containing creep cavities, for example, the cavities are found more or less to be distributed randomly along the grain boundaries, preferentially along boundaries normal to the tensile axis. Moreover substantial variations in cavity sizes and shapes may be observed. Herein the authors report the results of statistical analysis of experimental creep cavitation data obtained through the use of an automatic image analyzing computer, a device which is capable of scanning large numbers of microscopic fields on polished metal surfaces and making individual creep cavity measurements in each field.

701,157
PB87-153631 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
X-ray Absorption Studies of the Role of Chromium and Hydrogen in the Structure of Oxide Films on Iron.

Final rept.,
G. G. Long, J. Kruger, M. Kuriyama, D. R. Black, E. Farabaugh, D. M. Sanders, and A. I. Goldman. 1984, 4p
Pub. in *Proceedings - Int. Congr. Met. Corros.* 3, p419-422 1984.

Keywords: *Corrosion, *Iron, *Thin films, *X ray absorption, Chromium, Hydrogen, Iron oxides.

High resolution near edge x-ray absorption fine structure was measured for in-situ and ex-situ passive films on iron, where some of the films contained chromium as a glass former. Changes in the bonding are evaluated using the nearly free ion interpretation of known iron oxides.

701,158
PB87-162079 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Fracture and Deformation Div.
Microindentation Hardness Measurements on Metal Powder Particles.
Final rept.,
T. R. Shives, and L. C. Smith. 1985, 14p
Pub. in *American Society for Testing and Materials Special Technical Publication* 889, p243-256 1985.

Keywords: *Metal powder, *Indentation hardness tests, *Microhardness, *Powder(Particles), Atomizing, Measurement.

The National Bureau of Standards has undertaken a rather extensive metal processing program whereby metal powders will be produced by the inert gas atomization process. Powder particle sizes are expected to range from about 10 micrometer to 100 micrometers in diameter. Part of the overall program is the determination of the mechanical properties of the individual powder particles in the as-produced condition. Conventional microindentation hardness is one of the techniques that is planned to be employed for the mechanical properties characterization. In order to determine the applicability of this technique to very small particles, commercially available and experimental powders ranging in size from 3 to 65 micrometers have been mounted in various metallographic mounting media as well as in an electrodeposited metal mounting medium in order to evaluate the effects of the properties of the mounting materials on the measured hardness values. The effects of different applied loads and variations in particle size are also evaluated.

701,159
PB87-182903 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.
Carbon and Nitrogen Effects on the Elastic Constants of a Stainless Steel at 4 K.
Final rept.,
H. M. Ledbetter, M. W. Austin, and S. A. Kim. 1987, 5p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in *Materials Science and Engineering* 85, p85-89 1987.

Keywords: *Elastic properties, *Carbon, *Stainless steels, *Temperature, Nitrogen, Modulus of elasticity, Poisson ratio, Stiffness, Shear modulus, Magnetic properties, Ultrasonics, Reprints.

Nine AISI type 304 stainless steel alloys were studied between ambient temperature and liquid helium temperature. The carbon-plus-nitrogen contents of these alloys ranged from 0.080 to 0.359 wt.% (from 0.3 to 1.5 at %). Five elastic constants (the longitudinal modulus, Young's modulus, the shear modulus, the bulk modulus and Poisson's ratio) were determined by a pulse echo ultrasonic method. Except for the bulk modulus, all the elastic stiffnesses increase slightly with increasing interstitial content. Existing elastic theory predicts decreases in elastic stiffness caused by the volume increase.

701,160
PB87-182911 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Dilation of an fcc Fe-Cr-Ni Alloy by Interstitial Carbon and Nitrogen.

Final rept.,
H. M. Ledbetter, and M. W. Austin. Feb 87, 4p
Sponsored by Department of Energy, Washington, DC.
Office of Fusion Energy.
Pub. in Materials Science and Technology 3, p101-104
Feb 87.

Keywords: *Carbon, *Interstitials, *Iron alloys, Austenite, Nitrogen, Stainless steels, Alloying, Lattice parameters, Volume, Chromium, Nickel, Mathematical models, X ray diffraction, Face centered cubic lattices, Reprints, Dilation.

The volume change arising from introducing interstitial carbon and nitrogen into an fcc Fe-Cr-Ni alloy has been studied. The carbon plus nitrogen content varied from 0.3 to 1.3 at.-%. To complement these studies, alloys having a constant low-carbon content and a nitrogen content varying from 0.04 to 0.91 at.-% have also been studied. Volume was determined by X-ray diffraction using electropolished bulk polycrystalline specimens. An atom of carbon or nitrogen was found to increase volume by an amount approximately equal to three times its own volume or 70% of the atomic volume of the iron. In contrast with some studies, it was found that nitrogen exceeds carbon in dilating the fcc iron lattice. This occurs despite the atomic volume of carbon exceeding that of nitrogen. This is ascribed to electronic effects and to carbon-iron bonds stronger than nitrogen-iron bonds. A model calculation is given for the dilation.

701,161
PB87-197745

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Anaerobic Corrosion of Iron and Steel: A Novel Mechanism.

Final rept.,
W. P. Iverson, and G. J. Olson. 1984, 5p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Proceedings of International Symposium on Current Perspectives on Microbial Ecology (3rd), p623-627 1984.

Keywords: *Corrosion, *Anaerobic corrosion, *Cathodic depolarization, Disulfide/dimethyl, Hydrogen sulfide.

The anaerobic corrosion of iron has been postulated to be caused by the removal of hydrogen (electrons) from the surface of iron by sulfate-reducing bacteria, by iron sulfide, or by bacterial removal of hydrogen from iron sulfide. Results indicate, however, that severe anaerobic corrosion takes place in the absence of both bacteria and iron sulfide. The agent causing corrosion is a volatile, highly reactive phosphorus-containing compound which reacts with iron to form iron phosphide as a corrosion product. A phosphorus-containing gas which also reacts with iron to form iron phosphide can be prepared by the action of hydrogen sulfide on hypophosphite. In addition to the formation of this phosphorus compound and hydrogen sulfide, the sulfate-reducing bacteria also produced methylmercaptan and dimethylsulfide which are relatively non-corrosive to iron under anaerobic conditions. Hydrogen sulfide produced by sulfate-reducing bacteria normally produces a film of iron sulfide on iron at pH values near neutrality under anaerobic conditions. Corrosion can occur when the film of iron sulfide is disrupted, allowing the phosphorus-containing compound to come in contact with the iron surface.

701,162
PB87-199253

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Fracture Toughness of Weldments: Wide Plate Tests.

Final rept.,
D. T. Read. 1984, 17p
Sponsored by Metal Properties Council, Inc., New York.
Pub. in Proceedings of Pressure Vessels and Piping Conference and Exhibition, San Antonio, TX., June 17-21, 1984, p27-43.

Keywords: *Weldments, Plates (Structural members), Metal plates, Cracks, Steels, Impact tests, Toughness, Reprints.

A correlation was found between the failure loads of three as-welded, surface-cracked wide plates and the impact toughness of the welds. A fourth weldment, this

one stress-relieved, failed at a higher load than expected from its impact toughness and the test results for the as-welded plates. The base metal was ASTM A537 Class 1 steel plate; the welds were made using the submerged arc process SAW using AWS Class EL12 electrode wire. The four wide plates tested were 0.59 m wide by 44 mm thick by 1.5 m long. The welds were all transverse to the specimen axis. Three plates were tested at -60 C, two as-welded, one stress-relieved. The remaining plate was tested, as-welded, at -30 C. All the cracks were on the weld centerlines, except in one plate tested as-welded at -60 C, in which the crack was in the heat-affected-zone, 1 mm from the fusion line. Impact toughness results were used to determine T20, the temperature at which the minimum observed Charpy-V notch impact energy was 27.1 J (20 ft lb).

701,163
PB87-219218

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Manganese and Nitrogen in Stainless Steel SMA (Shielded Metal Arc) Welds for Cryogenic Service.

Final rept.,
C. N. McCowan, T. A. Siewert, R. P. Reed, and F. B. Lake. 1987, 9p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Welding Research Supplement, p84-s-92-s Mar 87.

Keywords: *Shielded metal arc welding, Manganese, Nitrogen, Cryogenics, Weldments, Ferrite, Reprints, Stainless steel-308.

Evaluation of a shielded metal arc (SMA) weld test matrix in which manganese (1.5 to 10 wt.-%) and nitrogen (0.04 to 0.26 wt.-%) were varied independently has clarified the effect of these elements on cryogenic mechanical properties and predicted ferrite number (FN). Several molybdenum and boron additions were also made, but they had no observable effect on strength or Charpy V-notch (CVN) absorbed energy. The matrix was based on a type 308L stainless steel weld metal composition. Desired compositions and constant FN were attained through alloy additions to the electrode coating. For each weld, one all-weld metal 4-K tensile specimen and five 76-K CVN impact specimens were tested.

701,164
PB87-232583

PC A06/MF A01

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Strain Hardening and Stable Tearing Effects in Fitness-for-Service Assessment: Progress Report.

D. T. Read. May 87, 121p NBSIR-86/3045
Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.

Keywords: *Strain hardening, *Tearing, Toughness, Ductility, Graphs (Charts), Fracture tests, Aluminum alloy 5052, Steel-ASTM-A710, Steel A-710, J integrals.

The report describes studies done to provide information on how to account for material strain-hardening and tearing in fitness-for-service assessment. Included are a literature review, a study of the strength and ductility of cracked tensile panels under compliant loading, a report on applied J-integral measurements in an HSLA steel, a study of the relationship of the essential work of fracture to the J-integral, and a description of potential drop techniques for crack length measurement in double-edge-notched tensile panels.

701,165
PB87-233623

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Effect of Prior Deformation on the 76-K Fracture Toughness of AISI 304L and AWS 308L Stainless Steels.

Final rept.,
P. T. Purtscher, and D. T. Read. Apr 87, 6p
Pub. in Jnl. of Engineering Materials and Technology 109, p151-156 Apr 87.

Keywords: *Stainless steel-304, *Stainless steel-308, Cryogenics, Fracture strength, Toughness, Reprints, *Foreign technology.

In the study, the effect of service-induced deformation on the toughness of AISI 304L and its weld metal, AWS 308L was determined. Low temperature compressive loading in the laboratory produced larger deformations. Crack initiation toughness, and tearing re-

sistance, at 76 K were evaluated as a function of martensite content, a measure of the deformation in these steels. The results showed that the toughness properties of the 304L decrease gradually as the martensite content increases from the 5 to 8 percent level found in the service condition to the 45 percent level obtained by compressive loading. The decrease was less than that expected on the basis of the increased flow stress. The toughness properties of the 308L weld metal decreased more sharply with increased martensite content than those of the 304L. The sharp decrease is associated with a degradation of the properties of the delta ferrite rather than that of the austenite.

701,166

PB87-233631

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Absence of Stretch Zones in Austenitic Stainless Steels Fractured at Cryogenic Temperatures.

Final rept.,
P. T. Purtscher. Sep 87, 3p
Sponsored by Department of Energy, Washington, DC. Pub. in Jnl. of Testing and Evaluation 15, n5 p296-298 Sep 87.

Keywords: *Austenitic stainless steels, Cryogenics, Ductility tests, Fracture properties, Reprints, *Foreign technology.

Stretch zones are normally observed on the surface of fracture toughness specimens that break in a ductile manner. However, no stretch zones were observed in the scanning electron microscope on the ductile fracture surfaces of austenitic stainless steels broken in accordance with ASTM E 813 procedure at cryogenic temperatures.

701,167

PB88-110341

PC A03/MF A01

National Bureau of Standards, Gaithersburg, MD. Metallurgy Div.

Weldability of a Lead Carbon Steel.

Final rept.,
J. G. Early, and J. H. Smith. Jun 87, 20p NBSIR-87/3598
Sponsored by Coast Guard, Washington, DC.

Keywords: *Carbon steels, *Lead steels, Weldability, Bend tests, Hardness tests, Steel AISI 12L14.

Samples of AISI 12L14, leaded free machining steel were welded using conventional metal-inert gas (MIG) welding procedures. The welds were evaluated for soundness and mechanical properties. Hardness, ductility and microstructure were evaluated to assess the integrity of the welds. Sound welds were produced but the overmatching strength of the weld metal resulted in failure in the HAZ.

701,168

PB88-117650

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Near-Threshold Fatigue Crack Growth Behavior of AISI 316 Stainless Steel.

Final rept.,
R. L. Tobler. 1985, 7p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Advances in Cryogenic Engineering Materials, v32 p321-327 1985.

Keywords: *Austenitic stainless steels, Fatigue (Materials), Cryogenics, Crack propagation, Test equipment, Reprints, *Foreign technology, Steel A-316.

The near-threshold fatigue behavior of an AISI 316 alloy was characterized using a newly developed, fully automatic fatigue test apparatus. Significant differences in the near-threshold behavior at temperatures of 295 and 4 K are observed. Results suggest that the near-threshold measurements of a 6.4-mm-thick specimen of this alloy are insensitive to cyclic test frequencies below 40 Hz.

701,169

PB88-122163

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

MATERIALS SCIENCES

Iron & Iron Alloys

Fracture, Acoustic Emission and Adiabatic Heating of Austenitic Stainless Steels at Liquid Helium Temperature.

Final rept.,
R. L. Tobler, T. Shoji, H. Takahashi, and K. Ohnishi. 1986, 9p
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy, and Ministry of Education, Science and Culture, Tokyo (Japan).
Pub. in Progress in Acoustic Emission III, p453-461 1986.

Keywords: *Austenitic stainless steels, Fracture mechanics, Alloys, Toughness, Fracture properties, Heating, Acoustic measurement, Microstructure, Reprints.

Conventional fracture mechanics tests supplemented with acoustic emission (AE) and adiabatic heating (AH) measurements were conducted to characterize commercial austenitic stainless steels at 4 K. Three alloys representing low, medium, and high toughness behaviors were examined, and high levels of AE are reported in each case. The high AE activity of these austenitic steels at 4 K is attributed to low temperature strengthening effects in general, and to the peculiar failure mechanism involving discontinuous deformation and adiabatic heating that occurs in ductile materials near absolute zero.

701,170
PB88-122171 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Elastic Plastic Models of Surface Cracks in Tensile Panels.

Final rept.,
D. T. Read, H. I. McHenry, and B. Petrovski. 1986, 6p
Pub. in Proceedings of SEM (Society for Experimental Mechanics) Fall Conference on Experimental Mechanics, 'Optical Methods in Composites', Keystone, CO., November 2-5, 1986, p210-215.

Keywords: *Tensile properties, *Panels, *Metal plates, Steels, Elasticity, Mathematical models, Cracks, Welded joints, Pipelines, Reprints.

The surface crack is a common flaw in structures and vessels, and its elastic characterization has been studied extensively as reviewed in (1) and its references. Elastic plastic fracture mechanics (EPFM) technology can be used to characterize surface cracks in tough materials. Two EPFM parameters are commonly used: the crack tip opening displacement (CTOD) and the three dimensional J-integral. The paper draws on a series of studies at the National Bureau of Standards related to the development and verification of analytical models for the calculation of EPFM parameters in surface cracked tensile panels. The models previously verified for pipeline steel plates, are used to calculate the crack mouth opening displacement (CMOD) and J for surface cracks in welded steel specimens.

701,171
PB88-129853 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Measurements and Interpretations of Sliding Wear Damage in Metals.
Final rept.,
P. J. Blau. 1985, 8p
Pub. in Jnl. of Tribology, Transactions of the ASME (American Society of Mechanical Engineers) 107, n4 p483-490 Oct 85.

Keywords: *Copper alloys, Wear, Friction, Deformation, Microstructure, Reprints, *Steel 1020, *Steel 4619.

Research on sliding friction and wear of metals has involved studies of subsurface microstructural deformation. The paper considers the difficulties of measuring deformation and analyzing the implications of such studies on several bases: (1) defining the physical extent of sliding-induced deformation, (2) making appropriate measurements of deformation for complex tribological conditions, and (3) correlating microstructural wear damage with the measurable friction forces on sliding contacts. Data for unlubricated block-on-ring tests of Cu and 1020 steel on 4619 steel is used to demonstrate limitations and correlations possible with metallographic studies in tribology.

701,172
PB88-141072 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Microstructural Characterization by Small Angle Neutron Scattering.

Final rept.,
R. J. Fields, R. C. Dobbyn, and C. I. Glinka. 1985, 9p
Sponsored by Army Materiel Command, Aberdeen Proving Ground, MD. Ballistic Research Lab., and David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in Proceedings of NDE of Microstructure for Process Control Conference, Detroit, MI., September 18-19, 1984, p123-131 1985.

Keywords: Deformation, Steels, Copper, Nondestructive tests, *Small Angle Neutron Scattering Facility, Small angle scattering, Creep cavitation.

A brief review of the NBS SANS (Small Angle Neutron Scattering) facility is given, including applications of the technique to: (1) Precipitation of copper in steel; (2) Volume changes during deformation of precipitate strengthened alloys; and, (3) Creep cavitation. Some comments as to SANS use as a NDE nondestructive evaluation tool are made.

701,173
PB88-141320 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Acoustic Emission: An NDE Technique for Characterizing the Martensitic Transformation.

Final rept.,
Y. Berlinsky, M. Rosen, J. A. Simmons, and H. N. G. Wadley. 1986, 10p
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v5 p1345-1354 1986.

Keywords: *Acoustic emission testing, *Nondestructive tests, *Martensitic stainless steels, Reprints.

Acoustic emission has been employed as a dynamic NDE characterization technique for the determination of kinetic and mechanistic parameters of the martensitic phase transformation in Fe-30wt.%Ni alloy. High-speed phenomena related to autocatalytic effect governing the transformation kinetics were observed. Using an energy calibration approach, it has been possible to estimate the elastic strain energy of the transformation. Values in accord with thermodynamic estimates have been obtained.

701,174
PB88-147509 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Ultrasonic Sensors to Measure Internal Temperature Distribution.

Final rept.,
B. E. Droney, F. A. Mauer, S. J. Norton, and H. N. G. Wadley. 1986, 8p
Sponsored by American Iron and Steel Inst., Washington, DC.
Pub. in Review of Progress in Quantitative Nondestructive Evaluation, v5A p643-650 1986.

Keywords: *Nondestructive tests, *Ultrasonic tests, Temperature measurement, Reprints, Steel 304, Steel 1018.

The in-process measurement of the internal temperature distribution is an important step toward improved processing of steels. A promising approach is the measurement of ultrasonic velocity, combined with a priori information on heat flow. Reference data on ultrasonic velocity versus temperature have been obtained for austenitic 304 stainless steel and for ferritic AISI 1018 steel. For stainless steel the longitudinal-wave velocity is nearly linear with temperature, with a proportionality constant of about -0.7 meters per second per degree Kelvin. In the paper the authors review the technical approach being used to ultrasonically determine internal temperature distribution.

701,175
PB88-147624 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Tensile and Fracture Properties of an Fe-18Cr-20Ni-5Mn-0.16N Fully Austenitic Weld Metal at 4 K.

Final rept.,
C. N. McCowan, T. A. Siewert, and R. L. Tobler. 1986, 4p
See also PB87-134763. Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Transactions of the ASME (American Society for Testing and Materials), Jnl. of Engineering Materials and Technology 108, p340-343 Oct 86.

Keywords: *Austenitic stainless steels, *Weld metals, Cryogenics, Weldments, Tensile properties, Fracture properties, Reprints, Steel 18Cr 5Mn 20Ni, Fracture toughness.

The 4-K tensile and fracture toughness properties of a fully austenitic stainless steel weld are reported. One tensile and two compact tension fracture specimens were tested. The weld was produced by gas metal arc welding using an Fe-18Cr-20Ni-5Mn-0.16N electrode and a 98 percent argon-2 percent oxygen shielding gas mixture. The suitability of this alloy for welding cryogenic structures is discussed.

701,176
PB88-152517 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Drop-Weight Testing of Non-Standard Geometries.

Final rept.,
S. R. Low, and J. G. Early. 1986, 21p
Pub. in ASTM (American Society for Testing and Materials) Special Technical Publication 919, p108-128 1986.

Keywords: *Impact tests, *Steels, Crack initiation, Fracture properties, Pipes(Tubes), Pressure vessels, Reprints, Steel 128, Steel 212.

The test requirements contained in the standard test method for drop weight testing ASTM (E208) generally limit its applicability to flat products or to products with at least one flat surface because of the shape of the standard test specimens and the need for the tension surface of the specimen to be an as-fabricated surface. Difficulties arise in the application of E207 to steel products whose fabricated shapes are not flat, e.g., piping and pressure vessels. For products with curved surfaces, some of the testing requirements must be violated, including: keeping the as-fabricated surfaces as the tension surface; uniform specimen thickness; flat compression surface; uniform stress on the tension surface. In the study, the nil-ductility transition temperature (NDT) was determined as function of test specimen geometry for two carbon/manganese structural steel grades.

Lubricants & Hydraulic Fluids

701,177
PB88-152699 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Effect of Solid Additives on Wear by Greases Containing Abrasive Particles.

Final rept.,
L. K. Ives, and M. B. Peterson. 1985, 9p
Pub. in Proceedings of International Conference on Wear of Materials, Vancouver, BC, Canada, April 14-18, 1985, p355-363.

Keywords: *Greases, *Additives, Lubricants, Abrasion, Wear, Particles, Molybdenum disulfide, Antimonates, Sulfur inorganic compounds, Reprints, Antimony thioantimonate.

The effect of additions of SbSbS4 and MoS2 on wear with greases containing abrasive particles (1 wt.% AC dust) has been investigated. Three greases were examined, a lithium 12-hydroxystearate thickened grease, and two clay thickened greases meeting Mil-G-24139 and Mil-G-81322C specifications. Wear tests were conducted with a machine utilizing a rotating pin on disk configuration.

Materials Degradation & Fouling

701,178
PB87-171740 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Disfigurement of External Paint Films by Algae and Bacteria and Quantitative Detection by Epifluorescence Microscopy.

Final rept.,
G. J. Olson, W. P. Iverson, and F. E. Brinkman.
1986, 9p
Pub. in *Biodeterioration* 6, p622-630 1986.

Keywords: *Paint, *Films, Algae, Bacteria, Reprints, *Biodeterioration.

Several cases of non-fungal microbial disfigurement of exterior paint films on houses and test panels were investigated. The paint films were examined by epifluorescence microscopy techniques and algae and bacteria were cultured from paint film samples. The growth and distribution of algae on surfaces was quantified by measuring in vivo or extracted chlorophyll fluorescence at 680 nm using a computerized photometer-monochromator system attached to the microscope. Methods for accelerated laboratory testing of algal and bacterial paint film disfigurement were investigated.

**701,179
PB87-182929** Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Stress Intensity Factors for Cracks in Panels with Uniformly Spaced Holes.

Final rept.,
R. H. Dodds, and D. T. Read. 1987, 11p
Sponsored by Naval Sea Systems Command, Washington, DC.
Pub. in *Engineering Fracture Mechanics* 26, n2 p267-277 1987.

Keywords: *Biaxial stresses, *Cracks, Panels, Cracking(Fracturing), Fatigue(Materials), Pressure vessels, Finite element analysis, Reprints, Stress intensity factors.

Stress intensity factors are presented for cracks at the edges of the central holes in a panel containing a uniformly spaced array of the circular holes. The finite element method is employed to obtain numerical values of the J-integral and the near-tip displacements from which the stress intensity factor K_I is inferred. Six representative ratios of hole spacing to hole radius are studied: 1.2, 1.25, 1.4, 1.6, 2.0 and 4.0. For each hole spacing, the stress intensity factor is computed for a number of crack lengths for each of two crack configurations. Uniaxial loading in two orthogonal directions is considered. Computed stress intensity factors are presented in graphical and functional form for all cases. The functional form should prove convenient for fatigue crack growth computation.

Miscellaneous Materials

**701,180
PB88-154042** Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Microstructural Analysis of Hardened Alite Paste. 1. Porosity.

Final rept.,
H. M. Jennings, and L. J. Parrott. 1986, 5p
Pub. in *Jnl. of Materials Science* 21, n11 p4048-4052 Nov 86.

Keywords: *Clinker, Calcium silicates, Hydrates, Porosity, Microstructure, Reprints, *Alite, Scanning electron microscopy.

New information about the pore structure of hydrating alite (impure tricalcium silicate) has been obtained with a scanning electron microscope. Specimens were taken at various intervals during hydration and impregnated with epoxy. Micrographs of polished surfaces, which were deeply etched to remove all material except the epoxy, were used to produce maps of the pore structure in a plane. Areas associated with pores were analyzed quantitatively and the results compared to measurements of porosity using volumetric techniques. The results suggest that pores < 50 nm diameter are an intimate part of calcium silicate hydrate. The structure of the large 'capillary pores' (i.e., pores > 50 nm diameter) changes with time from an open network of pores to an array of disconnected pores. Mature specimens contain regions, hundreds of micrometers across, which were relatively dense and were not observed in younger specimens.

**701,181
PB88-154059** Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Building Materials Div.
Microstructural Analysis of Hydrated Alite Paste. 2. Microscopy and Reaction Products.

Final rept.,
H. M. Jennings, and L. J. Parrott. 1986, 7p
Pub. in *Jnl. of Materials Science* 21, n11 p4053-4059 Nov 86.

Keywords: *Clinker, Calcium silicates, Calcium hydroxides, Hydrates, Microstructure, Cements, Reprints, *Alite, Scanning electron microscopy.

The distribution and composition of the products of hydrating alite have been studied using a backscattered electron detector in a scanning electron microscope. Polished surfaces of specimens were examined and quantitatively analyzed. Calcium hydroxide forms in the available water filled space. Calcium silicate hydrate appears to have several distinct morphologies, and their formation can be associated with the different stages of the reaction. These observations are compared with observations obtained from fracture surfaces which are commonly studied.

Nonferrous Metals & Alloys

**701,182
DE85000591** PC A02/MF A01
Brookhaven National Lab., Upton, NY.

Physical Modelling of Transition Metal Alloying: The Roles That Different Levels of Theory Play.
R. E. Watson, and L. H. Bennett. 1984, 15p BNL-35276, CONF-840417-8
Contract AC02-76CH00016
High-temperature alloys - theory and design conference, Bethesda, MD, USA, 8 Apr 1984.

Keywords: *Transition Element Alloys, *Band Theory, Electronic Structure, Enthalpy, Entropy, Thermodynamic Properties, ERDA/360104.

This paper is concerned with the properties of the ordered transition metal alloys, in particular, the prediction of the enthalpy of one system versus another. The current status of the results of the most detailed electron energy band machinery is reviewed as are cruder (and more economical) schemes. Evidence is presented indicating that electronic contributions are important to the relative entropy of one structure versus that of another and it is suggested that electronic (and phonon) contributions to a relative entropy should be a more severe test of detailed band theory than is the calculation of the relative enthalpy. The volume effects attending transition metal alloy formation are also considered. (ERA citation 10:000872)

**701,183
DE86000031** PC A02/MF A01
National Bureau of Standards, Gaithersburg, MD. Metallurgy Div.
Systematics of Alloying Behavior of the Noble Metals.

L. H. Bennett, and R. E. Watson. 1985, 13p BNL-37029, CONF-850211-14
Contract AC02-76CH00016
114. AIME annual meeting (includes Society of Mining Engineers), New York, NY, USA, 24 Feb 1985.

Keywords: *Copper, *Gold, *Intermetallic Compounds, *Metallic Glasses, *Silver, Electronegativity, Energy Levels, Experimental Data, Hyperfine Structure, Knight Shift, Metallurgical Effects, Nuclear Magnetic Resonance, Volume, ERDA/360102, ERDA/360104.

The noble metals (Cu, Ag and Au) often behave as a class in alloying with simple metals, metalloids, or transition metals, whether as hosts, in intermetallic compounds, or as dilute impurities. Examples are given of this behavior, as well as noting important differences between the three elements. Hyperfine effects (Knight shifts and isomer shifts), intrinsic elemental effects (electronegativity, structural maps, atomic volumes) and metallic glasses are reviewed. 20 refs., 7 figs. (ERA citation 10:051712)

**701,184
PATENT-4 627 482** Not available NTIS

Department of Commerce, Washington, DC.
Arc-Furnace for the Production of Small Investment Castings of Reactive or Refractory Metals Such as Titanium.
Patent,
R. M. Waterstrat. Filed 5 Feb 85, patented 9 Dec 86, 5p PB87-150850, PAT-APPL-6-698 268
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: *Electric arc furnaces, *Patents, *Investment casting, *Refractory metals, Casting, Titanium, Chemical reactivity, PAT-CL-164-514.

An arc furnace and investment casting apparatus includes a copper base with an integrally formed crucible having a passage there through. A vacuum chamber is positioned on the top of the copper crucible with a non-consumable cathode projecting into the chamber to effect melting of metal placed in the crucible. A vacuum chamber is also suspended beneath the crucible for support of a mold to receive molten metal flowing through the passage.

**701,185
PB87-149811** Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Aluminum-Copper System.

Final rept.,
J. L. Murray. 1985, 23p
Pub. in *International Metals Reviews* 30, n5 p211-233 1985.

Keywords: *Aluminum alloys, *Copper alloys, Thermodynamic properties, Phase diagrams, Reprints.

Data pertaining to stable and metastable phase equilibria, crystal structures, and thermodynamic properties of Al-Cu alloys have been compiled and critically assessed. The phase diagram has been calculated from optimized Gibbs energy functions. Estimates are provided for the contribution of elastic (coherency) energy to the Gibbs energy.

**701,186
PB87-150728** Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Complementary Use of Atom Probe Field-Ion Microscopy and Analytical Transmission Electron Microscopy for the Study of a Ni-Base Superalloy.

Final rept.,
A. J. Melmed, M. E. Twigg, R. Klein, M. J. Kaufman, and H. L. Fraser. 1984, 6p
Pub. in *Jnl. de Physique* 45, nC9 p373-378 1984.

Keywords: *Chemical analysis, *Nickel alloys, Metallurgy, Reprints, *Superalloys, Nickel alloy 6Al 18Mo, Nickel alloy 25Al 4Mo 4Ta, Nickel alloy 4Al 20Mo 3Ta.

Compositions of the gamma, gamma1 and DO22 phases in the nickel-base superalloy RSR143 (76Ni-13Al-9Mo-2Ta, at. %) have been determined via atom probe field-ion microscopy (APFIM) as 76Ni-6Al-18Mo, 76Ni-25Al-4Mo-4Ta and 73Ni-4Al-20Mo-3Ta respectively. Using energy dispersive x-ray spectroscopy in the analytical transmission electron microscopy (TEM), the composition of the gamma phase (69Ni-22Al-4Mo-5Ta) was found to be similar to that determined by APFIM. The deviation of the DO22 composition from Ni3Mo is in agreement with the prediction of a recent TEM study.

**701,187
PB87-151643** Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Compression Studies of a Nickel-Based Superalloy, MAR-M200, and of Ni3Al.

Final rept.,
F. A. Maurer, R. G. Munro, G. J. Piermarini, S. Block, and D. P. Dandekar. 15 Nov 85, 4p
Sponsored by Army Materials and Mechanics Research Center, Watertown, MA.
Pub. in *Jnl. of Applied Physics* 58, n10 p3727-3730, 15 Nov 85.

Keywords: *Nickel alloys, *Compression, Equations of state, Bulk modulus, Reprints, Superalloys, Nickel aluminate, Nickel alloy MAR-M200.

MATERIALS SCIENCES

Nonferrous Metals & Alloys

The lattice parameter of a cubic nickel-based alloy, MAR-M200, has been determined as a function of pressure for $O < P < 14$ GPa at room temperature. A similar study was made for Ni3Al in the range $O < P < 11$ GPa at room temperature. In both cases, the diamond anvil cell was used in conjunction with the energy dispersive method of x-ray diffraction. The data were analyzed in the context of model equations of state and in comparison with other results from ultrasonic studies.

701,188
PB87-151650 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Photons in LiC6 and in Heavy Alkali Metal Graphite Intercalation Compounds.
Final rept.,
A. Magerl, H. Zabel, and J. J. Rush. Dec 83, 7p
Pub. in Synthetic Metals (Switzerland) 7, n3-4 p339-345 Dec 83.

Keywords: Photons, Alkali metal compounds, Neutron scattering, Reprints, *Lithium carbides.

The authors have measured the longitudinal (ooq) and transverse (qoo) modes in LiC6 by inelastic neutron scattering, including the observation of a very-high-energy phonon branch, tentatively assigned to an optic mode. Analysis of the longitudinal (ooq) modes by a one dimensional shell model yields force constants which are considerably larger than those of the heavy alkali-metal stage 1 compounds. Also, the interlayer shear constant C44 is found to be distinctively larger than in the other stage 1 compounds. Yet, LiC6 still shows an omega - q (sub 2) dispersion of the transverse mode, characteristic for layered materials. Low temperature measurements on KC24 revealed a mode splitting in the longitudinal acoustic (ooq) branch, which persists at temperatures above the alkali order-disorder phase transition at 123 K. The splitting may be caused by an Einstein-like in-band mode, which seems also to hybridize the (qoo) transverse branch.

701,189
PB87-153607 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Correlation between Ultrasonic and Hardness Measurements in Aged 2024 Aluminum Alloy.
Final rept.,
M. Rosen, L. Ives, S. Ridder, F. Biancianiello, and R. Mehrabian. 1985, 10p
Pub. in Materials Science and Engineering 74, n1 p1-10 1985.

Keywords: Aging(Metallurgy), Nondestructive tests, Hardness, Reprints, *Aluminum alloy 2024.

Sound-wave velocity, ultrasonic attenuation, eddy currents and hardness measurements have been carried out on precipitation-hardening 2024 Al alloys subjected to a series of different preaging heat treatments prior to processing to T4, T351 and T851 tempers. For each temper the maximum hardness was found to correspond to a particular value of sound velocity. These results were correlated with electron microscopy observations of the microstructure. Ultrasonic attenuation was found to consistently decrease as hardness increased. Preaging at 350 °C was found to induce most rapid initial reduction in hardness, and corresponding changes in sound velocity and ultrasonic attenuation. The investigation has demonstrated the feasibility of ultrasonic techniques for nondestructive evaluation and characterization of age hardened aluminum alloys.

701,190
PB87-161626 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Phase Equilibria in the Titanium-Aluminum System.
Final rept.,
R. D. Shull, A. J. McAlister, and R. C. Reno. 1985, 8p
Pub. in Titanium-Science and Technology 3, p1459-1466 1985.

Keywords: *Titanium alloys, *Aluminum alloys, Phase diagrams, Reprints, *Phase equilibria.

The Ti-rich end of the Titanium-Aluminum phase diagram has been determined on high purity (low interstitial content) alloys. The phase equilibria was determined both dynamically (by means of differential thermal analysis - DTA) as well as statically (by means of

transmission electron microscopy, TEM, and large angle neutron diffraction), the latter being performed on well equilibrated and quenched samples. The consistency between these two types of data is evaluated for this system and explanations for confusion in the literature over the phase relationships in this alloy system are given. Chief among the results are a clarification of the order-disorder alpha-hexagonal phase boundaries.

701,191
PB87-161642 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Local Atomic Environments in Periodic and Aperiodic Al-Mn Alloys.
Final rept.,
L. H. Bennett, M. Kuriyama, G. G. Long, M. Melamud, R. E. Watson, and M. Weinert. 15 Dec 86, 3p
Pub. in Physical Review B 34, n12 p8270-8272, 15 Dec 86.

Keywords: *Aluminum alloys, *Manganese alloys, Molecular structure, Reprints.

The authors have applied Wigner-Seitz constructs to several known crystal phases of Al-Mn and to two independent descriptions of the Al-Mn icosahedral phase for which all the atomic positions are available. The resulting measures of local atomic environments for the icosahedral phase are in agreement with one another and with experiment: broad distributions in site metrics and volumes of both Mn and Al sites, none of which have local icosahedral point symmetry, and a similar radial distribution function.

701,192
PB87-163689 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD.
Dislocation - Crack Interactions.
Final rept.,
R. Thomson. 1986, 4p
Pub. in Scripta Metallurgica 20, n11 p1473-1476 1986.
Keywords: *Metallurgy, *Dislocations(Materials), Cracking(Fracturing), Reprints.

The paper gives a brief overview of the fundamental aspects of fracture in materials which rely on the interaction of cracks with dislocations.

701,193
PB87-164083 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Comparison of Several Path Independent Integrals Including Plasticity Effects.
Final rept.,
W. C. Carpenter, D. T. Read, and R. H. Dodds. 1986, 21p
Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD., and Naval Sea Systems Command, Washington, DC.
Pub. in International Jnl. of Fracture 31, p303-323 1986.

Keywords: *Fracture properties, Finite element analysis, Reprints, J integral.

Proceeding from the work of Eshelby, a path independent integral, J bar, is developed which is the negative of the rate of change of total energy for a material characterized by an incremental plasticity model. The integral is compared to several well known integrals to indicate that those integrals, for such a material, are deficient in certain terms with regard to the rate of change of total energy. The various integrals are compared on the three point bend specimen. The J integral was found to be very sensitive to the finite element idealization and limited studies indicate that under certain conditions that other more easily calculated integrals can be substituted for J bar.

701,194
PB87-165908 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Application of Pulse-Echo Ultrasonics to Locate the Solid/Liquid Interface During Solidification and Melting.
Final rept.,
R. L. Parker, and J. R. Manning. 1986, 13p
Pub. in Jnl. of Crystal Growth 79, p341-353 1986.

Keywords: *Solidification, *Metallurgy, Melting, Crystal growth, Reprints.

The velocity of sound and the density have values that are sufficiently different for liquid as compared to solid phases of metals, alloys, and semiconductors to permit the use of pulse-echo ultrasonic techniques to locate the solid/liquid interface during solidification and melting. Experimental results are presented for pulse-echo observation of the melting and freezing of pure iron, 304 stainless steel, tin and single-crystal (111) silicon using Bridgman-type furnaces with unidirectional heat flow, at frequencies from 1 to 5 MHz. Digital signal processing is applied to materials in which there is substantial Rayleigh grain scattering or for materials, such as concentrated alloys, that have solid/liquid interfaces that are not sharp. Recent experiments have shown that the technique is capable of locating, in real time, the solid/liquid interface with a sensitivity within one or two thousandths of an inch in favorable circumstances. It thus appears to have a number of potential applications to process control in the field of crystal growth from the melt, particularly for substances in which the solid/liquid interface cannot be conveniently located during growth since they are opaque to visible light (metals or semiconductor), as well as applications in metals processing and continuous casting. Additionally, information concerning the structure of the solid/liquid interface can be deduced from its ultrasonic reflectivity. The technique, since it provides information both on the location of the interface and on its characterization, may be regarded as real-time ultrasonic metallography.

701,195
PB87-167409 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Microanalytical Study of Secondary Precipitation in a Nickel-Base Superalloy with Use of Atom Probe Field Ion Microscopy and Analytical Transmission Electron Microscopy.
Final rept.,
M. E. Twigg, A. J. Melmed, R. Klein, M. J. Kaufman, and H. L. Fraser. 1984, 4p
Pub. in Anal. Electron Microsc., p185-188 1984.

Keywords: Nickel alloys, Phase transformations, Reprints, *Nickel alloy 13Al 9Mo 2Ta, Electron microscopy, Super alloys.

At temperatures below 800 deg C, RSR 143 (76Ni-13Al-9Mo-2Ta, at. %) exhibits a 20 % improvement in stress capability over directionally solidified Mar-M200. Pearson, et al. have ascribed this improvement to fine scale secondary precipitates and have recommended the stabilization of these precipitates through compositional modification of the alloy. Such an objective in alloy design would be more easily accomplished if the composition of the precipitates and the surrounding gamma matrix were known and if the kinetics for formation and dissolution of such precipitates were understood. The question of kinetics has been addressed in an extensive transmission electron microscopy (TEM) study by Martin, et al. The small size of these secondary precipitates hinders the determination of such compositions through current analytical TEM techniques. These compositions can, however, be determined using atom probe field ion microscopy (APFIM), the principal technique employed in the study.

701,196
PB87-179396 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Thermosolutal Convection during Directional Solidification. 2. Flow Transitions.
Final rept.,
G. B. McFadden, and S. R. Coriell. Mar 87, 13p
See also report dated Dec 84, PB85-172484.
Pub. in Physics of Fluids 30, n3 p659-671 Mar 87.

Keywords: *Convection, *Solidification, Concentration(Composition), Fluid flow, Prandtl number, Nonlinear differential equations, *Binary alloys.

The effect of thermosolutal convection on the solute segregation in crystals grown by vertical directional solidification of binary metallic alloys or semiconductors is considered. Numerical results are obtained using finite differences in a two-dimensional, time-dependent model that assumes a planar crystal-melt interface. The configuration is assumed to be periodic in

the horizontal direction with a given period, and the possibility of multiple flow states sharing the same period is examined. The results are summarized in bifurcation diagrams of the nonlinear states associated with the critical points of linear theory. The use of a time-dependent numerical scheme results in gaps in the bifurcation diagram where presumed unstable states exist that cannot be computed by this procedure. As the solutal Rayleigh number is varied, multiple steady states, time-periodic states, and quasiperiodic states may occur. The case is compared to the simpler case of thermosolutal convection with linear vertical gradients and stress-free boundaries, for which a rather complete numerical treatment is possible through the use of a simple spectral representation of the nonlinear solution.

701,197
PB87-196366 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Surface Segregation in Liquid Ga-Sn Alloys by AES (Auger Electron Spectroscopy).
Final rept.,
S. C. Hardy, and J. Fine. 1983, 11p
Pub. in Surface Science 134, n1 p184-194 1983.

Keywords: *Gallium alloys, *Tin alloys, *Adsorption, Liquid phases, Surface properties, Separation, Reprints, Auger electron spectroscopy.

The surface segregation of Sn in liquid Ga-Sn alloys has been studied by Auger electron spectroscopy as a function of bulk composition at 350 degrees C. The tin was found to be strongly adsorbed at the surface. The surface concentrations of Sn and Ga were calculated from the Auger measurements using inelastic mean free paths and backscattering factors estimated in recent theoretical work. The values found for the surface concentrations are essentially in agreement with those deduced from surface tension measurements using Gibbs adsorption theory assuming a monolayer adsorption distribution.

701,198
PB87-201395 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Magnetism and the Observation of NMR Lines in Hexagonal Al₄Mn and Icosahedral Al-Mn Alloys.
Final rept.,
L. H. Bennett, M. Rubinstein, G. Xiao, and C. L. Chien. 1987, 2p
Pub. in Jnl. of Applied Physics 61, n8 p4364-4365, 15 Apr 87.

Keywords: *Magnetism, *Aluminum, Manganese, Magnetic susceptibility, Reprints, *Nuclear magnetic resonance, Icosahedral alloys.

Previous measurements of the magnetic susceptibility and the intensity of the 55Mn NMR line in a number of periodic and quasiperiodic (i.e., icosahedral) Al-Mn and Al-Mn-Si alloys suggested some correlation, in that the 55Mn line intensity decreases as the magnetic susceptibility increases. The correlation had led to the tentative conclusion that the reduction of the 55Mn line intensity is due to the magnetism, and that the 'magnetic' Mn atoms are not seen in the NMR. The authors have found that the above correlation breaks down in a very substantial way for hexagonal Al₄Mn which (i) shows a small magnetic susceptibility, and (ii) no observable 55Mn line. Thus the reduction in intensity in the 55Mn NMR line in the icosahedral phase is not necessarily due to its magnetism but may have its origin in another line broadening mechanism.

701,199
PB87-201398 PC A04/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Evaluation of Cracking in Aluminum Cylinders.
Final rept.,
J. H. Smith. Mar 87, 52p NBSIR-86/3492
Sponsored by Department of Transportation, Washington, DC.

Keywords: *Gas cylinders, *Aluminum, Pressure vessels, Cracking(Fracturing), Threads, Aluminum alloy 6351.

Cracking was first observed in the threaded area of high pressure (4500 psi) fiberglass-wrapped composite-aluminum compressed gas cylinders and has resulted in the leaking and rupture of a few of these cylinders in the last three years. More recently, the neck

and threaded area of some fiberglass-wrapped composite-aluminum and some seamless aluminum (type 3A1) cylinders have been visually inspected during the normal periodic retest. As a result of this visual inspection at the time of retesting, several aluminum cylinders were reported to show evidence of cracking in the neck and threaded area. A group of these cylinders was obtained for more detailed laboratory examination to determine the extent of the cracking and to attempt to assess the significance of the cracking. The report describes the results of the laboratory tests on this group of cylinders that were reported to have cracks.

701,200
PB87-201737 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Effects of Sliding Motion and Tarnish Films on the Break-in Behavior of Three Copper Alloys.
Final rept.,
P. J. Blau. 1987, 8p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Wear of Materials 1987, v1 p93-100 1987.

Keywords: *Copper alloys, *Sliding, *Tarnishing, Wear tests, Friction tests, Steels, Microstructure, Aluminum containing alloys, Tin containing alloys, Zinc containing alloys.

The effects of both sliding direction and tarnish films on the unlubricated break-in behavior of Cu-3.5 wt% Al, Cu 5 wt% Sn, and Cu 15 wt% Zn on AISI 52100 steel are compared. The tests were conducted on all three alloys using a hemispherically tipped pin-on-flat geometry. The present research compares the break-in friction curves and track widths of these materials as-polished, with a copper oxide tarnish coating, and with testing in both unidirectional and reciprocating sliding directions.

701,201
PB87-233995 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Temperature Dependence of Yield Stress and Fracture Toughness in Unstabilized Zirconia Crystals.
Final rept.,
T. W. Coyle, R. P. Ingel, and P. A. Willging. 1987, 7p
Pub. in Materials Research Society Symposium Proceedings, v78 p89-96 1987.

Keywords: *Zirconium oxides, Crystals, Fracture strength, High temperature tests, Toughness, Yield strength, Reprints, *Foreign technology.

The flexural strength and the single edge notch beam fracture toughness of undoped ZrO₂ crystals, grown by the skull melting technique, were examined from room temperature to 1400 deg C. On heating the toughness increased with test temperature to a maximum of 4.0 MPa/m at 1225 deg C then gradually decreased to 2.6 MPa/m. Upon cooling after a 20 minute hold at 1250 deg C an increase in toughness to 5 MPa/m was observed at 1200 deg C; upon cooling to lower temperatures gradually diminished. The load-deflection curves for the flexural strength tests showed marked non-linearity before failure for samples tested on cooling. The temperature dependence of the apparent yield stress suggests that initial yielding occurs by slip above 1200 deg C but that from 1200 deg C to 1050 deg C the observed yielding is due to stress induced tetragonal to monoclinic transformation.

701,202
PB88-117320 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Neutron Diffraction Study of Age-Hardened U - 0.75wt% Ti Alloy.
Final rept.,
C. S. Choi, H. J. Prask, and G. M. Ludtka. 1987, 8p
Pub. in Jnl. of Nuclear Materials 150, p85-92 1987.

Keywords: Reprints, *Uranium alloy, *Lattice distortion, *Neutron diffraction, Particle size, Precipitation hardening.

Depleted uranium alloys containing 0.75 wt% titanium were prepared by gamma-quenching followed by aging with five different aging time and temperature conditions. The microstructural properties of the alloys were studied by using the neutron powder diffraction method and the small angle neutron scattering (SANS) method. The Rietveld refinement of the powder diffraction patterns for the uranium phase indicated two dis-

tinct aging stages for the alloy. In the first aging stage, the distortion of the b-axis length and the unit cell volume of the uranium phase increased with aging, and reached a peak value at an aging condition between 500 deg C/100 s and 550 C/1000 s. In the second aging stage, the above parameters decreased with increasing aging. The entire profiles of the diffraction patterns of the aged samples (two phases) were analyzed with multiphase Rietveld refinement to determine the amounts of U₂Ti (sigma-phase) as a function of aging treatment. The particle size distributions of the sigma-phase precipitates were determined from the SANS data. The observed indentation hardness versus aging conditions closely paralleled the aging dependencies of the lattice distortion of the uranium phase and the number of the precipitates.

701,203
PB88-117429 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD.
Historical Perspective on the Utilization of Phase Diagrams for Precipitation Hardening.
Final rept.,
J. W. Cahn. 1983, 3p
Pub. in Bulletin of Alloy Phase Diagrams 4, n4 p349-351 1983.

Keywords: *Precipitation hardening, *Phase diagrams, Reprints, Historical aspects, Uses.

The suggestion in 1919 that precipitation would harden alloys had an immediate impact on the development of new alloys and led to a period of extremely active interest in careful phase diagram determinations. It also sparked a lively debate that had a lasting impact on physical metallurgy and led to a forerunner of dislocation theory.

701,204
PB88-117676 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div. Creep Cavities in Copper: An Ultrasonic-Velocity and Composite-Modeling Study.
Final rept.,
H. M. Ledbetter, R. J. Fields, and S. K. Datta. 1987, 6p
Pub. in Acta Metallurgica 35, n9 p2393-2398 1987.

Keywords: *Copper, *Creep properties, Cavities, High temperature tests, Sound waves, Reprints, *Foreign technology.

The study considered cavities produced in polycrystalline copper by high-temperature tensile creep. Experimentally, the authors measured longitudinal sound-wave velocities, both parallel and perpendicular to the stress axis. Theoretically, the authors used a scattered-plane-wave ensemble-average model to predict the effects of voids on sound velocity.

701,205
PB88-121942 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Microstructural Studies on Supercooled Sub-Micrometer Powder Particles.
Final rept.,
D. Shechtman, S. D. Ridder, and R. Mehrabian. 1982, 9p
Pub. in Proceedings of Conference on Rapid Solidification Processing (3rd): Principles and Technologies III, Gaithersburg, MD., December 1982, p96-104.

Keywords: *Aluminum alloys, *Copper alloys, Microstructure, Powder(Particles), Transmission electron spectroscopy, Rapid solidification, Rapid quenching(Metallurgy).

Various Al-Cu alloy powders were made by the Micro-particle Processor, and their microstructure was studied by transmission electron microscopy. The powder particles which sizes range from 3 nm to a few micrometers demonstrate different structural characteristics ranging from amorphous to ordered crystalline intermetallic, depending upon composition and particle size. Extended solid solubility was observed in all the alloys examined. Some of the results obtained from Al-Cu alloy powders will be shown and discussed. The cooling rates needed to suppress crystallization in some alloys will be calculated.

MATERIALS SCIENCES

Nonferrous Metals & Alloys

701,206

PB88-129861

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Analysis of the Microstructure of Rapidly Solidified Al-8 wt% Fe Powder.

Final rept., W. J. Boettinger, L. Bendersky, and J. G. Early.

1986, 10p

Pub. in Metallurgical Transactions A 17, n5 p781-790 May 86.

Keywords: *Aluminum alloys, *Solidification, *Powder metals, Eutectics, Microstructure, Reprints.

Rapidly solidified powders of Al-8 wt% Fe exhibit four distinct microstructures with increasing particle diameter in the size range of 5 micrometer to 45 micrometers; microcellular alpha-Al; cellular alpha-Al; and AlFe eutectic; and Al₃Fe primary intermetallic structure. Small powder particles undercool significantly prior to solidification and typically exhibit a two-zone microcellular-cellular structure in individual powder particles. Larger particles experience little or no initial undercooling prior to solidification and do not exhibit the two-zone structure. The larger particles contain cellular, eutectic, or primary intermetallic structures that are consistent with growth rates controlled by heat extraction through the particle surface (external heat flow).

701,207

PB88-129879

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Microstructure Formation in Rapidly Solidified Alloys.

Final rept., W. J. Boettinger, and S. R. Coriell. 1986, 19p

Pub. in NATO ASI (Advanced Study Institute) Series E 114, p81-109 1986.

Keywords: *Solidification, *Powder alloys, Microstructure, Dendritic powder, Reprints.

In order to apply solidification theory to the interpretation of microstructures produced by rapid solidification, several modifications are required. A modification is presented here for alloy dendritic growth theory. For alloys solidifying dendritically into undercooled melts, solute redistribution dominates the relationship between growth rate and initial undercooling when the initial undercooling is smaller than the alloy freezing range (difference between liquidus and solidus temperatures). The fact has several important consequences for the eutectic coupled zone boundaries and for arrayed dendritic growth.

701,208

PB88-139159

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Residual Stress Determination in Aluminum Using Electromagnetic Acoustic Transducers.

Final rept., A. V. Clark, and J. C. Moulder. 1985, 7p

Pub. in Ultrasonics 23, n6 p253-259 Nov 85.

Keywords: *Ultrasonic tests, *Residual stress, Aluminum alloys, Texture, Reprints, EMAT(Electromagnetic Acoustic Transducer).

The residual stresses in a shrink-fit specimen were measured ultrasonically, using shear-horizontal (SH-) waves transmitted and received by noncontacting electromagnetic acoustic transducers. The presence of stress induces a small change in the velocity of the SH-waves. The difference in velocities of orthogonally polarized SH-waves is measured with a simple time-interval averaging system; the velocity difference can be related to the difference of principal stresses. The presence of material anisotropy (texture) also causes relative velocity changes comparable to stress-induced changes.

701,209

PB88-141312

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Fundamentals of Rapid Solidification.

Final rept., W. J. Boettinger, and J. H. Perepezko. 1985, 38p

Pub. in Proceedings of TMS-AIME Conference on Rapidly Solidified Crystalline Alloys, Morristown, NJ, May 1-3, 1985, p21-58.

Keywords: *Solidification, Phase transformations, Nucleation, Kinetics, Thermodynamics, Heat transfer, *Rapid quenching (Metallurgy).

General principles governing the liquid to solid transformation at high rates can provide a unified framework to understand the variety of processing approaches used in rapid solidification. These principles can be divided into four areas: heat flow, thermodynamics, nucleation, and growth kinetics. To a certain extent, heat flow determines the relationship between externally controllable processing parameters and the internal fundamental solidification parameters. The thermodynamics of metastable and non-equilibrium solidification sets the possible range of solidification product phases, while nucleation and growth kinetics determine the detailed microstructural evolution. Selected topics in these four areas are examined, including the role of melt subdivision, undercooling and liquid cooling rate on nucleation kinetics, and the role of solute redistribution on growth kinetics.

701,210

PB88-147467

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Icosahedral Al-Mn and Related Phases: Resemblance in Structure.

Final rept., L. Bendersky, R. J. Schaefer, F. S. Biancaniello, W. J. Boettinger, M. J. Kaufman, and D. Shechtman.

1985, 6p

Pub. in Scripta Metallurgica 19, n7 p909-914 1985.

Keywords: *Aluminum alloys, *Manganese containing alloys, *Crystal structure, Solidification, Reprints, *Icosahedral phase, *Aluminum intermetallics, *Manganese intermetallics, Rapid quenching (Metallurgy), Transmission electron microscopy, Aluminum manganese.

An icosahedral phase showing non-crystallographic point group symmetry (M-3-5) and at the same time sharp single crystal-like electron diffraction has recently been reported. In Al-Mn alloys, the phase is formed at alloy compositions between 15 and 35 wt% Mn. Several different techniques of rapid solidification provide sufficient melt undercooling to produce this phase. The icosahedral phase has been found to solidify in conjunction with other phases. One of these phases, called T phase, was previously reported as a product of solid state precipitation and is of interest due to the striking resemblance of electron diffraction patterns obtained from this phase and the icosahedral phase. In the present paper the authors report preliminary studies of the crystallographic relationship between these phases: icosahedral, T and Al₄Mn. The study was performed using conventional and high-resolution transmission electron microscopy.

701,211

PB88-147491

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Rapidly Solidified Al-Cr Alloys: Structure and Deformation Behavior.

Final rept., L. Bendersky, R. J. Schaefer, F. S. Biancaniello, and D. Shechtman. 1986, 8p

Pub. in Jnl. of Materials Science 21, n6 p1889-1896 Jun 86.

Keywords: *Aluminum alloys, *Chromium containing alloys, Solidification, Precipitation hardening, Supersaturation, Reprints.

Melt-spun ribbons of Al containing up to 15wt% Cr were examined in the as-spun condition and after annealing. The more concentrated alloys contained multi-phase spherulites embedded in an alpha-Al matrix: chemical microanalysis showed the average composition of the spherulite core to be + or - 2 wt% Cr. The kinetics of precipitation at grain boundaries and within the matrix were determined by TEM and x-ray diffraction. Three very similar Al-Cr intermetallic phases are present in the equilibrium phase diagram, but most of the precipitates in the melt-spun ribbons could be identified as Al₇Cr.

701,212

PB88-147616

Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.

Strength and Toughness of AISI 304 and 316 at 4 K.

Final rept.,

N. J. Simon, and R. P. Reed. 1986, 5p

Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.

Pub. in Jnl. of Nuclear Materials 141-143, p44-48 1986.

Keywords: *Superconducting magnets, Nuclear fusion, Fracture strength, Grain size, Yield strength, Cryogenics, Reprints, *Steel 304, *Steel 316.

Structural design of superconducting magnets in fusion energy devices requires reliable property data at 4 K. Nitrogen-strengthened AISI 304 and 316 stainless steels are considered to be the best currently available low temperature structural alloys on the basis of their fabricability and their potential to meet the US fusion research goals of combined yield strength and fracture toughness at 4 K. The paper presents provisional equations for the yield strength of 304- and 316-type alloys at 4 K as a function of N content and grain size.

701,213

PB88-152137

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Unit Cell Structure of Rapidly Cooled Al-Mn Alloys with Icosahedral Symmetry.

Final rept.,

M. Kuriyama, G. G. Long, and L. Bendersky. 1985,

3p

Pub. in Physical Review Letters 55, n8 p849-851 1985.

Keywords: *Aluminum alloys, *Manganese containing alloys, *Crystal structure, Reprints, Icosahedral phase, Rapid quenching (Metallurgy).

The structure of rapidly cooled Al - 14 at. pct. Mn with icosahedral symmetry is shown to be a three dimensionally layered structure consisting of a periodic unit cell.

701,214

PB88-152707

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Single Crystal Structure of Rapidly Cooled Alloys with Icosahedral Symmetry: 2. Theoretical Analysis-Internal Modulations.

Final rept.,

M. Kuriyama, and G. Long. 1986, 9p

Pub. in Acta Crystallographica, Section A A42, pt3 p164-172, 1 May 86.

Keywords: *Aluminum alloys, *Manganese containing alloys, *Crystal structure, Electron diffraction, Single crystals, Reprints, *Icosahedral phase, Rapid quenching (Metallurgy).

Applying traditional crystallographic analysis to a set of electron diffraction patterns taken from a rapidly cooled Al - 14 at. pct. Mn alloy, the authors have reconstructed the reciprocal lattice patterns in complete agreement with the observed icosahedral patterns. The results lead to an atomic scale model which is derived from two sets of modulations, each of which has six independent modulation vectors. The resultant structure is completely regular, and is shown to possess a unit cell with all the required symmetry properties. The relationship of this unit cell to 3D nonperiodic Penrose tilings is shown.

701,215

PB88-157722

PC A06/MF A01

National Bureau of Standards (IMSE), Gaithersburg, MD.

Institute for Materials Science and Engineering, Metallurgy: Technical Activities 1987.

Annual rept.

Oct 87, 106p NBSIR-87/3615

See also PB87-136685.

Keywords: *Metallurgy, Processing, Metals, Alloys, Nondestructive tests, Chemical properties, Mechanical properties, Corrosion, Wear, Electrodeposition, Magnetic materials, Radioactive waste, Technical activities.

The report summarizes the FY 1987 activities of the Metallurgy Division of the National Bureau of Standards. The research centers upon the structure-processing-properties relations of metals and includes alloys and on the methods of their measurement. The

activities also include the generation and evaluation of critical materials data. Efforts comprise studies of metallurgical processing, corrosion and wear, chemical metallurgy, electrodeposition, nondestructive characterization and magnetic materials. The work described also includes three cooperative programs with American professional societies and industry: the American Society for Metals (ASM) - NBS Alloy Phase Diagram Program, the National Association of Corrosion Engineers (NACE) - NBS Corrosion Data Program, the American Iron and Steel Institute (AISI) - NBS Steel Sensor Program, and the Aluminum Association. Work in support of other government agencies includes a major program to assist the Nuclear Regulatory Commission in addressing the critical national problem of disposing of high level nuclear waste in geologic repositories.

Plastics

701,216
N87-11589/5 PC A02/MF A01
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
Effects of Backing Plates on the Electron Exposure of Thin Polymer Films.
C. K. Chang, S. M. Seltzer, and J. W. Wilson. Nov 86, 16p NAS 1.15:88995, L-16183, NASA-TM-88995 Grant NSG-1614

Keywords: Electron irradiation, *Polymeric films, *Radiation dosage, Substrates, Thin plates, Electron bombardment, Monte carlo method, Transport properties.

The effects of backing plates on the radiation dose received by thin nylon films were calculated using recently developed multilayer electron transport codes. The film dose increased with increasing atomic number of the backing plate. The estimated dose could be off by a factor of 2 or more if the backing plate were ignored in the calculations.

701,217
PB87-152914 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Modeling of Chain Twist Boundaries in Polyvinylidene Fluoride as a Mechanism for Ferroelectric Polarization.
Final rept.,
D. H. Reneker, and J. Mazur. Jun 85, 6p
Pub. in Polymer 26, n6 p821-826 Jun 85.

Keywords: *Ferroelasticity, Polarization, Thermoplastic resins, Polymers, Reprints, *Polyvinylidene fluoride.

It is assumed that the process of ferroelectric polarization of the beta phase of polyvinylidene fluoride (PVF2) in response to the action of the external electric field in direction perpendicular to the molecular axis and to the film, involves movement of the chain twist boundaries. These boundaries, at which every chain is twisted by 180 degrees, separate domains of opposite polarization. The energy barriers that are surmounted as the boundary was advanced one repeat unit were calculated and compared with the energy gained by reversing the polarization of an unfavorably oriented repeat unit in an electric field that produces polarization in PVF2. It is suggested that the movement of chain twist boundaries, in contradistinction to previously postulated models in which only one is twisted at a time, provides a model for the poling of PVF2 that is feasible energetically and kinetically. Theoretical modeling, analogous to that for Bloch wall that separates domains in magnetic materials, suggest that the process of polarization might be described either as a diffusion process or as the propagation of a soliton along the chains.

701,218
PB87-173035 PC A05/MF A01
National Bureau of Standards, Gaithersburg, MD.
Reference Standard Polyethylene Resins and Piping Materials. Final Report October 1, 1985-September 30, 1986.
J. M. Crissman, F. W. Wang, C. M. Guttman, J. R. Maurey, and H. L. Wagner. Mar 87, 99p NBSIR-87/3506-GRI, GRI-86/0070-FR
Contract GRI-5084-260-1013
See also report for FY 85, PB86-203254. Sponsored by Gas Research Inst., Chicago, IL.

Keywords: *Plastic pipes, *Gas pipes, Standards, Polymers, Tensile tests, *Polyethylene resins, *Reference materials.

Polyethylene piping is currently in widespread use in gas distribution in the United States, and represents approximately 80% of new installation. Research that is currently being performed on gas pipes often employs many different polyethylenes selected from the large number of polyethylenes available for this use. The variation in materials makes it difficult to compare results from different research laboratories, or to compare measurements carried out in the same laboratory at different times. To avoid this difficulty Gas Research Institute and the National Bureau of Standards (NBS) have undertaken to provide a permanent store of one particular polyethylene resin as well as piping and fittings made from it which would provide a source of well characterized materials for research related to gas distribution systems. The report describes the choice of this resin and the types and quantities of the materials to be provided by NBS and the characterizations performed which include the determination of the branch content, melt flow rate, molecular weight and molecular weight distribution, density, and specific tensile properties.

701,219
PB87-197810 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
World of Polycarbonates.
Final rept.,
S. K. Sikdar. 1987, 7p
Pub. in Chemtech 17, p112-118 1987.

Keywords: *Polycarbonates, Thermoplastics, Reprints.

Polycarbonates, a member of a select group of engineering thermoplastics, have found applications to replace metals and glass where its strength and optical properties are important. More recently, because of intense competition from other thermoplastic formulations, blends and alloys of polycarbonates are being introduced. These blends and alloys optimally match performance for the cost justified for specific applications.

701,220
PB87-197950 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Thermal and Mechanical Properties of Polyurethane Foams at Cryogenic Temperatures.
Final rept.,
L. L. Sparks, and J. M. Arvidson. 1985, 35p
See also PB85-187367. Sponsored by Gas Research Inst., Chicago, IL.
Pub. in Jnl. of Thermal Insulation 8, p198-232 Jan 85.

Keywords: *Polyurethane resins, *Foam, *Thermal properties, *Mechanical properties, *Insulation, Cryogenics, Physical properties, Gas chromatography, Mass spectroscopy, Thermal expansion, Reprints, *Expanded plastics.

Expanded plastics are used extensively for thermal insulation in cryogenic fuel facilities. Properties determined were thermal conductivity, thermal expansion, strength and moduli in compression and in tension, proportional limit, yield strength, ultimate strength, and shear strength. Physical properties were determined both parallel and perpendicular to the direction of foam rise. The gas content of the specimens was determined using a gas chromatograph-mass spectrometer, and the cell morphology was studied optically. Empirical procedures for estimating the temperature dependent thermophysical properties are discussed. These procedures utilize the characterization parameters for molar gas concentration and cell morphology.

701,221
PB87-224465 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Glass Temperature of Polymer Rings.
Final rept.,
E. A. Di Marzio, and C. M. Guttman. 1987, 5p
Pub. in Macromolecules 20, n6 p1403-1407 Jun 87.

Keywords: Temperature, Reprints, *Cyclic polymers, Entropy glass theory, *Glass transition, *Polymer rings.

The entropy theory of glass formation is used to predict the glass temperatures of a bulk polymer system

consisting of noncatenated rings. It is found that the glass temperature of ring systems increases as the molecular weight is lowered, while the glass temperature of linear polymers decreases with decreasing molecular weight. Quantitative predictions for cyclic and linear poly(dimethylsiloxanes) and for cyclic and linear polystyrene are made and compared to experiment.

701,222
PB87-224473 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
WAXS (Wide-Angle X-ray Scattering) Study of the Deformation Behaviour of MDI/BDO Based Polyurethanes.
Final rept.,
R. M. Briber, and P. Sung. 1987, 5p
Pub. in Polymer Communications 28, n6 p162-166 Jun 87.

Keywords: Reprints, *Polyurethane, Wide angle x ray scattering, *Deformation, Segmented copolymer, WAXS.

The deformation of MDI/BDO based segmented polyurethanes has been studied by WAXS. The meridional portion of the MDI/BDO chain axis reflection moves to larger d-spacings with increasing deformation. The position of the reflection varies from 0.770 nm at 0 percent deformation to 0.877 nm at 700 percent stretch. At 700 percent stretch the reflection exhibits continuous diffuse scattering along the fourth layer line. This is evidence for a high degree of disorder between neighboring chains along the stretch direction. Upon annealing the stretched sample the disorder is lost and the polymer crystallizes in the type III crystal structure. The continuous change of d-spacing with stretch indicates a continuous change in length of the MDI/BDO repeated length with deformation. This leads to the conclusion that the conformational energy of the system is relatively insensitive to the butanediol conformation and may be dominated by effects such as hydrogen bonding and phenyl ring interactions.

701,223
PB88-110689 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Calculation of Thermal Degradation Initiated by Random Scission, Unsteady Radical Concentration.
Final rept.,
A. Inaba, and T. Kashiwagi. 1987, 11p
Pub. in European Polymer Jnl. 23, n11 p871-881 1987.

Keywords: *Polymers, Thermal degradation, Molecular weight, Cleavage, Computation, Reprints.

Changes in molecular weight distribution and in sample volume were calculated for thermal degradation of a polymer. The thermal degradation scheme consists of random scission initiation, depropagation and disproportionation termination reactions. An unsteady radical concentration was considered. There are two parameters, normalized zip length z/χ sub 0 and radical number per initial chain length z' chi sub 0, describing the thermal degradation scheme with an unsteady radical concentration.

701,224
PB88-134630 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Molecular Mechanism of Deformation in Epoxies--A Neutron Scattering Study.
Final rept.,
W. L. Wu. 1987, 7p
Pub. in Proceedings of the 1987 Materials Research Society Symposium, Boston, MA., December 1-4, 1986, p97-103 1987.

Keywords: *Epoxy resins, Deformation, Strain measurement, Neutron scattering, Crosslinking, Molecular structure.

Neutron scattering was used to investigate the molecular mechanism of large strain deformation in epoxies. Partially deuterated diglycidyl ether of bisphenol A (DGEBA) was cured with either tri- or di-amines of different molecular weights. The change of the average distance between crosslinks along the epoxy and the amine linkages could easily be determined from the shift in the positions of the scattering maxima.

MATERIALS SCIENCES

Plastics

701,225
PB88-147145 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.
**Creep and Recovery Behavior of a Linear High
Density Polyethylene and an Ethylene-Hexene Co-
polymer in the Region of Small Uniaxial Deforma-
tions.**
Final rept.,
J. M. Crissman. 1986, 10p
Pub. in Polymer Engineering and Science 26, n15
p1050-1059 Aug 86.

Keywords: *Polyethylene, *Ethylene copolymers,
*Creep tests, Molecular weight, Plasticity tests, Me-
chanical properties, Stress analysis, Recovery, Re-
prints, Ethylene hexene copolymer.

The results of creep and recovery experiments are re-
ported for two types of polyethylene, one a linear high
density homopolymer, and the other an ethylene-
hexene copolymer. Data were obtained at tempera-
tures in the range 23 degrees C to 57 degrees C and
creep times of from 10 sec to 4.33×100000 sec. In
order to approximate constant true stress conditions
all of the experiments were carried out at the same
value of applied stress (4 MPa) and the change in
strain during creep was in all cases less than 2 per-
cent. Comparison of these results with those from ear-
lier work on an ultra high molecular weight polyethylene
show that there is a great similarity in the behavior of
all three materials, and the behavior of all three can be
described quite well by a one-dimensional constitutive
equation consisting of two terms, one a hereditary
term and the other a plasticity term. It is further shown
that to a very good approximation the idea of time-tem-
perature superposition can be applied to the descrip-
tion of the hereditary term.

701,226
PB88-147152 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.
**Energy Calculations for the Crystal Structure of
the High Temperature Phases (I and IV) of Polyte-
trafluoroethylene.**
Final rept.,
B. L. Farmer, and R. K. Eby. 1985, 9p
Pub. in Polymer 26, n13 p1944-1952 1985.

Keywords: *Polymers, Crystal structure, Conformal
mapping, Crystal defects, Computation, Reprints, *Te-
trafluoroethylene resins, Phase transformations,
Order-disorder transformations, High temperature,
Energy levels.

Energy analysis is used to determine the low energy
crystal structure for polytetrafluoroethylene in the 15/7
conformation. It is also used to determine the energies
of various conformational defects. The perfect struc-
ture has a motif of two left- and two right-handed mo-
lecular stems in a triclinic unit cell with parameters, a,
b, and gamma of 1.102 nm, 1.142 nm, and 121 de-
grees, respectively. A variety of other perfect struc-
tures with higher energies exist. None of these corre-
sponds to the experimentally observed metrically hex-
agonal cell containing one rotationally disordered
stem. Excess energies were calculated for rotationally
disordering defects such as molecules with the 15/7
conformation in a crystal of 54/25 molecules (and vice
versa), rotated setting angle, reversed hand, and the
2/1 conformation.

701,227
PB88-147178 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Polymers Div.
**Mechanical Preconditioning of Ultra High Molecu-
lar Weight Polyethylene at Small Uniaxial Deforma-
tions.**
Final rept.,
J. M. Crissman, and L. J. Zapas. 1985, 12p
Pub. in Jnl. of Polymer Science, Polymer Physics Ed-
ition 23, n12 p2599-2610 Dec 85.

Keywords: *Polyethylene, *Creep strength, *Creep re-
covery, *Plasticity tests, Mechanical properties, Crys-
tallization, Stress relaxation, Molecular weight, Time
dependence, Temperature, Reprints.

The results of creep and recovery experiments are re-
ported for a sample of UHMWPE at three different
temperatures and creep times in the range from 10 sec
to $1.47 \times 100,000$ sec. In order to approximate con-
stant true stress conditions all of the experiments were

carried out at the same value of applied stress (4MPa)
and the change in strain during creep was never more
than about 2%. Findings are cited.

Refractory Metals & Alloys

701,228
PB88-117478 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Thermophysics Div.
**Microsecond-Resolution Transient Technique for
Measuring the Heat of Fusion of Metals: Niobium.**
Final rept.,
A. Cezairliyan, and J. L. McClure. 1987, 16p
Sponsored by National Aeronautics and Space Admin-
istration, Washington, DC.
Pub. in International Jnl. of Thermophysics 8, n5 p577-
592 Sep 87.

Keywords: *Refractory metals, *Niobium,
*Fusion(Melting), Electrical resistivity, Heat of fusion,
Reprints.

A microsecond-resolution pulse-heating technique is
described for the measurement of the heat of fusion of
refractory metals. The method is based on rapid resis-
tive self-heating of the specimen by a high-current
pulse from a capacitor discharge system and measure-
ment of the current through the specimen, the voltage
across the specimen, and the radiance temperature of
the specimen as a function of time. Melting of the
specimen is manifested by a plateau in the tempera-
ture versus time function. The time integral of the
power absorbed by the specimen during melting yields
the heat of fusion. Electrical resistivity of solid and
liquid niobium at its melting temperature was also
measured.

701,229
PB88-147483 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Metallurgy Div.
**Microstructural Characterization of Rapidly Solidi-
fied Nb-Si Alloys.**
Final rept.,
L. Bendersky, F. S. Biancaniello, W. J. Boettinger,
and J. H. Perepezko. 1987, 9p
Pub. in Materials Science and Engineering 89, p151-
159 May 87.

Keywords: *Niobium alloys, Solidification, Microstruc-
ture, Metastable state, Grain size, Glass, Reprints.

Rapidly solidified alloys of Nb-Si containing between
12 and 25 at.% Si are examined by analytical electron
microscopy to identify the phases present and the so-
lidification path. The phase Nb₃Si is absent either as
the equilibrium tetragonal phase or the A15 phase.
Glass formation is observed in high Si alloys but is dif-
ficult and observed only near the chill side of melt spun
ribbons.

Solvents, Cleaners, & Abrasives

701,230
PB87-197737 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Building Materials Div.
Performance Tests for Graffiti Removers.
Final rept.,
J. R. Clifton, and M. Godette. 1986, 11p
Pub. in ASTM STP (American Society for Testing and
Materials Special Technical Publication) 935, p14-24
1986.

Keywords: *Paint removers, Paints, Performance crite-
ria, Masonry, Cleaning, Reprints, *Crayon marks,
*Graffiti.

The defacing of the surfaces of masonry buildings with
graffiti has increased substantially during the past
decade, with removal cost exceeding several hundred
million dollars annually. An assortment of materials
have been used to remove graffiti with varying suc-
cess. The report discusses performance tests devel-
oped to form a technical basis for selecting effective
graffiti removers. Important considerations in develop-

ing the tests and criteria for graffiti removers were ef-
fectiveness in removing marks and effects on the ap-
pearance of masonry substrates. In developing per-
formance criteria, 'standard graffiti' were produced by
applying aerosol paints, crayons, lipstick, and felt tip
pens and markers to the surfaces of brick, sandstone,
limestone, and aluminum specimens. The effective-
ness of removers and their compatibility with masonry
substrates was determined by comparing the color
changes of unmarked, marked, and remover treated
masonry surfaces. Test methods were also developed
to determine the ability of removers to migrate into ma-
sonry.

Wood & Paper Products

701,231
PB87-158564 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.
**NBS (National Bureau of Standards) Voluntary
Product Standard: American Softwood Lumber
Standard (Amended 1986).**
1 Jan 86, 30p NBS/PS-20/70
Also available from Supt. of Docs as SN003-003-
02766-9.

Keywords: *Softwoods, *Lumber, *Standards, Size
determination, Manufacturing, Surface roughness,
Structural timber, Dimensional measurement, Thick-
ness, Width, Inspection, Requirements.

The responsibility of the entire softwood lumber indus-
try for maintaining, in the public interest, nationally re-
cognized size, grade, and inspection standards is re-
cognized. The purpose of this Product Standard is to
establish voluntary standards for the size, grade, and
inspection of softwood lumber. This Product Standard
is intended to establish a common basis for uniform
industrywide inspection and grade-marking practices
for each piece of lumber which is produced and sold in
accordance with the provisions hereof.

General

701,232
PB87-162251 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Office of Standard Reference Data.
**Progress Towards a Computerized Materials Data
System.**
Final rept.,
J. R. Rumble. 1985, 10p
Pub. in Computerized Materials Data - A Workshop for
Ground Vehicle Engineering, p25-34 1985.

Keywords: *Mechanical properties, Corrosion, *Com-
puterized materials data, Computer applications.

A survey is given of progress towards developing a
comprehensive computerized materials data system.
The various supporting activities are identified.

701,233
PB88-110838 Not available NTIS
National Bureau of Standards (NML), Gaithersburg,
MD. Surface Science Div.
**Progress of the VAMAS (Versailles Project on Ad-
vanced Materials and Standards) Surface Chemi-
cal Analysis Working Party.**
Final rept.,
C. J. Powell. 1987, 6p
Pub. in VAMAS (Versailles Project on Advanced Mate-
rials and Standards) Bulletin No. 6, p1-6 Jul 87.

Keywords: *Materials, *Surface chemistry, Standards,
Workshops, Reprints.

A brief status report is presented on recent activities
and current plans of the Surface Chemical Analysis
Working Party of the Versailles Project on Advanced
Materials and Standards (VAMAS).

701,234
PB88-152723 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Metallurgy Div.

Terminology Update - Fatigue and Fracture.

Final rept.,
C. G. Interrante. 1985, 2p
Pub. in ASTM (American Society for Testing and Materials) Standardization News, p28-29 Nov 85.

Keywords: *Standards, *Terminology, Documents, Fatigue(Materials), Fractures, Reprints, ASTM(American Society for Testing and Materials).

ASTM terminology standards are an essential part of the development and use of ASTM standard documents. Possibilities for expanding the applicability of terminology standards beyond the support of ASTM standards are explored as an invitation to all members of the Society to consider these wider uses. Approaches taken in ASTM Terminology Standards for fatigue and fracture are used as examples.

MATHEMATICAL SCIENCES

Analysis

701,235
PB87-164117 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Generalized Exponential and Logarithmic Functions.
Final rept.,
C. W. Clenshaw, D. W. Lozier, F. W. J. Olver, and P. R. Turner. 1986, 11p
Pub. in Computers and Mathematics with Applications 12B, n5-6 p1091-1101 1986.

Keywords: *Generalized functions, *Exponential functions, *Logarithm functions, Reprints.

Generalizations of the exponential and logarithmic functions are defined and an investigation is made of two possible versions of these functions. Some applications are described, including computer arithmetic, properties of very large and very small numbers, and the determination of functional roots.

701,236
PB87-197836 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Scientific Computing Div.
Polyadic Structure of Factorable Function Tensors with Applications to High-Order Minimization Techniques.
Final rept.,
R. H. F. Jackson, and G. P. McCormick. 1986, 32p
Pub. in Jnl. of Optimization Theory and Applications 51, n1 p63-94 1986.

Keywords: *Functions(Mathematics), Computation, Optimization, Tensors, Reprints, Matrices, Factorization, Halley method, Tangent hyperbolas method.

Factorable functions are shown to have arrays of Nth order derivatives (tensors) which are naturally computed as sums of generalized outer product matrices (polyads). The computational implications of this for high order minimization techniques (such as Halley's method of tangent hyperbolas) are investigated. A direct derivation of these high order techniques is also given.

701,237
PB87-225421 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Scientific Computing Div.
Generalization of the Eckart-Young-Mirsky Matrix Approximation Theorem.
Final rept.,
G. W. Stewart. Apr 87, 11p
Sponsored by Maryland Univ., College Park. Dept. of Computer Science.
Pub. in Linear Algebra and Its Applications 88-9, p317-327 Apr 87.

Keywords: *Matrices(Mathematics), *Approximation, Reprints, Eckart-Young theorem, Singular value decomposition.

The Eckart-Young theorem solves the problem of approximating a matrix by one of lower rank. However, the approximation generally differs from the original in all its elements. In the paper it is shown how to obtain a best approximation of lower rank in which a specified set of columns of the matrix remains fixed. The paper concludes with some applications of the generalization.

701,238
PB87-233524 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Infinitely Divisible Pulses, Continuous Deconvolution, and the Characterization of Linear Time Invariant Systems.
Final rept.,
A. S. Carasso. Aug 87, 36p
Contract ARO-63-82
Sponsored by Army Research Office, Research Triangle Park, NC.
Pub. in SIAM (Society for Industrial and Applied Mathematics) Jnl. on Applied Mathematics 47, n4 p892-927 Aug 87.

Keywords: Reprints, *Impulse response, *Time invariant system, *Pulse probing, *Volterra equations.

The paper addresses the problem of determining the impulse response of a linear time invariant system, by probing the system with a causal, C infinity approximation to the Dirac delta-function. The authors analyze the ill-posed deconvolution problem which results from a wide choice of possibly multimodal, infinitely divisible, probe pulses. The notion of infinite divisibility is shown to play a key role when the system's response is suspected of having nondifferentiable singularities. The authors reformulate the Volterra integral equation as a Cauchy problem for a linear partial differential equation in two independent variables, and introduce the concepts of partial and continuous deconvolution. The authors then show that partial deconvolution of the output waveform results in infinity error bounds for the regularized solution and its derivatives under L2 a priori bounds on the data noise and the unknown system response. Using the Poisson summation formula and FFT algorithms, the authors construct an efficient computational algorithm for performing continuous deconvolution, given sufficiently long but finite records of the probe pulse, and the output waveform. The theory is illustrated with several examples of computational reconstructions of singular elastic Green's functions, from smooth synthetic noisy data.

701,239
PB88-141049 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Ionizing Radiation Physics Div.
Further Results on Generalized Elliptic-Type Integrals.
Final rept.,
S. L. Kalla, C. Leubner, and J. H. Hubbell. 1987, 6p
Pub. in Applicable Analysis 25, p269-274 1987.

Keywords: *Elliptic functions, Reprints, *Integrals, Asymptotic approximation.

Simple direct proofs of some recent results by Kalla, Conde, and Hubbell for a generalized elliptic type integral (Appl. Anal., 22 (1986), pp. 273-287) are presented. Furthermore, a new single term asymptotic approximation for the function is derived, which is superior to the two term approximation given by these authors.

701,240
PB88-152574 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Molecular Spectroscopy Div.
Generalized Stirling Approximations to N Factorial.
Final rept.,
C. Leubner. 1985, 3p
Pub. in European Jnl. of Physics 6, n4 p299-301 1985.

Keywords: *Gamma function, Transcendental functions, Approximation, Reprints, *Stirling formula, Asymptotic methods.

Generalized asymptotic approximations to Gamma (x+1), which contain an arbitrary parameter, are derived both from the integral representation of the Gamma function without assuming the knowledge of the Stirling series, and through elementary rearrangements of the Stirling series. By optimizing the arbitrary parameter according to appropriate criteria, several known Stirling-like approximations are recovered in a

unifying way. Furthermore, a new such asymptotic series emerges, with a leading term that is as compact as but numerically superior to the known Stirling approximations, meaningful on the entire interval $-1 < x < \infty$, reasonably accurate even for x close to -1, and has a singularity as x tends to -1. It is pointed out that these interesting results - arrived at by elementary but generally applicable asymptotic techniques - can be exploited in physics teaching to demonstrate the power and utility of asymptotic methods in the analysis of a variety of physics problems.

701,241
PB88-152582 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Molecular Spectroscopy Div.
Note on the Uniform Asymptotic Expansion of Integrals with Coalescing End Point and Saddle Points.
Final rept.,
C. Leubner, and H. Ritsch. 1986, 7p
Pub. in Jnl. of Physics A 19, n3 p329-335, 21 Feb 86.

Keywords: Asymptotic series, Reprints, *Integrals, Contour integration.

For the uniform asymptotic expansion of certain types of contour integrals, one of whose critical points is an end-point of the interval of integration, a method alternative to Bleistein's is introduced and numerically tested by way of a non-trivial physical example.

701,242
PB88-153010 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Scientific Computing Div.
Algorithm HFFT - High-Order Fast-Direct Solution of the Helmholtz Equation.
Final rept.,
R. F. Boisvert. 1987, 15p
Pub. in ACM (Association for Computing Machinery) Transactions on Mathematical Software 13, n3 p235-249 Sep 87.

Keywords: Elliptic differential equations, Partial differential equations, Boundary value problems, Finite difference theory, Fourier analysis, Algorithms, Reprints, *Helmholtz equation, Two-dimensional calculations, Three-dimensional calculations, Discretization(Mathematics), HFFT algorithm.

HFFT is a software package for solving the Helmholtz equation on bounded two- and three-dimensional rectangular domains with Dirichlet, Neumann, or periodic boundary conditions. The software is the result of combining new fourth-order accurate compact finite difference (HODIE) discretizations and a fast-direct solution technique (the Fourier method). In the paper the authors briefly describe the user interface to HFFT and present an example of its usage and several details of its implementation.

701,243
PB88-153028 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Scientific Computing Div.
Fourth-Order-Accurate Fourier Method for the Helmholtz Equation in Three Dimensions.
Final rept.,
R. F. Boisvert. 1987, 14p
Pub. in ACM (Association for Computing Machinery) Transactions on Mathematical Software 13, n3 p221-234 Sep 87.

Keywords: Fourier analysis, Elliptic differential equations, Partial differential equations, Boundary value problems, Finite difference theory, Reprints, *Helmholtz equation, Discretization(Mathematics), Two-dimensional calculations, Three-dimensional calculations.

The author presents fourth-order-accurate compact discretizations of the Helmholtz equation on rectangular domains in two and three dimensions with any combination of Dirichlet, Neumann, or periodic boundary conditions. The resulting systems of linear algebraic equations have the same block-tridiagonal structure as traditional central differences and hence may be solved efficiently using the Fourier method. The performance of the method for a variety of test cases, including problems with nonsmooth solutions, is presented. The method is seen to be roughly twice as fast as deferred corrections and, in many cases, results in a smaller discretization error.

MATHEMATICAL SCIENCES

Analysis

701,244
PB88-153044 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Scientific Computing Div.
Status of the NBS (National Bureau of Standards)
Guide to Available Mathematical Software.
Final rept.,
S. E. Howe. 1986, 6p
Pub. in Computer Sciences and Statistics, Proceed-
ings of the Symposium on the Interface (17th), Lexing-
ton, KY., March 17-19, 1985, p307-312 1986.

Keywords: *Scientific data, *Statistics, *Mathematics,
Data processing, *Classifications, *Cataloging, Com-
putation, *Data bases, *Relational data bases, *Soft-
ware libraries, National Bureau of Standards, GAMS
system, Access, End use.

The Guide to Available Mathematical Software (GAMS) is a classification scheme, a data base system, and a printed catalog. GAMS provides a framework for both the end-user scientist and the software maintainer to handle large quantities of mathematical and statistical software. The extensive problem-oriented GAMS classification scheme provides a structure for organizing software for general purpose mathematical and statistical computations. The software currently cataloged in GAMS consists of approximately 2400 programs, sub-programs, and interactive systems in some two dozen libraries. These libraries are available on a variety of computers. Data about the software and about library availability are stored in a relational data base and are maintained using a variety of software tools. Users access the data via an on-line query system based on the classification scheme. The printed GAMS catalog organizes information about the software according to the classification scheme and in several other useful ways.

701,245
PB88-153648 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg,
MD. Mathematical Analysis Div.
Expected $O(N)$ and $O(N \sup 4/3)$ Algorithms for
Constructing Voronoi Diagrams in Two and Three
Dimensions,
J. Bernal. Nov 87, 44p NBSIR-87/3679

Keywords: Computation, Algorithms, Theorems, *Vor-
onoi diagrams, Computational geometry, Computa-
tional complexity, Two dimensional, Three dimension-
al.

Bentley, Weide and Yao have proposed an expected $O(N)$ cell technique for computing Voronoi diagrams in two dimensions that does not generalize readily to three. In this paper their work is further developed and generalized to produce expected $O(N)$ and $O(N \sup 4/3)$ algorithms for constructing Voronoi diagrams in two and three dimensions, respectively. Computational experience is presented for the algorithm in two dimensions.

701,246
PB88-162490 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Scientific Computing Div.
Stable and Efficient Algorithm for Nonlinear Or-
thogonal Distance Regression.
Final rept.,
P. T. Boggs, R. H. Byrd, and R. B. Schnabel. 1987,
17p
See also AD-A164 346.
Pub. in SIAM (Society for Industrial and Applied Mathe-
matics) Jnl. on Scientific and Statistical Computing 8,
n6 p1052-1078 Nov 87.

Keywords: *Curve fitting, Algorithms, Regression anal-
ysis, Equations, Errors, Nonlinear analysis, Reprints,
Levenberg Marquardt algorithm, *Least squares
method.

One of the most widely used methodologies in scientific and engineering research is the fitting of equations to data by least squares. In cases where significant observation errors exist in the independent variables as well as the dependent variables, however, the ordinary least squares (OLS) approach, where all errors are attributed to the dependent variable, is often inappropriate. An alternate approach, suggested by several researchers, involves minimizing the sum of squared orthogonal distances between each data point and the curve described by the model equation. The authors refer to this as orthogonal distance regression (ODR). The paper describes a method for solving the orthogon-

nal distance regression problem that is a direct analog of the trust region Levenberg-Marquardt algorithm. The number of unknowns involved is the number of model parameters plus the number of data points, often a very large number. By exploiting sparsity, however, the authors algorithms has a computation effort per step which is of the same order as required for the Levenberg-Marquardt method for ordinary least squares. The authors prove their algorithm to be globally and locally convergent, and perform computational tests that illustrate some differences between ODR and OLS.

Operations Research

701,247
PB87-233573 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Sci-
entific Computing Div.
Modular System of Algorithms for Unconstrained
Minimization.
Final rept.,
R. B. Schnabel, J. E. Koontz, and B. E. Weiss. 1985,
22p
See also report dated Nov 82, AD-A123 204.
Pub. in ACM Transactions on Mathematical Software
11, n4 p419-440 Dec 85.

Keywords: *Mathematical programming, Finite differ-
ence theory, Approximation, Algorithms, Reprints,
*Unconstrained minimization.

The authors describe a new package, UNCMIN, for finding a local minimizer of a real valued function of more than one variable. The novel feature of UNCMIN is that it is a modular system of algorithms, containing three different step selection strategies (line search, dogleg, and optimal step) that may be combined with either analytic or finite difference gradient evaluation and with either analytic, finite difference, or BFGS Hessian approximation. The authors present the results of a comparison of the three step selection strategies on the problems in More, Garbow, and Hillstom in two separate cases: using finite difference gradients and Hessians, and using finite difference gradients with BFGS Hessian approximations. They also describe a second package, REVMIN, that uses optimization algorithms identical to UNCMIN but obtains values of user supplied functions by reverse communication.

701,248
PB88-129762 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Scientific Computing Div.
Efficient Strategy for Utilizing a Merit Function in
Nonlinear Programming Algorithms.
Final rept.,
P. T. Boggs, and J. W. Tolle. 1986, 11p
Pub. in Lecture Notes in Mathematics 1230, p127-137
1986.

Keywords: *Nonlinear programming, Sequential anal-
ysis, Optimization, Algorithms, Reprints, Quadratic pro-
gramming, Merit functions, Newton method.

The problem considered is the equality constrained nonlinear programming problem. Many implementa-
tions of algorithms for solving such problems involve a merit function to assess the step, i.e., a procedure for deciding whether the next iterate is 'better' than the current iterate. In a previous paper, the authors introduced a merit function with desirable properties. The function is differentiable, an unconstrained minimum corresponds to a solution of the original problem, and its use will not interfere with q-superlinear convergence. The major drawback is that the merit function involves gradients of both the objective function and the constraint functions and hence it is expensive to use. In the paper, a related merit function which is cheap to evaluate and easy to implement is described. Some theoretical and numerical results are presented.

701,249
PB88-141346 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Scientific Computing Div.

Numerical Optimization, 1984.
Final rept.,
P. T. Boggs, R. H. Byrd, and R. B. Schnabel. 1985,
287p
Pub. in Proceedings of SIAM (Society for Industrial and
Applied Mathematics) Conference on Numerical Opti-
mization, Boulder, CO., June 12-14, 1984, 287p 1985.

Keywords: *Mathematical programming, *Numerical
analysis, *Optimization, *Meetings, Constrained opti-
mization, Computer software, Nonlinear analysis,
Global optimization.

The volume contains a selection of the papers presented at the SIAM Conference on Numerical Optimization held in Boulder, Colorado on June 12-14, 1984. The aim of the conference was to bring together researchers and practitioners of numerical optimization techniques to discuss the latest developments in the important area of numerical computation. Three topics were selected as the foci of the conference, namely nonlinearly constrained optimization, optimization software, and global optimization. Eight speakers were invited to give presentations on these topics. In addition, contributed papers on all topics pertinent to numerical optimization were solicited; approximately 90 papers covering the spectrum from research in new methods to novel applications were delivered. The conference was attended by 248 people widely distributed among government, industry, and academia.

701,250
PB88-153036 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Scientific Computing Div.
LP-Based Combinatorial Problem Solving.
Final rept.,
K. Hoffman, and M. Padberg. 1985, 69p
Pub. in NATO Adv. Sci. Inst. Ser. F: Comput. Systems
Sci. 15, p55-123 1985.

Keywords: *Linear programming, *Combinatorial anal-
ysis, Computation, Optimization, Problem solving, Integer
programming, Traveling salesman problem, Matrices.

A tutorial outline of the polyhedral theory that underlies linear-programming (LP)-based combinatorial problem solving is given. Design aspects of a combinatorial problem solver are discussed in general terms. Three computational studies in combinatorial problem solving using the polyhedral theory developed in the past fifteen years are surveyed: one addresses the symmetric traveling salesman problem, another the optimal triangulation of input/output matrices, and the third the optimization of large-scale zero-one linear programming problems.

Statistical Analysis

701,251
AD-A159 104/9 PC A02/MF A01
North Carolina Univ. at Chapel Hill. Inst. of Statistics.
Note on the Effect of Ignoring Small Measurement
Errors in Precision Instrument Calibration.
Technical rept. Sep 84-Sep 85,
R. J. Carroll, and C. H. Spiegelman. Jun 85, 17p
MIMEO SER-1580, AFOSR-TR-85-0701
Contract F49620-82-C-0009

Keywords: *Calibration, *Errors, Least squares
method, Measurement, Variations, Models, Linear re-
gression analysis, Mathematical models, Confidence
limits, Intervals, Measurement, Instrumentation, Preci-
sion, Slope, Statistical processes, Variables, Standard
deviation, Documents, Statistics, Confidence intervals,
Precision instruments.

The authors' focus is the simple linear regression model with measurement errors in both variables. It is often stated that if the measurement error in x is small, then we can ignore this error and fit the model to data using ordinary least squares. There is some ambiguity in the statistical literature concerning the exact meaning of a small error. For example Draper and Smith (1981) state that if the measurement error variance in x is small relative to the variability of the true x 's, then errors in the x 's can be effectively ignored, see Montgomery & Peck (1983) for a similar statement. Scheffe (1983) and Mandel (1984) argue for a second criterion, which may be informally summarized that the error in x

should be small relative to (the standard deviation of the observed Y about the line)/(slope of the line). We argue that for calibration experiments both criteria are useful and important, the former for estimation of x given Y and the latter for confidence intervals for x given Y . (Author)

701,252
PB87-152385 PC A14/MF A01
National Bureau of Standards, Boulder, CO.
STARPAC - The Standard Times Series and Regression Package,
J. R. Donaldson, and P. V. Tryon. Jan 87, 309p
NBSIR-86/3448

Keywords: *Time series analysis, *Statistical analysis, Analysis of variance, Least squares method, Correlation techniques, Regression analysis, Spectrum analysis, *STARPAC system, Subroutine libraries, Random number generators, Nonlinear analysis, Digital filtering.

STARPAC, the Standards Time Series and Regression Package, is a library of Fortran subroutines for statistical data analysis developed by the Statistical Engineering Division (SED) of the National Bureau of Standards (NBS), Boulder, Colorado. Earlier versions of this library were distributed by the SED under the name STATLIB (Tryon and Donaldson, 1978). STARPAC incorporates many changes to STATLIB, including additional statistical techniques, improved algorithms and enhanced portability. STARPAC emphasizes the statistical interpretation of results, and, for this reason, comprehensive printed reports of auxiliary statistical information, often in graphical form, are automatically provided to augment the basic statistical computations performed by each user-callable STARPAC subroutine. STARPAC thus provides the best features of many stand-alone statistical software programs within the flexible environment of a subroutine library.

701,253
PB87-162137 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Two Pitfalls of Using Standard Regression Diagnostics When Both X and Y Have Measurement Error.

Final rept.,
C. H. Spiegelman. 1986, 4p
Pub. in American Statistician 40, n3 p245-248 1986.

Keywords: *Regression analysis, Measurement, Errors, Reprints.

Modern data analysis produces models that are not based on physical theory, but rather on a model that is consistent with pictures of the data. When both X and Y have errors, this can be risky because important features are hidden. Two examples are given which show that systematic model departures and heteroscedasticity are not detectable in standard plots of the data.

701,254
PB87-162145 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Jensen's Inequality for General Location Parameter.

Final rept.,
C. H. Spiegelman. 1985, 1p
Pub. in Amer. Statist. 39, n1 p54 1985.

Keywords: *Inequalities, Convex functions, Reprints, *Location problems, *Jensen inequality.

The purpose of the note is to show that a wide class of location parameters satisfy Jensen's inequality. When the expectation EX exists and I is a convex function, then Jensen's inequality states $E(I(x))$ less than or equal to $I(EX)$. What the authors show is that for $\mu(a)$ location parameter appropriately defined, $\mu(I(x))$ less than or equal to $I(\mu(x))$.

701,255
PB87-165759 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Planning of Comparative Experiments.

Final rept.,
M. G. Natrella. 1985, 14p
Pub. in Metals Handbook (9th edition), Vol. 8--Mechanical Testing, p639-652 1985.

Keywords: *Experimental design, Block design, Latin squares, Factorial design, Response surface analysis, Youden squares.

The chapter outlines some general principles for planning good experiments, e.g. randomization, replication, and planned grouping (blocking). It describes some classes of statistical designs for experiments, including factorial and fractional factorial designs, complete and incomplete block designs, Latin and Youden squares, and response - surface designs. A selected set of specific plans is provided for each class.

701,256
PB87-213484
(Order as PB87-213476, PC A05/MF A01)
National Physical Lab., Teddington (England).
Two Theories of Experimental Error,
A. R. Colclough. 20 Jan 87, 19p
Sponsored by National Bureau of Standards, Gaithersburg, MD.
Included in Jnl. of Research of the National Bureau of Standards, v92 n3 p167-185 May-Jun 87.

Keywords: *Error analysis, Experimentation, Uncertainty.

Two theories of error are identified, and their possible justifications assessed. They are the 'orthodox theory' based on the familiar distinction between random and systematic errors and the 'randomatic theory' which dispenses with the distinction and treats all errors as the orthodox theory treats random errors.

701,257
PB87-218335 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Confidence-Intervals for Inequality-Constrained Least-Squares Problems, with Applications to I11-Posed Problems.

Final rept.,
D. P. O'Leary, and B. W. Rust. 1986, 17p
Pub. in SIAM (Society for Industrial and Applied Mathematics) Jnl. on Scientific and Statistical Computing 7, n2 p473-489 1986.

Keywords: *Confidence limits, *Multivariate analysis, Integral equations, Nonlinear programming, Algorithms, Estimating, Reprints, Ill posed problems, Quadratic programming.

Computing confidence intervals for functions $\phi(x) = (w \sup T)x$ where $Kx = y + e$ and e is a normally distributed error vector, is a standard problem in multivariate statistics. In this work, the authors develop an algorithm for solving this problem if additional information, $x =$ or > 0 , is given. Applications to estimating solutions to integral equations of the first kind are given.

701,258
PB87-225355 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD.
Analysis of a Two-Way Table.

Final rept.,
J. Mandel. 1987, 15p
Pub. in Design, Data and Analysis, Chapter 11, p245-259 1987.

Keywords: Curve fitting, Surfaces, *Row linear model.

A set of data dealing with viscosity measurements of filled and plasticized elastomer compounds was originally analyzed using the Box-Cox Transformation. In the paper the data are reanalyzed by a different technique, the 'Row Linear Model'. The advantages of the approach are discussed in detail.

701,259
PB87-234043 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Scientific Computing Div.
Testing Spatial Autocorrelation of Regression Residuals.

Final rept.,
S. E. Howe. 1982, 4p
Pub. in Proceedings of American Statistical Association, Statistical Computing Section (1982), p149-152.

Keywords: *Regression analysis, Autocorrelation, Paleoclimatology, Moran statistics, Voronoi diagrams, Residuals.

Regression data are on occasion obtained from a set of sites in a planar or geographical region. The residuals from the regression may be spatially autocorrelated if location information is not included in the regression. The spatial relationships among randomly distributed sites can be described by the dual of the Voronoi dia-

gram, and the dual can be used to define a spatial weight matrix in the Moran statistic to test spatial autocorrelation of residuals from ordinary least squares regression. Software for constructing the Voronoi diagram and its dual in a possibly non-convex bounded polygonal region, and for computing the Moran statistic, is described. The test is used in calibrating temperature using pollen data for paleoclimatic estimation.

701,260
PB88-147400 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Comparison of Least Squares and Errors-in-Variables Regression, with Special Reference to Randomized Analysis of Covariance.

Final rept.,
R. J. Carroll, P. Gallo, and L. J. Gleser. 1985, 4p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Jnl. of the American Statistical Association 80, n392 p929-932 1985.

Keywords: *Regression analysis, Analysis of variance, Covariance, Errors, Least squares method, Comparison, Reprints.

In an errors-in-variables regression model, the least squares estimate is generally inconsistent for the complete regression parameter but can be consistent for certain linear combinations of this parameter. The authors explore the conjecture that, when least squares is consistent for a linear combination of the regression parameter, it will be preferred to an errors-in-variables estimate, at least asymptotically. The conjecture is false, in general, but it is true for important classes of problems. One such problem is a randomized two-group analysis of covariance, upon which they focus.

701,261
PB88-152335 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Fundamentals of Error Analysis.

Final rept.,
H. H. Ku, and R. M. Judish. 1986, 3p
Pub. in Proceedings of IEEE (Institute of Electrical and Electronics Engineers) 74, n1 p25-27 Jan 86.

Keywords: *Error analysis, Measurement, Statistics, Reprints, Calibration, Uncertainty.

The paper discusses the process of assessing the uncertainty of measurement results through error analysis. The authors restrict the discussion to sources of errors, measurement errors, modelling errors, and calibration errors in the context of physical experiments.

701,262
PB88-162557 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.
Limiting Distribution of Least Squares in an Errors-in-Variables Linear Regression Model.

Final rept.,
R. J. Carroll, L. J. Gleser, and P. P. Gallo. 1987, 4p
See also AD-A160 190. Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Annals of Statistics 15, n1 p220-233 1987.

Keywords: *Linear regression analysis, *Least squares method, Attenuation, Calibration, Confidence limits, Intervals, Hypotheses, Errors, Reprints.

It is well-known that the ordinary least squares (OLS) estimator Beta of the slope and intercept parameters in a linear regression model with errors of measurement for some of the independent variables (predictors) is inconsistent. However, Gallo (1982) has shown that certain linear combinations of Beta are consistently estimated by the corresponding linear combinations of Beta. In the paper, it is shown that under reasonable regularity conditions such linear combinations are (jointly) asymptotically normally distributed. Some methodological consequences of the authors results are given in a companion paper (Carroll, Gallo and Gleser, 1985).

MEDICINE & BIOLOGY

Biochemistry

701,263

PATENT-4 705 949 Not available NTIS
Department of Commerce, Washington, DC.
Method and Apparatus Relating to Specimen Cells for Scanning Electron Microscopes.

Patent.

J. W. Grimes, H. Jennings, and P. W. Brown. Filed 25 Nov 85, patented 10 Nov 87, 8p PB88-132535, PAT-APPL-6-802 091

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Patents, *Cells(Biology), *Laboratory equipment, *Chemical analysis, *Bioassays, Samples, Electron irradiation, Performance evaluation, Design criteria, *Scanning electron microscopes.

The invention discloses an improved specimen cell for maintaining a scanning electron microscope specimen under nearly physiological conditions during observation when said specimen includes liquids having a relatively high vapor pressure. A cavity in the specimen cell mounts an open or closed specimen module which is scanned by the electron beam through a small aperture. During preparation of the electron microscope for observation, the aperture is closed by a door so as to prevent evaporation of liquids from the specimen. The door is mechanically or electronically opened to facilitate observation thus minimizing the exposure of the specimen to the desiccation and/or destructive vacuum effects.

701,264

PB87-149407 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Theoretical Model for the Binding of Cis-Pt(NH₃)₂(2+) to DNA.

Final rept.,

K. J. Miller, E. R. Taylor, H. Basch, M. Krauss, and W. J. Stevens. 1985, 15p

Pub. in Jnl. of Biomolecular Structure and Dynamics 2, n6 p1157-1171 1985.

Keywords: *Deoxyribonucleic acid, Stability, Reaction kinetics, Ligands, Reprints, *Binding energies.

The binding of cis-Pt(NH₃)₂ 2 B(sub 1) B(sub 2) to bases B(sub 1) and B(sub 2) of DNA is studied theoretically. The components of the binding are analyzed and a model structure is proposed for the intrastrand binding to the d B(sub VpdB(sub 2) sequence of a kinked double helical DNA. Quantum mechanical calculations of the liquid binding energy indicates that Pt+2 binds to N7(G), N3(C), O2(C), O6(G), N3(A), N7(A), O4(T) and O2(T) in order of decreasing binding energy. Conformational analysis provides structures of kinked DNA which yield a proper placement of base atoms involved in complex formation. Only bending toward the major groove allows the construction of acceptable square planar complexes. Examples are presented for kinks of -70 deg and -40 deg at the receptor site to orient the base pairs for ligand binding to B1 and B2 to form a nearly square planar complex.

701,265

PB87-161691 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Study of Proline Peptide Bond Conformation and Ring Dynamics in Crystalline Cyclic Peptides Using ¹³C MAS NMR.

Final rept.,

S. K. Sarkar, D. A. Torchia, K. D. Kopple, and D. L. VanderHart. 1984, 4p

Pub. in Jnl. of American Chemistry Society 106, n11, p3329-3331 1984.

Keywords: *Peptides, Chemical bonds, Amino acids, Nuclear magnetic resonance, Relaxation, Reprints, *Proline, Carbon 13.

The authors have studied three cyclic peptides, cyclo(Val-Pro-Gly)₂, cyclo(Phe-Pro-D-Ala)₂ and cyclo(Gly-Pro-D-Ala)₂, in the crystalline powder form using ¹³C MAS NMR. A comparison of chemical shift differences between the beta- and gamma-carbons of the proline ring suggests that the Val-Pro and Phe-Pro peptide bonds are cis and that the Gly-Pro bonds are trans. These results for crystalline samples agree with those obtained in solution and are verified by crystal structures of cyclo(Phe-Pro-D-Ala)₂. Solid state relaxation data show that the disorder reported at one proline ring in the crystal structure of the latter peptide results from ring motion. A ring correlation time of 1.4x10⁻¹¹ is obtained when the relaxation data are analyzed using the two site exchange model suggested by the crystal structure.

701,266

PB87-162160 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.
Thermodynamics of the Conversion of Aqueous Glucose to Fructose.

Final rept.,

Y. B. Tewari, and R. N. Goldberg. 1984, 25p

Pub. in Jnl. of Solution Chemistry 13, n8 p523-547 1984.

Keywords: *Thermodynamics, *Glucose, *Fructose, Carbohydrates, Calorimetry, Enthalpy, Specific heat, Reprints.

The thermodynamics of the conversion of aqueous glucose to fructose has been investigated using both heat-conduction microcalorimetry and high pressure liquid chromatography (HPLC). The reaction was carried out in both aqueous TRIS/HCl buffer and in aqueous phosphate buffer in the pH range 7 to 8 using the enzyme glucose isomerase and the co-factors CoCl₂ and MgSO₄. The temperature range over which this reaction was investigated was 298.15 to 358.15 K. The authors have found that the enthalpy of reaction is independent of pH over the range investigated. A combined analysis of both the HPLC and microcalorimetric data leads to the following results at 298.15 K: delta G = 349 +/- 53 J/mol, delta H = 2.78 +/- 0.20 kJ/mol, and delta C = 76 +/- 30 J/mol K. The stated uncertainties are based upon an analysis of both the random and systematic errors inherent in the measurements. Comparisons are made with literature data. The percent conversion of glucose to fructose has been calculated for the temperature range 300 to 373.15 K.

701,267

PB87-171765 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Predicted Structures of cAMP Binding Domains of Type I and II Regulatory Subunits of cAMP-Dependent Protein Kinase.

Final rept.,

I. T. Weber, T. A. Steitz, J. Bubis, and S. S. Taylor.

1987, 9p

Pub. in Biochemistry 26, n2 p343-351 1987.

Keywords: *Molecular structure, Binding, Enzymes, proteins, Reprints, *AMP, Cyclic adenosine monophosphate, Regulatory subunits, E coli.

The mammalian cAMP-dependent protein kinases have regulatory (R) subunits that show substantial homology in amino acid sequence with the catabolite gene activator protein (CAP), a cAMP-dependent gene regulatory protein from *Escherichia coli*. Each R subunit has two in-tandem cAMP binding domains, and the structure of each of these domains has been modeled by analogy with the crystal structure of CAP. Both the type I and II regulatory subunits have been considered, so that four cAMP binding domains have been modeled. The binding of cAMP in general is analogous in all the structures and has been correlated with previous results based on photolabeling and binding of cAMP analogues. The model predicts that the first cAMP binding domain correlates with the previously defined fast dissociation site, which preferentially binds N6-substituted analogues of cAMP. The second domain corresponds to the slow dissociation site, which has a preference for C8-substituted analogues. The model also is consistent with cAMP binding in the syn conformation in both sites. Finally, this model has targeted specific regions that are likely to be involved in interdomain contacts. This includes contacts between the two cAMP binding domains as well as contacts with the amino-terminal region of the R subunit and with the catalytic subunit.

701,268

PB87-231510 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Conformational Transitions of Synthetic DNA (Deoxyribonucleic Acid) Sequences with Inserted Bases, Related to the Dodecamer d(CGCGAATTCGCG).

Final rept.,

M. Miller, W. Kirchhoff, F. Schwarz, E. Appella, Y. Y.

H. Chiu, J. S. Cohen, and J. L. Sussman. 1987, 14p

Pub. in Nucleic Acids Research 15, n9 p3877-3890 1987.

Keywords: *Deoxyribonucleic acids, Nucleic acids, Synthesis(Chemistry), Reprints, Dodecamer, Palindromes.

Conformational transitions for a series of imperfect palindromes related to the dodecamer d(CGCGAATTCGCG) have been investigated. These sequences are: two isomeric 13-mers d(CGCGAATTCGCG) (13-merI) and d(CGCGAATTCGCG) (13-merII), and 15-mers d(CGCGGAATTCGCG) and d(CGCGAAATTCGCG). Insertion of a single-adenine nucleotide prevents these sequences from being self-complementary. Analysis of thermodynamic parameters derived from the melting profiles together with other data at higher concentrations (NMR and calorimetry) indicates that the insertion of the additional nucleotide which lacks a complement in the opposite strand does not change the enthalpy of the duplex formation, but does alter the number of stable nucleation configurations. The relative position of the insertion within the self-complementary sequence determines the equilibrium between the duplex form and the single-stranded hairpin loop. C-G segments separated by the insertion from the rest of the molecule can undergo an independent conformational transition at high salt concentration, probably to the Z form.

701,269

PB88-129655 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.

Nuclear Magnetic Resonance and Neutron Diffraction Studies of the Complex of RNase A with Uridine Vanadate, a Transition-State Analog.

Final rept.,

B. Borah, C. W. Chen, W. Egan, M. Miller, A.

Wlodawer, and J. S. Cohen. 1985, 10p

Pub. in Biochemistry 24, n8 p2058-2067 1985.

Keywords: *Enzymes, *Ribonuclease, Proteins, Spectroscopy, Nuclear magnetic resonance, Neutron diffraction, Reprints.

The complex of RNase A with uridine-vanadate (U-V), a transition-state analog, has been studied with ⁵¹V and proton NMR spectroscopy in solution and by neutron diffraction in the crystalline state. Upon the addition of aliquots of U-V at pH 6.6, the ((C sup epsilon-H)) resonances of the two active site histidine residues 119 and 12 decrease in intensity while four new resonances appear. These four resonances are assigned to His-119 and His-12 in protonated and unprotonated forms in the RNase-(U-V) complex. The results of both proton NMR in solution and neutron diffraction in the crystal are compared and interpreted in terms of the mechanism of action of RNase.

701,270

PB88-134655 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Calcium Phosphate Formation in Aqueous Suspensions of Anionic Liposomes.

Final rept.,

E. D. Eanes. 1986, 6p

Sponsored by National Inst. of Dental Research, Bethesda, MD.

Pub. in International Congress Series--Excerpta Medica 705, p187-192 1986.

Keywords: *Calcium phosphates, Ionophore, Liposomes, Matrix vesicles, Reprints, *Amorphous calcium phosphate, Apatite, Biomineralization, Calcification.

Artificial phospholipid vesicles (liposomes) have recently been investigated as possible models for membrane-bound biological calcification processes, such as those which occur in matrix vesicles. An effective way to induce mineral formation in liposomes is to pre-

fill their aqueous interiors with buffered phosphate solutions and then, with the addition of cationophores, make the enclosing membranes permeable to Ca^{2+} -ion fluxes from physiological-like external solutions. Using the procedure, it was found that at pH 7.4 crystalline apatite readily formed in the microinteriors of the liposomes. If Mg^{2+} was encapsulated along with the phosphate, amorphous calcium phosphate was the initial product. The latter phase was unstable, however, and hydrolyzed to apatite. The accumulation of intraliposomal precipitate was also found to disrupt the membrane covering and induce precipitation in the external solution phase as well. These precipitation events parallel in many ways those which appear to occur in matrix vesicles and suggest that liposomes could be useful vehicles for investigating, *in vitro*, possible effects native membrane constituents may have on the calcification process. One such constituent, phosphatidylserine, was found to retard extraliposomal precipitation.

701,271

PB88-137088 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.
Immunoreactor-Based Flow Injection Analysis System.
Final rept.,
L. L. Brown, A. L. Plant, R. M. Kannuck, and R. A. Durst. 1986, 19p
Pub. in Bioelectroanalytical Symposium (1st), p15-33 1986.

Keywords: Reprints, *Flow injection analysis, *Immunoreactors, Continuous flow method.

Flow injection analysis is a continuous-flow method based on the introduction of a sample aliquot into a moving, nonsegmented carrier stream. As the injected sample is transported through the system, it undergoes controlled dispersion and can be chemically and/or physically treated by the introduction of appropriate reagents or processing. The results of the sample treatment can then be quantitated using suitable flow-through detectors. A novel flow injection analysis system is being developed which utilizes an immunospecific reactor and incorporates many features over current solid-phase immunoassays. In the immunoreactor system, free antigen (the analyte) competes with antigen covalently coupled to the surface of marker-loaded liposomes for binding to antibodies immobilized in the reactor column.

701,272

PB88-138904 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Thermodynamics Div.
Thermodynamics of the Conversion of Aqueous L-Aspartic Acid to Fumaric Acid and Ammonia.
Final rept.,
R. N. Goldberg, E. Gajewski, D. K. Steckler, and Y. B. Tewari. 1986, 11p
Pub. in Biophysical Chemistry 24, n1 p13-23 1986.

Keywords: *Enzymes, *Aspartic acid, *Fumaric acid, Thermodynamic properties, Chemical equilibrium, pH, Reprints, Conversion, Liquid chromatography.

The thermodynamics of the conversion of aqueous L-aspartic acid to fumaric acid have been investigated using both heat conduction microcalorimetry and high-pressure liquid chromatography. The reaction was carried out in aqueous phosphate buffer over the pH range 7.25 to 7.43, the temperature range 13 to 43 degrees C, and at ionic strengths varying from 0.066 to 0.366 mol/kg. Calculations have also been performed which give values of the apparent equilibrium constant for the conversion of L-aspartic acid to fumaric acid and ammonia as a function of temperature, pH, and ionic strength.

Botany

701,273

PB87-231981 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Further Carbon-13 NMR Evidence for the Coexistence of Two Crystalline Forms in Native Celluloses.

Final rept.,
D. L. VanderHart, and R. H. Atalla. 1987, 31p
Pub. in ACS (American Chemical Society) Symposium Series 340, Chapter 5 p88-118 1987.

Keywords: *Algae, *Celluloses, *Hydrolysis, Reprints, Carbon 13, *Nuclear magnetic resonance, Polymorphism, Spin exchange.

The hypothesis that all native celluloses are composites of two crystalline polymorphs, I alpha and I beta, is further explored using solid state (^{13}C) NMR techniques. Spectra of several algal and higher plant celluloses and the effects of acid hydrolysis and mechanical heating are investigated. No significant alteration of the I alpha and I beta ratios is seen upon hydrolysis of a cellulose from cotton linters. However, both beating and hydrolysis are seen to enhance the I beta proportion in an algal cellulose obtained from *Cladophora*. Methods of enhancing the crystalline core resonances are used to verify that unit cell inequivalence rather than crystal surface chains determines the crystalline resonance profiles. These studies indicate that the C4 resonance region, from 88-92 ppm in all native celluloses is a faithful monitor of unit cell inequivalences. Also, the higher plant celluloses contain a much smaller fraction of the I alpha crystalline form than originally proposed. The possibility even exists that the higher plant celluloses represent the pure I beta form. If so, the corresponding unit cell contains more than the usually accepted four non-equivalent anhydroglucose residues.

701,274

PB88-129820 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Dielectric Properties of Biological Tissue (*Crassula portulaca*) from 0.01 to 1 Billion Hz.

Final rept.,
M. G. Broadhurst, C. K. Chiang, K. J. Wahlstrand, R. M. Hill, L. A. Dissado, and J. Pugh. 1987, 9p
Sponsored by Food and Drug Administration, Rockville, MD.
Pub. in Jnl. of Molecular Liquids 36, p65-73 1987.

Keywords: Reprints, *Dielectric constant, Conductivity, Ion diffusion, *Biological tissue, Plant leaves, **Crassula portulaca*.

Dielectric data from 0.01 Hz to 1 billion Hz are given for fresh leaves of *Crassula portulaca* (Jade plant), liquid extracted from such leaves and extracted liquid containing a synthetic polymer film. Features associated with the bulk electrolyte, the cell walls and the electrical double layer at the electrodes of the specimen holder are clearly delineated in the data. A synthetic film is shown to produce interfacial polarization that appears quite similar to that due to cell walls. Interpretation of the data is given in terms of ionic movement through the leaf structure. The data presented here are intended to be a prototype for live tissue data and used, for example, to design synthetic dielectric phantom materials.

Clinical Chemistry

701,275

PB87-161709 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Calcium Phosphate Saturation Levels in Ultrafiltered Serum.

Final rept.,
N. Eidelman, L. C. Chow, and W. E. Brown. 1987, 8p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Calcified Tissue International 40, p71-78 1987.

Keywords: *Calcium phosphates, Serum (Blood), Tissues, Chemical analysis, Reprints.

Calcifications occurring in arteriosclerotic plaque and other pathological deposits are important health concerns, and the nature of these deposits and their mechanisms of formation warrant investigation. Crystals of the relevant calcium phosphates were equilibrated with the undiluted ultrafiltered human serum (u.f.s.) at 37 degrees C by constant stirring and periodically removing samples for calcium and phosphate

analysis and for pH measurement. The ion activity products of DCPD and OCP in u.f.s. under CO_2 indicate that the concentrations of calcium and phosphate complexing agents (except bicarbonate) are quite low.

701,276

PB87-219150 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Calcium Phosphate Phase Transformations in Serum.

Final rept.,
N. Eidelman, L. C. Chow, and W. E. Brown. 1987, 9p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Calcified Tissue International 41, p18-26 1987.

Keywords: Reprints, *Calcium phosphate phase transformations, *Dicalcium phosphate dihydrate, Hydroxyapatite, Octacalcium phosphate, Serum, Ultra filtered serum.

A better knowledge of the pathological calcification mechanisms should provide a rational basis for their control. In the present study, dicalcium phosphate dihydrate (DCPD, $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$) was used as a source of calcium and phosphate ions to investigate the mechanism of formation of more basic and more insoluble calcium phosphates in ultrafiltered serum (u.f.s.) DCPD crystals were suspended in u.f.s. at 37 C by constant stirring; samples were removed periodically for calcium and phosphate analysis and pH measurement. Occasionally, samples of solids were removed for X-ray diffraction. The experiments were carried out both with and without a 5.5% CO_2 atmosphere. After initially becoming saturated with DCP, the u.f.s. composition changed and became saturated with respect to octacalcium phosphate (OCP, $\text{Ca}_8\text{H}_2(\text{PO}_4)_6 \cdot 5\text{H}_2\text{O}$). At this point OCP crystals were detected in the solid phase by X-ray diffraction.

701,277

PB87-233797 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Statistical Engineering Div.

Distribution-Free Tolerance Limits Using a Covariate with Clinical Chemistry Applications.

Final rept.,
K. R. Eberhardt, and R. W. Mee. 1986, 4p
Pub. in Proceedings of 1986 Biopharmaceutical Section of the American Statistical Association, Chicago, IL., August 15-18, 1986, p48-51.

Keywords: *Clinical chemistry, Regression, Statistical data, *Tolerance interval, Covariate, Order statistics, Standard Reference Material.

A solution is prepared by adding a fixed amount of water to a mass X of solute. Let Y denote the measured concentration of a particular analyte in the resulting solution. The relation between Y and X is modeled as linear regression through the origin, $Y = \theta X + e$, where e is random measurement error and X is observed without error. The problem consists of setting tolerance limits for the true analyte concentration θX with respect to a nonnormal population of masses, X. The available data consist of a small sample of (X_i, Y_i) pairs ($i = 1, \dots, n$), plus a large sample of masses X_i ($i = n+1, \dots, N$). The limits for the distribution of concentration are based on order statistics of X and an estimate of theta. The problem arose in setting tolerance limits for a human serum standard reference material at the National Bureau of Standards. The authors solution has application to other tolerance limit problems where data on a covariate may be obtained inexpensively.

701,278

PB88-120928 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Determination of Retinol, alpha-Tocopherol, and beta-Carotene in Serum by Liquid Chromatography with Absorbance and Electrochemical Detection.

Final rept.,
W. A. MacCrehan, and E. Schonberger. 1987, 8p
Pub. in Clinical Chemistry 33, n9 p1585-1592 1987.

Keywords: *Blood serum, Electrochemical detection, Liquid chromatography, Provitamin A, Retinol, Vitamin A, Reprints, *Tocopherol.

The authors describe a method for the determination of retinol, a-tocopherol, and Beta-carotene in serum,

MEDICINE & BIOLOGY

Clinical Chemistry

using a liquid-chromatographic separation with wavelength-programmed ultraviolet/visible absorbance and amperometric electrochemical detection with a glassy carbon electrode. After protein denaturation and addition of an internal standard, tocol, 250-microl samples are twice extracted with hexane. The reversed-phase, gradient-elution chromatographic separation provides baseline resolution of: the all-trans isomer of retinal from the cis isomers, alpha from gamma-tocopherol, and all-trans-Beta carotene from alpha-carotene and from cis Beta-carotene isomers. The linearity of response and the detection limits for the two detectors for the three analytes are measured. A comparison of the values obtained for serum extracts shows good agreement between the absorbance and electrochemical detectors.

701,279

PB88-137070

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Organic Analytical Research Div.

Clinical Electrolyte Potentiometry: Sources of Error, Reference Methods and Materials.

Final rept.,

R. A. Durst. 1985, 15p

Sponsored by National Committee for Clinical Lab. Standards, Villanova, PA.

Pub. in Proceedings of Workshop on Direct Potentiometric Measurements in Blood, Gaithersburg, MD., May 18-20, 1983, p143-157 1985.

Keywords: *Blood analysis, *Electrolytes, *Potentiometric analysis, *Errors, Electrodes, Calibration, References(Standards), Materials, pH, Gases.

A general review of the sources of error associated with the use of reference and ion-selective electrodes is presented. In the case of indicator electrodes, topics considered include types of interferences, ionic distribution and speciation, fouling, water activity, and the effect of disease states and therapy. Detailed consideration is given to the reference electrodes and the factors which affect their performance. Of primary concern is the liquid junction which is the site of most of the reference electrode problems. Factors such as the electrolyte composition and structure of the salt bridge, streaming and tip potentials, and suspension effects are discussed with suggestions for minimizing their influence on the reference electrode. Problems associated with various types of electrode drift is also treated. Finally, no matter how perfect the measurement system and solution conditions, accurate results cannot be achieved if the electrode system is not calibrated properly. Sources of calibration errors, such as preparation and matrix effects, will be discussed. The general concept of reference materials and methods is presented, followed by a more detailed discussion of present and future reference materials for pH, gases, and electrolytes.

Clinical Medicine

701,280

PB87-181756

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Nature and Properties of Cardiovascular Deposits.

Final rept.,

B. B. Tomazic, E. S. Etz, and W. E. Brown. 1987,

11p

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

Pub. in Scanning Microscopy 1, n1 p95-105 1987.

Keywords: Reprints, *Cardiovascular deposits, Scanning electron microscopy.

Mineral deposits from human aortas and bioprosthetic devices implanted in experimental animals show close similarities in chemical compositions, solubility and structural characteristics. Chemical analyses show compositions corresponding to a Na, Mg, CO₃ substituted apatitic calcium phosphate. The data indicate that the deposits can be represented by a series of carbonate-substituted products, arising from OCP that has hydrolyzed to varying degrees. Dissolution of deposits can be described kinetically as a surface controlled rate process. The similarities in the two types of deposits suggest that they form by a common mechanism (e.g., OCP could be the precursor for both deposits).

701,281

PB88-134663

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Dielectric Phantoms for Electromagnetic Radiation.

Final rept.,

M. G. Broadhurst, C. K. Chiang, and G. T. Davis.

1987, 18p

See also PB86-212065. Sponsored by Food and Drug Administration, Rockville, MD. Center for Devices and Radiological Health.

Pub. in Jnl. of Molecular Liquids 36, p47-64 1987.

Keywords: Electromagnetic radiation, Models(Simulation), Design, Performance, Reprints, *Health physics, *Phantoms, *Radiation effects.

The report describes the design and performance of a synthetic material that has the same dielectric heating characteristics as living muscle in the 1-1000 MHz frequency range. This dielectric phantom is a combination of four components: (1) a 50/50 solution of ethylene carbonate and propylene carbonate chosen to have the same dielectric constant as water, (2) an organic salt to provide the same conductivity as biological electrolytes, (3) flakes of polyethylene terephthalate to provide the interfacial polarization that occurs at cell walls in biological tissue and (4) an inorganic and/or polymeric gelling agent to provide mechanical rigidity. The resulting composite material is more stable to biological attack and drying than are existing aqueous based phantom materials, and its dielectric properties are more closely matched to those of natural tissues over most of the frequency range from 1-1000 MHz.

Cytology, Genetics, & Molecular Biology

701,282

PB87-165775

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Structure of Bovine Pancreatic Trypsin Inhibitor: Results of Joint Neutron and X-ray Refinement of Crystal Form II.

Final rept.,

A. Wlodawer, J. Walter, R. Huber, and L. Sjolin.

1984, 29p

Pub. in Jnl. of Molecular Biology 180, n2 p301-329 1984.

Keywords: X ray diffraction, Molecular structure, Proteins, Reprints, *Trypsin inhibitor.

The structure of form II crystals of bovine pancreatic trypsin inhibitor has been investigated by joint refinement of x-ray and neutron data. Crystallographic R factors for the final model were 0.200 for the x-ray data extending to 1 Angstrom resolution and 0.197 for the 1.8 Angstrom neutron data. The model was strongly restrained, with 0.020 Angstrom r.m.s. departure of bond lengths from their ideal values and 0.019 Angstrom r.m.s. departure of planar groups from planarity. The resulting structure was very similar to that of crystal from I (r.m.s. deviation for main chain atoms was 0.40 Angstrom); nevertheless larger deviations were observed in particular regions of the chain. Twenty out of sixty three ordered water molecules occupy similar positions (deviation less than 1 Angstrom in both models. Eleven amide hydrogens were found to be protected from exchange after three months of soaking the crystals in deuterated mother liquor at pH 8.2. Their locations were in excellent agreement with the results obtained by two-dimensional NMR, but the rates of exchange are much lower in the crystalline state.

Dentistry

701,283

PB87-150793

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Calcium Phosphate Precipitation in Aqueous Suspensions of Phosphatidylserine-Containing Anionic Liposomes.

Final rept.,

E. D. Eanes, and A. W. Hailer. 1987, 6p

Sponsored by National Inst. of Dental Research, Bethesda, MD.

Pub. in Califed Tissue International 40, n1 p43-48 1987.

Keywords: *Calcium phosphate, Tissues, Bone, Reprints, Precipitation, Liposomes.

Liposomes prepared from 6.3:1.8:0.9:1.0 molar mixtures of phosphatidylcholine, dicetyl phosphate, cholesterol, and phosphatidylserine, respectively, (PS(+)) liposomes were compared with similarly prepared liposomes without the phosphatidylserine (PS(-)) liposomes for their effect on calcium phosphate precipitate formation in aqueous solutions at pH 7.4 and 22 degrees C. In the present study, Ca(2+) losses resulting from intraliposomally confined precipitation were found to be marginally greater in PS(+) liposomes due primarily to a larger volume of entrapped P1 available for reaction in these liposomes. However, with the addition of P1 to the external solution, the reverse was observed, i.e., considerably less Ca(2+) was lost in PS(+) than in PS(-) suspensions, a result of markedly less X-537A-induced precipitate forming outside PS(+) liposomes.

701,284

PB87-150819

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Research in Improved Composites.

Final rept.,

R. L. Bowen, and M. W. Chalkley. 1986, 12p

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

Pub. in Anterior Restoratives p1-12 1986.

Keywords: *Dental materials, *Composite materials, Bonding, Dentin, Dentistry, Reprints.

Landmark advances in the history of restorative composites have been delineated in order to discuss improved composites effectively. The paper deals with the first author's experience in the area of developments in composite research beginning in the early 1950's when the shortcomings of silicate cements and methyl methacrylate unfilled resins stimulated research to improve esthetic direct restorative materials. This limited review includes the advances made possible through the development of composites that incorporated, separately or in combination, epoxy resins, spherical reinforcement particles, semiporous glass filler particles, x-ray opacity, etc. Also discussed is the effect, beneficial to dentistry, of the acid etch technique on the application of composites and the promise of further refinements in materials and techniques.

701,285

PB87-152823

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Callahan Award Lecture - Dental Composites: State-of-the-Art in Dentin Bonding.

Final rept.,

N. W. Rupp. Nov 84, 3p

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

Pub. in Ohio Dental Jnl. 58, n11 p23-25 Nov 84.

Keywords: *Dental materials, *Composite materials, Bonding, Dentin, Dentistry, Reprints.

Dental composite restorative materials have been improved in their physical properties and manipulation characteristics. Further improvements are required before they can be used in load bearing areas. Also, dentin bonding adhesion needs strengthening.

701,286

PB87-161683

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Discoloration of Dental Cements and Composites in a Sulfide Solution.

Final rept.,

A. Sugawara, M. Ohashi, J. M. Antonucci, and G. C. Paffenbarger. 1984, 1p

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

Pub. in Jnl. of Dental Research 63, p232 1984.

Keywords: *Acid bonded reaction cements, *Dental materials, *Discoloration, Exposure, Composite materials, Reprints.

An aqueous solution of 0.1% Na₂S (pH = 9) is an effective medium for inducing discoloration in esthetic dental restorative materials containing base metal contaminants. Glass ionomer cements exhibited greater discoloration due to base metal contaminants than did composite resin materials containing equivalent amounts of the same metal.

701,287
PB87-171732 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
In vitro Wear Rates of Three Types of Commercial Denture Tooth Materials.

Final rept.,
D. J. Whitman, J. E. McKinney, R. W. Hinman, R. A. Hesby, and G. B. Pelleu. Feb 87, 4p
Pub. in Jnl. of Prosthetic Dentistry 57, n2 p243-246 Feb 87.

Keywords: *Dental prostheses, *Acrylic resins, *Wear tests, Dentistry, Thermoplastic resins, Wear resistance, Reprints.

One disadvantage of acrylic resin teeth is that they abrade easily. Two new denture tooth materials are reported as more resistant than conventional materials to wear and chemical degradation. IPN (Dentsply) and Iositol were compared with conventional acrylic tooth, Bioform, for in vitro wear resistance. Specimen disks were processed exactly as denture teeth are. To simulate the long-term effects of foods, the disks were pre-conditioned for one week at 37 deg C in 75% ethanol or distilled water (control). Wear was generated with a stainless steel pin by the pin-and-disk apparatus described by McKinney. The results suggest that IPN and Iositol denture teeth would wear much better under intraoral conditions than the conventional acrylic resin teeth.

701,288
PB87-182861 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Diametral Tensile Strength and Dental Composites.
Final rept.,
R. W. Penn, R. G. Craig, and J. A. Tesk. 1987, 3p
Pub. in Dent. Mater. 3, p46-48 1987.

Keywords: *Dental materials, Composite materials, Tensile strength, Reprints, Dental composites, Diametral tensile strength.

The diametral tensile strength (DTS) is a property described by ADA/ANSI Specification 27 for characterizing dental composite restoratives (DCR). Since the approval of Specification 27 in 1977, numerous new DCR's have been developed. These are often quite different in terms of filler and filler type, resin matrix and method of curing. A question naturally arises as to the applicability of the diametral tensile test (DTT) to the newer systems DTT is suited only for truly brittle materials. Materials which plastically deform would produce erroneous DTS values and also would be expected to display strain rate sensitivity. Linear regressions of DTS vs log CS showed weak to moderate dependency for all materials tested as did the correlation coefficients which ranged from 0.10 to 0.50. Statistical analysis correlate composites behaved in sufficiently brittle manner to conclude that the DTT is valid for evaluation of the tensile strength of newer composites.

701,289
PB87-200291 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Resin Based Dental Composites. An Overview.
Final rept.,
J. M. Antonucci. 1986, 27p
Sponsored by National Inst. of Dental Research, Bethesda, MD.
Pub. in Polymers in Medicine II, p277-303 1986.

Keywords: *Dental materials, *Composite materials, Fillers, Bonding, Resins, Polymerization, Reprints.

The quest for a durable, esthetic, adhesive and biocompatible material suitable for the restoration of lost tooth structure has long challenged dental materials researchers. A significant step toward the realization of this goal was the development of resin based dental

composites which overcame many of the shortcomings of the silicate cements (a purely inorganic composite) and unfilled resin restoratives (a purely organic composite based on methyl methacrylate and its polymer). The synthesis of BIS-GMA (an offspring of the marriage of epoxy and acrylate chemistry) by Bowen, ushered in the modern era of resin based dental composite restorative materials and also dental sealants. Efforts to enhance the durability and range of applications (e.g. posterior as well as anterior fillings) of dental composites include optimization of the types, sizes, shapes and volume of the dispersed phase, reductions in residual vinyl unsaturation and polymerization shrinkage of the resin phase, and the development of more effective interfacial bonding phases.

701,290
PB87-200325 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Research Opportunities for American Industry at the National Bureau of Standards.

Final rept.,
J. A. Tesk. 1987, 1p
Pub. in UPDATE (Newsletter of the American Dental Trade Association), 1p Jan-Apr 87.

Keywords: *Dental materials, *Composite materials, Research, Castings, Restoratives, National Bureau of Standards.

The research associate program in dental materials at the NBS is briefly described. Opportunities for collaborative research are presented; specific programs are cited. This is an introductory article which will be followed by others in 'Update'.

701,291
PB87-219168 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Wear and Microhardness of Glass-Ionomer Cements.
Final rept.,
J. E. McKinney, J. M. Antonucci, and N. W. Rupp. 1987, 6p
Sponsored by National Inst. of Dental Research, Bethesda, MD.

Pub. in Jnl. of Dental Research 66, n6 p1134-1139 Jun 87.

Keywords: *Cements, *Dental materials, *Composites, Hardness, Wear, Reprints, Glass ionomers.

Pin-and-disc wear and Knoop Hardness measurements were made on three commercial glass-ionomer cements having slightly different compositions. The specific objective was to determine whether these cements have potential for use in posterior teeth, and if not, what modifications in composition and structure would be appropriate to enhance their performance. The specimens were pre-conditioned in air, water, or lactic acid at 37 deg C for one week prior to being wear-tested. Although differences among the samples were noted, some common trends were observed. From changes in hardness, before and after storage, two opposing trends were observed. The trend involved continued cross-linking and possible dehydration, resulting in a substantial increase in hardness. The other trend involved softening from penetrant liquid absorption and a concomitant decrease in hardness.

701,292
PB87-219176 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Ultramicro Analysis of the Fluid in Human Enamel during In vitro Caries Attack by Hydrochloric Acid.
Final rept.,
G. L. Vogel, C. M. Carey, L. C. Chow, T. M. Gregory, and W. E. Brown. 1987, 16p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Caries Research 21, p310-325 1987.

Keywords: *Diffusion, *Enamel fluid, Reprints, *Dental caries.

An in vitro experimental caries model is described in which an ultramicro system of analysis was used during simulated decay to study the composition of fluid in micro wells drilled within human enamel. In this experiment, hydrochloric acid was used as the demineralizing agent because the results could be directly compared to recent bench-scale studies using a two-

compartment diffusion cell. The two sets of results agree in principle and generally confirm an earlier 'diffusion-controlled' caries model. Furthermore, the results are contrary to caries models based on the assumption that the rate-controlling process is release of ions from the enamel crystal surfaces because: (1) The solutions at various points in the lesion remained saturated during the attack, although a highly demineralized lesion was used in the experiment, and a high degree of undersaturation was used to drive the demineralization, (2) The Ca/P ratio in the lesion solution increased during the demineralization. (3) The calcium and phosphate concentrations increased during the demineralization above their initial values although there was no concentration gradient for hydrochloric acid in this system. (4) Small membrane potentials developed during the demineralization, indicating that the tooth surface was permselective. (5) The directions of the changes in the concentrations of all the ions in solution could be predicted from the permselectivity using the 'diffusion-controlled' model. These results have major implications relative to the design of theoretical physicochemical models employed to elucidate the mechanism of caries.

701,293
PB87-224481 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Dental Materials Research at the National Bureau of Standards, Opportunities for Industry.
Final rept.,
J. A. Tesk. 1987, 1p
Pub. in Trends and Techniques 4, n6 p5 Jul/Aug 87.

Keywords: Reprints, *Dental materials, *National Bureau of Standards, Dental alloys, Dental castings, Castability.

A brief description of the research program in dental materials is presented. The overview is a prelude to subsequent articles which will appear. Items of specific interest to dental laboratories are cited including research on dental investments and casting of dental alloys.

701,294
PB87-233813 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Wear Mechanisms of Dental Composite Restorations.
Final rept.,
W. L. Wu. 1982, 20p
Sponsored by National Inst. of Dental Research, Bethesda, MD.
Pub. in Proceedings of International Symposium on Posterior Composite Resins, Chapel Hill, NC., October 13-14, 1982, p127-146.

Keywords: *Polymerization, Diffusion, *Dental composites, Solubility parameters, Swelling, Thermoset resins.

The in vivo wear process of dental composite restorations is believed to be accelerated by a chemical softening mechanism. The degree of polymerization can be increased by raising the curing temperature which, in turn, decreases the diffusion rate of foreign substances within the dental composites. Accordingly, the extent of chemical softening can be mitigated by improving the degree of polymerization.

701,295
PB88-117346 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Ultrastructural Study of Calcium Phosphate Formation in Multilamellar Liposome Suspensions.
Final rept.,
B. R. Heywood, and E. D. Eanes. 1987, 10p
Sponsored by National Inst. of Dental Research, Bethesda, MD.
Pub. in Calcified Tissue International 41, p192-201 1987.

Keywords: *Liposomes, *Calcium phosphates, Reprints, *Apatite, Matrix vesicles, TEM.

Calcium phosphate precipitation can be induced within liposomes containing buffered inorganic phosphate by the ionophore-mediated loading of calcium ions. Negative staining, positive staining for thin sectioning, and freeze-fracture electron microscopy were used to characterize these synthetic vesicles and to evaluate

Dentistry

the liposome-mineral interactions resulting from apatite formation. Suspensions of phosphate (0-50 mM KH_2PO_4)-encapsulated liposomes were prepared from mixtures of phosphatidylcholine, dicetyl phosphate, and cholesterol in the molar ratios of 7:2:1. Precipitation reactions were initiated by first suspending the liposomes in a buffered solution containing calcium (1.3-2.2 mM $\text{Ca}(\text{NO}_3)_2$) and then adding the cationic ionophore X-537A. All experiments were carried out at 22 deg C, pH 7.4, and 240 mosm.

701,296
PB88-117353 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Rapid Determination of Extracellular Potassium Concentrations in Whole Human Dental Plaque and Plaque Fluid.
Final rept.,
C. M. Carey, A. Tatevossian, and G. L. Vogel. 1987, 1p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of Dental Research 66, n9 p1516 Sep 87,
Keywords: *Dentistry, Electrodes, Reprints, Dental plaque, Potassium.

Recently, Dibdin et al., (1986) found concentrations of potassium in plaque fluid lower than previously reported. These authors attributed the higher levels reported in other studies to prolonged sample storage. In the paper a rapid ion selective micro electrode technique was used to study the effect of sample storage and fluid separation procedures on potassium concentrations in fast plaque. The potassium concentrations obtained, 64 plus or minus 8 mmol/L $N=28$ were similar to previous values and indicate that differences in sampling techniques may be responsible for the lower values obtained by Dibdin et al., (1986). The high levels of potassium and other ions in plaque fluid appear to indicate a poor exchange between plaque fluid and saliva.

701,297
PB88-117361 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Dentin Adhesive Bonding.
Final rept.,
R. L. Bowen. 1987, 1p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Trends and Techniques 4, n8 Oct 87.
Keywords: *Adhesion, *Bonding, *Dental composites, Dental materials, Dentin, Enamel, Technology transfer, Reprints.

After decades of research, a combined dentin and enamel bonding method developed at the Paffenbarger Research Center, National Bureau of Standards, is beginning to address and minimize problems associated with the adhesion of dental composites to tooth surfaces. At the conclusion of a five-year clinical trial, it is hoped that new products based on these new adhesive materials will be introduced into U.S. and international dental materials markets.

701,298
PB88-120902 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Forces Fracturing Cements at Die Interfaces and Their Dependence on Film Thickness.
Final rept.,
H. Iizuka, G. M. Brauer, N. Rupp, M. Ohashi, and G. Paffenbarger. 1987, 7p
Sponsored by National Inst. of Dental Research, Bethesda, MD., and Nihon Univ., Tokyo.
Pub. in Dental Materials 3, p187-193 1987.

Keywords: *Dental materials, *Cements, Venting, Reprints, *Crown forms, Ionomers, Polycarboxylates, Zinc phosphate.

Film thickness (FT) and retention of zinc phosphate, polycarboxylate and ionomer cement as a function of powder-liquid (P/L) ratio were determined for both non-vented and vented crowns and using a standard ADA/ANSI test. The effect of P/L ratio on FT was more dependent on the composition of the brand than on the type of cement. FT values obtained from the specification test usually lay between those obtained from the vented crowns and from the non-vented crowns. Higher consistency (higher P/L ratio) of the

mix increased the FT. The relationship between FT of P/L ratio and retention is complex and depended on the type of cement, brand, and on the technique used. Venting of the prepared crown lowered the FT and usually tended to increase retention.

701,299
PB88-120910 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Enhanced Enamel F Uptake by Monocalcium Phosphate Monohydrate Gels.
Final rept.,
S. Takagi, L. C. Chow, E. M. Yamada, and W. E. Brown. 1987, 4p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of Dental Research 66, n10 p1523-1526 Oct 87.

Keywords: *Teeth, *Dentistry, Reprints, Dicalcium phosphate dihydrate, Fluorapatite, Fluoride, Monocalcium phosphate monohydrate, Remineralization, *Enamel.

Application of DCPD-forming solutions has been shown to increase substantially the enamel reactivity toward F. The effectiveness of a variation of the treatment procedure, in which the DCPD-forming solution was replaced by a viscous carboxymethylcellulose gel containing monocalcium phosphate monohydrate (MCPM), was evaluated by use of 12 extracted human molars. The MCPM gel was highly effective in enhancing the F uptake by enamel. The mean F uptakes by teeth treated with MCPM gel, followed by exposure to a F solution, were 3972 (plus or minus 565), 2383 (plus or minus 312), and 1751 (plus or minus 313) ppm, respectively, in the outer 5-, 10-, and 15-micrometer depths in enamel. These uptakes were 2374, 1273, and 852 ppm more than those of the control teeth. Because the F solution was undersaturated with respect to CaF_2 , the F incorporated into the enamel was believed to be in apatitic form and not as CaF_2 . The MCPM gel has advantages over the DCPD-forming solution because (1) much longer gel-tooth contact times can be achieved, and (2) the treatment agent can readily be delivered to specific sites where the tooth needs the protection most.

701,300
PB88-129812 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Adhesion to Dentin Mediated by Gluma: Effect of Pretreatment with Various Amino Acids.
Final rept.,
E. Asmussen, and R. L. Bowen. 1987, 5p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Scandinavian Jnl. of Dental Research 95, p521-525 1987.

Keywords: Reprints, *Adhesive dentistry, *Composite resins, *Dentin bonding agents, Operative dentistry.

Dentin surfaces were treated with various amino acids. The treatment caused an alteration of the dentin surface that influenced the tensile bond strength to a restorative resin obtained with the Gluma system. The bond strengths varied between 5.6 and 14.2 MPa. Among the amino acids tested, N-phenylglycine produced the strongest bonds.

701,301
PB88-134614 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Report on State of the Art in Titanium Castings.
Final rept.,
R. M. Waterstrat. 1987, 1p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Trends and Techniques 4, n7 p46 Sep 87.

Keywords: *Dental materials, Ceramics, Reprints, *Titanium castings, Castings, *Biocompatibility, Implant dentistry.

The paper presents a summary of the current state of dental titanium castings technology in the United States. The field is developing rapidly, and a variety of commercial applications can be anticipated shortly. Progress in the direction, both in the U.S. and in Japan, will bear continued surveillance.

701,302
PB88-140959 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Micro-Electrode Techniques for the Analysis of Oral Fluids.
Final rept.,
G. L. Vogel, C. M. Carey, L. C. Chow, and W. E. Brown. 1987, 7p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of Dental Research 66, n11 p1691-1697 Nov 87.

Keywords: *Dental plaque, Dental enamel, Microanalysis, Microvolumes, Reprints.

The paper describes the use of micro-electrodes for the analysis of small fluid volumes recovered from the oral environment. The analysis has several advantages: (1) It directly measures the activity of ions, a quantity more relevant to mineral saturation than the conventionally measured concentration; (2) minimum fluid volume for analysis is usually less than 0.005 micro L, small enough to avoid sample pooling in most analyses; (3) numerous ions can be measured simultaneously; (4) the analysis time is very short; and, (5) the use of mineral oil to isolate specimens provides a simple method for controlling the CO_2 tension and humidity over the specimens.

701,303
PB88-147160 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Effect of Acidic Pretreatment on Adhesion to Dentin Mediated by Gluma.
Final rept.,
E. Asmussen, and R. L. Bowen. 1987, 3p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. of Dental Research 66, n8 p1386-1388 Aug 87.

Keywords: *Dental materials, *Dentin, *Dentistry, *Acid bonded reaction cements, Bonding, Adhesives, Enamels, Tensile strength, Amino acids, Reprints, *Resin bonding.

Tensile bond strengths between dentin and a typical restorative resin were measured after the dentin was treated with Gluma. Solutions of phosphoric, pyruvic, nitric, or oxalic acid, also containing various amino acids, were used as pretreatments. Without amino acids in the solutions, the pretreatments conferred bonds of low strength. Use of acidic solutions containing glycine or N-phenylglycine was found to give bonds of high strength to both dentin and enamel.

701,304
PB88-152095 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Piezoelectric Polymer Transducers.
Final rept.,
G. T. Davis. 1987, 5p
Pub. in Adv. Dent. Res. 1, n1 p45-49 Oct 87.

Keywords: *Piezoelectric transducers, *Dental equipment, Piezoelectric materials, Polymers, Reprints, *Vinylidene fluoride polymers, Polyvinylidenes.

Poly(vinylidene fluoride) ($\text{CH}_2\text{-CF}_2$)_n is a tough, flexible polymer readily available in the form of thin film which can be made piezoelectric by the temporary application of a high electric field. The areas of the film which become piezoelectric can be controlled to be the areas where metal electrodes are evaporated onto the film. The same electrodes and associated leads are subsequently used to detect the electric charge generated by the application of pressure to the active area. Such films may have applications in the measurement of occlusal forces. The physical properties of such polymer films and examples of their use in pressure transducers are reviewed with the intent of stimulating interest in development of a system useful for measuring occlusal forces.

Microbiology

701,305
PB87-233557 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Use of Epifluorescence Microscopy for Characterizing the Activity of 'Thiobacillus ferrooxidans' on Iron Pyrite.

Final rept.,
T. Y. Yeh, J. R. Godshalk, G. J. Olson, and R. M. Kelly. 1987, 9p

Grant NSF-CBT85-07399

Sponsored by National Science Foundation, Washington, DC.

Pub. in Biotechnology and Bioengineering 30, p138-146 Jul 87.

Keywords: *Iron pyrite, *Bacteria, Oxidation, Reprints, Thiobacillus ferrooxidans, *Epifluorescence microscopy, Metal oxidation, Ore bioleaching.

The enumeration and characterization of microorganisms attached to solid surfaces have always presented significant difficulties. This is particularly true for microorganisms that are indigenous to coal mines and mineral deposits where metal sulfides are ubiquitous. The complications that arise are the result of the variety of inorganic compounds that are present in these environments, the harsh conditions under which the microorganisms proliferate, and the low cell densities to which they grow. The work presented here suggests that epifluorescence microscopy using acridine orange can be a useful probe to study acidophilic metal-leaching bacteria. Experiments involving the growth of Thiobacillus ferrooxidans on iron pyrite are described which indicate a relationship between cell fluorescence color and bacterial activity.

Nutrition

701,306

PB87-197828

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Preparation of a Mixed Human Diet Material for the Determination of Nutrient Elements, Selected Toxic Elements and Organic Nutrients: A Preliminary Report.

Final rept.,
G. V. Iyengar, J. T. Tanner, W. R. Wolf, and R. Zeisler. 1987, 18p

Sponsored by Food and Drug Administration, Rockville, MD., and Department of Agriculture, Beltsville, MD.

Pub. in Science of the Total Environment 61, p235-252 1987.

Keywords: *Diets, *Nutrition, *Atomic absorption, Atomic emission, Elemental analysis, Neutron activation.

Using 201 foods from the United States Food and Drug Administration's Total Diet Study (FDA TDS), a mixed diet composite (USDIT-1) was prepared to represent the intake of 25-30-year-old males in the United States. Proximate analyses, phytate determination, and assays for nutrient elements and selected toxic elements, as well as organic nutrients were carried out on this composite. As part of a quality control exercise for a coordinated research program, atomic absorption spectrophotometry, inductively coupled atomic emission spectrometry, colorimetry and neutron activation analysis were used to determine up to 30 elements in the diet material. A comparison of the daily intakes of As, Ca, Cd, Cu, Fe, Hg, K, Mg, Mn, Na, P, Se and Zn from the composite USDIT-1 shows excellent to good agreement with FDA TDS values calculated from results of single food analyses. These USDIT-1 results demonstrate the feasibility of the mixed diet concept as a viable approach for a reliable assessment of daily intakes, especially for a number of elements such as Cd, Cr, Hg and Mo that occur at low concentrations in individual food products. Simultaneously, stability of some organic nutrients during storage was also investigated. Initial findings suggest that this program may also be useful in the development of reference materials for organic nutrients, for which there is a great need. These aspects are discussed.

Pathology

701,307

PB87-162095

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Evaluation of Biological Samples for Specimen Banking and Biomonitoring by Nuclear Methods.

Final rept.,
S. F. Stone, R. L. Zeisler, and J. R. Vogt. 1984, 12p
See also DE84-017348.

Pub. in Proceedings of International Conference on Nuclear Methods in Environmental and Energy Research (5th), Mayaguez, Puerto Rico, April 2, 1984, p801-812 1984.

Keywords: *Specimen banking, *Biomonitoring, Humans, Livers, Mussels, Neutron activation analysis, Trace elements, Mytilus edulis.

In a pilot program for environmental specimen banking, human livers and marine mussels (Mytilus edulis) were sampled, analyzed and banked. Nuclear methods played a major role in the evaluation of the samples, providing concentration data for up to 38 major, mineral and trace elements. Instrumental neutron activation analysis was complemented by neutron capture prompt gamma activation analysis, radiochemical separations and, for the mussels, by instrumental X-ray fluorescence analysis. The cryogenic homogenization procedure was applied for sample preparation and was evaluated. Assessment of accuracy was made by analyzing Standard Reference Materials and by inter-comparison of the techniques. Results are reported for 66 individual human liver specimens, collected at three locations in the United States, and for batches of 65 mussels from a collection made at Narragansett Bay, Rhode Island.

Pharmacology & Pharmacological Chemistry

701,308

PB88-152970

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

One-Electron Redox Reactions of Pyrazolin-5-Ones. A Pulse Radiolysis Study of Antipyrine and Analogues.

Final rept.,
S. V. Jovanovic, P. Neta, and M. G. Simic. 1985, 4p
Pub. in Molecular Pharmacology 28, n4 p377-380 1985.

Keywords: *Pyrazolines, *Drugs, Electrode potentials, Oxidation, Reprints, *Antipyrine, Aqueous solutions.

One-electron oxidation of several derivatives of pyrazolin-5-one, including the drug antipyrine, were studied by pulse radiolysis of aqueous solutions.

Physiology

701,309

PB87-149852

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Dynamics of Calcium Metabolism in Infancy and Childhood. 1. Methodology and Quantification in the Infant.

Final rept.,
L. J. Moore, L. A. Machlan, M. O. Lim, A. L. Yergey, and J. W. Hansen. 1985, 6p
Pub. in Pediatric Research 19, n4 p329-334 1985.

Keywords: *Calcium, *Metabolism, *Calcium isotopes, *Infant nutrition, Pediatrics, Infants, Calcium metabolism disorders, Stable isotopes, Mass spectroscopy, Reprints, Calcium dynamics, Calcium disorders.

Stable isotopes of calcium, (46)Ca and (48)Ca were injected intravenously and administered orally, respectively, to newborn infants. Methodology was developed to chemically separate calcium from serum and excreta, and to measure the enriched calcium isotopes with thermal ionization mass spectrometry. These studies have demonstrated that the dynamics of calci-

um metabolism can be quantified in infants by fitting the data to a multicompartmental model that consists of three expanding, rapidly exchangeable calcium pools interacting with bone, the kidney, and the gastrointestinal tract. The data suggest that in the process of reaching adulthood, urinary calcium losses fail to show the large decrease observed in other kinetic parameters; relative to other parameters, the rate of urinary calcium excretion increases. Applications of the procedures are expected to be useful in studying the calcium dynamics in selected individuals during growth and development or with various calcium disorders.

701,310

PB87-233433

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Precipitation of Sodium Acid Urate from Electrolyte Solutions.

Final rept.,
H. Furedi-Milhofer, V. Babic-Ivancic, O. Milat, W. E. Brown, and T. M. Gregory. 1987, 9p
Sponsored by American Dental Association Health Foundation, Chicago, IL., and Public Health Service, Rockville, MD.
Pub. in Jnl. of Crystal Growth 83, p572-580 1987.

Keywords: *Renal stones, Reprints, *Phase diagrams, *Gouty stones, Precipitation boundaries, Precipitation diagrams, Sodium acid urate monohydrate, Urolithiasis.

The precipitation of sodium urate from solutions containing uric acid, sodium hydroxide, hydrochloric acid, sodium chloride and water was investigated at constant pH (7.5 + or - 0.1) and temperature (308 K). Precipitates were observed by light and electron microscopy and characterized by electron and X-ray diffraction. The results are represented in the form of 'precipitation' and 'chemical potential' diagrams, the latter giving the sodium-to-urate molar ratios of the precipitates. Two types of precipitation boundaries were observed, both of which had indicated sodium-to-urate molar ratios of 1:1. The ion activity product, (Na⁺)(HU⁻), associated with boundary I was API = (4.8 + or - 1.1) times 10 to the minus 5th power and with boundary II was APII = (6.5 + or - 0.4) times 10 to the minus 4th power. The supersaturation, S, at boundary II was S = APII/K(sp) = 12.3, in which K(sp) is the solubility product of sodium acid urate monohydrate. The latter precipitated as well-formed crystals at supersaturations of 12.3 and above. The ion activity product associated with boundary I is approximately equal to the solubility product of sodium acid urate monohydrate. Small amounts of several morphologically different sodium urate crystals formed in the range of supersaturations (1 less than or equal to S less than or equal to 12.3). Crystals formed in this range may include the monohydrate of sodium acid urate and possibly a higher hydrate. The findings have relevance to pathological renal stone formation and gouty arthritis.

701,311

PB87-233441

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.

Computed Phase Diagrams for the System: Sodium Hydroxide - Uric Acid - Hydrochloric Acid - Water.

Final rept.,
W. E. Brown, T. M. Gregory, and H. Furedi-Milhofer. 1987, 11p
Sponsored by American Dental Association Health Foundation, Chicago, IL., and Public Health Service, Rockville, MD.
Pub. in Jnl. of Crystal Growth 83, p588-598 1987.

Keywords: Solubility, Uric acid, *Isotherms, *Phase diagrams, Renal stones, Sodium acid urate monohydrate, *Sodium hydroxide, Urolithiasis.

Renal stone formation is made complex by the variety of solid phases that are formed, by the number of components in the aqueous phase, and by the multiplicity of ionic dissociation and association processes that are involved. In the present work the authors apply phase diagrams calculated by the use of equilibrium constants from the ternary system sodium hydroxide-uric acid-water to simplify and make more rigorous the understanding of the factors governing dissolution and precipitation of uric acid (anhydrous and dihydrate) and sodium urate monohydrate. The system is then examined in terms of four components. Finally, procedures are described for fluids containing more than four components. The isotherms, singular points, and

MEDICINE & BIOLOGY

Physiology

fields of supersaturation and undersaturation are shown in various forms of phase diagrams. The system has two notable features (1) in the coordinates $-\log(\text{H}_2\text{U})$ versus $-\log(\text{NaOH})$, the solubility isotherms for anhydrous uric acid and uric acid dihydrate approximate straight lines with slopes equal to +1 over a wide range of concentrations. As a result, substantial quantities of sodium acid urate monohydrate can precipitate from solution or dissolve without changing the degree of saturation of uric acid significantly. (2) The solubility isotherm for $\text{NaHU} \cdot \text{H}_2\text{O}$ has a deltoid shape with the low-pH branch having a slope of infinity. As a result of the vertical slope of this isotherm, substantial quantities of uric acid can dissolve or precipitate without changing the degree of saturation of sodium acid urate monohydrate significantly. The $\text{H}_2\text{U} \cdot \text{NaOH}$ singular point has a pH of 6.87 at 310 K in the ternary system.

Radiobiology

701,312
PB87-149548 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Measurement of Absorbed Dose and Dose Distribution.

Final rept.,
A. Miller, and W. L. McLaughlin. 1984, 10p
Sponsored by Risoe National Lab., Roskilde (Denmark).
Pub. in Proceedings of Conference on Radiation Processing for Plastics and Rubber II, Canterbury, England, March 28-30, 1984, p10.1-10.10.

Keywords: *Dosimeters, Electron accelerators, Electron beams, *Radiation doses, Gamma radiation.

Absorbed dose from electron accelerators and cobalt irradiators can be measured reproducibly, e.g. with thin film plastic dosimeters, which also are useful for dose distribution measurements. Corrections must be applied to obtain the dose in product from measurement of the dose in a dosimeter. New developments in absolute dosimetry by means of calorimetry are discussed, as well as new developments in relative dosimetry.

701,313
PB87-165593 PC A07/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
Approximate Procedures for Calculating Protection from Initial Nuclear Radiation from Weapons.
C. M. Eisenhauer, and L. V. Spencer. Feb 87, 131p
NBSIR-87/3507
Sponsored by Federal Emergency Management Agency, Washington, DC.

Keywords: *Structures, *Radiation shielding, *Nuclear weapons, Radiation protection, Nuclear explosion effects, Nuclear radiation, Buildings, Radiation transport, Neutron transport, Gamma radiation, Dose rates.

In the report the authors discuss procedures for routine evaluation of the protection of complex structures against the initial radiations from nuclear detonations. They describe procedures for evaluating and combining dose reduction factors for four radiation components: early fission product gamma rays, air secondary gamma rays generated by neutron interactions in the air, neutrons, and wall capture gamma rays generated by neutrons through interactions with nuclei in structural materials. They describe computer codes developed to evaluate reduction factors for each of these components.

701,314
PB88-108535 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Calibration of Beta-Particle-Emitting Ophthalmic Applicators.
Final rept.,
J. S. Pruitt. Jul 87, 38p NBS/SP-250/9
Also available from Supt. of Docs. as SN003-003-02817-7. Library of Congress catalog card no. 87-619844.

Keywords: *Ophthalmology, *Strontium 90, Quality assurance, *Beta sources, *Yttrium 90, *Calibration, Radiation doses.

The service provides calibrations for (90)Sr + (90)Y beta particle ophthalmic applicators. The calibration determines the average surface absorbed-dose rate to water over the active area of the applicator. The technique used is to measure current per unit mass of air at the active surface with an extrapolation ionization chamber, and to convert this into absorbed-dose rate with Bragg-Gray cavity ionization theory. The extrapolation chamber measurements are made in three parts. Data book measurements and a calibration report are given for one particular applicator.

701,315
PB88-110374 PC A04/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Fricke Dosimetry in High-Energy Electron Beams.
Final rept.,
C. G. Soares, E. L. Bright, and M. Ehrlich. Jul 87, 58p NBS/SP-250/4
Also available from Supt. of Docs. as SN003-003-02816-9. Library of Congress catalog card no. 87-619834.

Keywords: *Chemical dosimeters, Iron sulfate, Spectrophotometry, Quality assurance, Electron beams, *Electron dosimetry, Radiation doses, Fricke solution, High energy, US NBS.

The NBS Fricke-Dosimetry Service (advertised in NBS Special Publication 250, 1986-1988 and earlier editions) is described in detail. After a brief historical introduction and description of the service, the theoretical basis (including what quantities are measured, how, and why) and the philosophy of internal quality checks are discussed in some detail. This is followed by a description of the physical setup and of the step-by-step operating and reporting procedures. Throughout the section, there is reference to sample records of past performance, in order to facilitate continuity of operation in the case of personnel changes. The document concludes with a discussion of the uncertainties involved in the measurement quality assurance service, safety considerations, and an appendix containing samples of all form letters and of the final report mailed to the participants.

701,316
PB88-117700 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Tissue-Equivalent Radiochromic Waveguide Dosimeters for X-and Gamma Rays and Fast Neutrons.
Final rept.,
S. Kronenberg, W. L. McLaughlin, and C. R. Siebert. 1986, 4p
Sponsored by Army Communications-Electronics Command, Fort Monmouth, NJ., and Federal Emergency Management Agency, Washington, DC.
Pub. in Nuclear Tracks 12, n1-6 p561-564 1986.

Keywords: *Dosimeters, Fast neutrons, Real time operations, Reprints, *Tissue-equivalent detectors, *Neutron dosimetry, *Gamma dosimetry, *X-ray dosimetry, Radiochromatography, Optical waveguides.

Radiochromic waveguide dosimeters consist of small fluorinated ethylene propylene (FEP) tubing containing a radiation-sensitive organic liquid or gel, which, because of its higher refractive index, propagates light through the tubing as an optical waveguide. The measurement of dose is accomplished by reading radiation induced changes in the ratio of transmittances at two visible light wavelengths. These dosimeters read the gamma and neutron tissue doses. Real time dosimeters were built on this principle for use in radiation therapy.

701,317
PB88-141031 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Nuclear Data for Biomedical Applications.
Final rept.,
R. S. Caswell. 1986, 12p
Sponsored by Department of Energy, Washington, DC. Office of Health and Environmental Research.
Pub. in Radiation Effects 94, n1-4 p1-12 1986.

Keywords: *Decay schemes, Nuclear cross sections, Neutron cross sections, Neutron irradiation, Reprints, *Nuclear medicine, Radioisotopes, Radiopharmaceuticals, Radiation therapy.

Needs for better nuclear data for biomedical applications are chiefly of two kinds: decay-scheme and production data for radionuclides used in nuclear medicine, and cross sections and spectral information for high-LET radiations used in radiation therapy of cancer, especially high-energy neutrons. Radiopharmaceuticals are used primarily for diagnostic and physiological function studies. Decay scheme information is important to establish the internal radiation dose received by the patient. Radionuclides for which better decay scheme data are needed are identified. Protons, alphas, pions, neutrons, and heavy nuclei such as Si-28 and A-40 are all being studied or used for radiation therapy of cancer. Of these, the most widely used is neutron radiation therapy at about 8 centers in the United States, 22 worldwide. The nuclear data needed are total and partial neutron cross sections for the elements that compose tissue and for dosimeter materials up to about 60 MeV.

701,318
PB88-141056 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Effect of Air Scatter on Calibration of Instruments for Detecting Neutrons.

Final rept.,
C. M. Eisenhauer, R. B. Schwartz, and R. C. McCall. 1987, 8p
Sponsored by Defense Nuclear Agency, Washington, DC.
Pub. in Radiation Protection Dosimetry 19, n2 p77-84 1987.

Keywords: *Dosimeters, Neutron sources, Californium isotopes, Americium isotopes, Reprints, *Neutron dosimetry, Personnel dosimetry, Atmospheric correction, Calibration, Radiation doses.

Monte Carlo calculations of the effect of air scatter on neutron fluence from Cf, moderated Cf, Am-Be, and Am-B neutron sources are presented. Net scattered fluence ratios of 1.38 + or - 0.10%, 4.40 + or - 0.21%, 0.95 + or - 0.10%, and 0.99 + or - 0.10% per meter, respectively, are indicated. Application of these results to the calibration of neutron personnel protection instruments is discussed, and a method is given for estimating air scattering from other neutron sources.

701,319
PB88-147574 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Monte Carlo Studies of X-ray Scattering in Transmission Diagnostic Radiology.
Final rept.,
G. Barnea, and C. E. Dick. 1987, 6p
Pub. in Medical Physics 13, n4 p490-495 Jul/Aug 87.

Keywords: *Radiology, Monte Carlo method, Polystyrene, Water, Reprints, *X-ray scattering, Nuclear medicine, KeV range 10-100, KeV range 100-1000.

Monte Carlo methods have been used to simulate the scattering of x rays in polystyrene and water phantoms. In particular, the ratio of the scattered-to-total x-ray fluence (scatter fraction) has been calculated for monoenergetic x-ray beams in the energy region relevant to diagnostic radiology and nuclear medicine (300-660 keV). Simulations have been made for representative values of the pertinent geometrical factors: phantom thickness from 5 to 21 cm, x-ray beam diameters of 10 and 25 cm, and scatter-to-image-plane separations from 0 to 20 cm. As a function of x-ray energy, the scatter fraction was found to vary slowly between 30 and 100 keV, and to decrease between 100 and 660 keV. The present results were generated with a special transport code which included the effects of special geometries and the response of the x-ray detector.

701,320
PB88-152665 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Effects of Varying Geometry on Dose Calibrator Response: Cobalt-57 and Technetium-99m.
Final rept.,
J. M. Calhoun, D. B. Golas, and S. Harris. 1987, 6p
Pub. in Jnl. of Nuclear Medicine 28, n9 p1478-1483 Sep 87.

Keywords: Ionization chambers, Standards, Geometry, Shape, Reprints, *Radiation doses, Technetium 99,

Cobalt 57, Radiopharmaceuticals, Nuclear medicine, Calibration.

A joint project between the National Bureau of Standards (NBS) and Biomedical Products Department, E.I. du Pont de Nemours and Company, Inc. compared the indicated activity of (a) cobalt-57 samples in NBS 5-ml ampoules, plastic syringes, Du Pont 27-ml Vial E epoxy- and Solution-filled containers, and (b) technetium-99m solutions in NBS 5-ml ampoules, elution vials, and syringes. The measurements were made in ionization chambers from two manufacturers. The main objective was to examine the use of radionuclides in NBS ampoules and Du Pont Vial E containers as suitable reference sources for ionization chambers used to assay radiopharmaceuticals in elution vials and syringes. The exercise illustrated that regardless of the brand of dose calibrator used, a calibration factor for each geometry should be determined to ensure the highest accuracy. The data show that as much as a 9% difference from the correct activity can be observed for these radionuclides, even when the ampoule reference source gives the appropriate reading.

701,321
PB88-152673 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Energy Loss and Range of Electrons.
Final rept.,
M. J. Berger. 1987, 23p
Sponsored by Department of Energy, Washington, DC., and Office of Naval Research, Arlington, VA.
Pub. in Nuclear and Atomic Data for Radiotherapy and Related Radiobiology, p323-345 1987.

Keywords: *Electrons, Dosimetry, Distance, *Stopping power, Range, Energy losses, Radiation therapy, KeV range 01-10, KeV range 10-100.

The paper reviews the information available on electron stopping powers and ranges, both in the energy region above 10 keV, where the information is found to be adequate for dosimetry and radiation therapy planning, and in the region below 10 keV, where the information is fragmentary and should be improved to meet the needs of microdosimetry and track structure research. Attention is focused on the state of the art as represented by the compilation in ICRU Report 37, 1984.

701,322
PB88-152954 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Free Radical-Induced Cross-Linking of Polydeoxythymidylic Acid in Deoxygenated Aqueous Solution.
Final rept.,
L. R. Karam, M. G. Simic, and M. Dizdaroğlu. 1986, 9p
Pub. in International Jnl. of Radiation Biology and Related Studies in Physics, Chemistry and Medicine 49, n1 p67-75 1986.

Keywords: *Deoxyribonucleic acids, Irradiation, Cross-linking, Spectrophotometry, Hydrogen, Chromatic analysis, Reprints, *Polydeoxythymidylic acid, Aqueous solutions, Hydroxyl radicals.

Radiation-generated hydroxyl radicals and hydrogen atoms were shown to induce the cross-linking of polydeoxythymidylic acid in N₂O-saturated aqueous solution. The irradiated samples were hydrolyzed with formic acid and then analyzed by high performance liquid chromatography. Products were isolated and subsequently characterized by capillary gas chromatography-mass spectrometry. The presence of previously described monomeric thymine products was also shown. Yields were determined and mechanisms of formation were described for the products.

701,323
PB88-154588 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Secondary Charged Particle Spectra and Kerma Calculations.
Final rept.,
J. J. Coyne, H. M. Gerstenberg, and L. A. Hennen. 1987, 16p
Pub. in Nuclear and Atomic Data for Radiotherapy and Related Radiobiology, p189-204 1987.

Keywords: *Alpha particles, Carbon, *Kerma, Particle production, Breakup reactions, Radiation therapy.

A detailed analysis had been made of the reaction mechanisms which could contribute to the (n,n')₃ alpha reaction in carbon, and their contribution to kerma.

Toxicology

701,324
PB88-138888 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Toxicological Interactions between Carbon Monoxide and Carbon Dioxide.
Final rept.,
B. C. Levin, M. Paabo, J. L. Gurman, S. E. Harris, and E. Braun. 1987, 30p
Sponsored by Harry G. Armstrong Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
Pub. in Proceedings of Conference of Toxicology (16th), Dayton, OH., October 28-30, 1986, p1-30 1987.

Keywords: *Toxicology, *Carbon dioxide, *Carbon monoxide, Bioassay, Carboxyhemoglobin, Combustion products, Inhalation, Materials, Plastics, Rats, Laboratory animals, *Air pollution effects, Synergism.

Fischer 344 male rats were subjected to 30-min individual or combined exposures of carbon monoxide (CO) and carbon dioxide (CO₂). All deaths from CO occurred during the exposures, and the LC50 values were 4600 and 5000 ppm, depending on experimental conditions. Animals exposed to CO₂ concentrations ranging from 1.3 to 14.7% for 30 min were neither incapacitated nor fatally injured. The addition of non-lethal concentrations of CO₂ (1.7 to 17.3%) to sublethal concentrations of CO (2500 to 4000 ppm) caused deaths of the exposed rats both during and following (up to 24 h) the 30-min exposures. The most toxic combination of these two gases (2500 ppm CO plus 5% CO₂) increased the rate of carboxyhemoglobin (COHb) formation 1.5 times that found in rats exposed to 2500 ppm of CO alone. The COHb equilibrium levels were the same. Exposure to both CO and CO₂ produced a greater degree of acidosis and a longer recovery time than that observed with either single gas. The results fit a mathematical model indicating a synergistic interaction. Combustion of 11 materials at their LC50 values indicated that CO was probably the primary toxicant in one case and that the combined CO plus CO₂ was the cause of the deaths in three other cases. Additional fire gases need to be studied to explain deaths from the other materials.

701,325
PB88-141296 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Chronic Cadmium Intoxication: Tissue-Response in an Occupationally Exposed Patient.
Final rept.,
V. F. Garry, B. Pohlman, M. Wick, J. Garvey, and R. Zeisler. 1986, 9p
Pub. in American Jnl. of Industrial Medicine 10, n2 p153-161 1986.

Keywords: *Toxicology, *Tissues(Biology), *Cadmium, In vitro analysis, Reprints.

A report on a case of high level cadmium exposure is given. Investigations include morphologic studies of the patient's tissues, neutron activation analyses of kidney and liver samples, metallothionein analyses of the patient's liver, and comparison to human liver's from the Pilot National Environmental Specimen Bank.



MILITARY SCIENCES

Logistics, Military Facilities, & Supplies

701,326
PB88-110234 PC A05/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.
Interim Survey of Selected Military Building Environments: A Research Approach.
Interim rept. Sep 86-Mar 87,
A. I. Rubin, and B. L. Collins. Aug 87, 98p NBSIR-87/3606
Sponsored by Army Intelligence and Security Command, Arlington Hall Station, VA.

Keywords: *Military facilities, *Workplace layout, *Work environment, Environmental engineering, Interiors lighting, Air quality.

Because many military and civilian employees of the U.S. Army are required to work in environments unlike those experienced by most civilian workers, a project involving a comprehensive assessment of such workplaces was initiated. This assessment involves a two-phase effort in which the first phase consisted of a literature search, interviews with experts, site visits, and limited field environmental measurements. The second phase will include a comprehensive assessment of environmental conditions including lighting at selected military facilities. The present report documents findings from phase 1, including a detailed bibliography of target areas: lighting, stress, and shiftwork. It also includes preliminary results from a visit to two military field stations.

701,327
PB88-113394 PC A23/MF A01
National Bureau of Standards (ICST), Gaithersburg, MD. Center for Programming Science and Technology.
Final NBS (National Bureau of Standards) Report for CALS (Computer Aided Logistic Support), FY86.
S. J. Kemmerer. May 87, 547p NBSIR-87/3566
Sponsored by Assistant Secretary of Defense (Acquisition and Logistics), Washington, DC.

Keywords: *Weapon systems, *Manufacturing, *Logistics, *Contracts, *Digital systems, *Computer systems design, *Computer graphics, Product development, Program management, *Computer aided design, *Computer aided manufacturing, Data base management, Department of Defense, Computer Aided Logistic Support (CALS) program.

The overall objective of the DoD Computer Aided Logistic Support (CALS) Program is to integrate the design, manufacturing, and logistic functions through the efficient application of computer and communications technology. DoD requires functional and interface standards and procedures that will enable the digital interchange of data in weapon system and automated system contracts, that will be common to all Services and DLA. The FY86 Final Report provides NBS recommendations for standards usage to support the interchange of CALS digitized technical information in four major areas: product data, graphics, database management, and text.

General

701,328
PB88-122114 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.
NBS' (National Bureau of Standards) Role in Calibration Support for Modern Defense Systems: Meeting the Challenge of Today's High Technology.
Final rept.,
B. C. Belanger. 1983, 13p
Pub. in Proceedings of the Worldwide Air Force PMEL Conference (2nd), Granville, OH., July 11-15, 1983, 13p.

Keywords: *Calibrating, *Weapon systems, Metrology, Reprints, *Foreign technology, US NBS.

The paper reviews the challenges faced by a modern calibration laboratory manager, describes the role of the National Bureau of Standards in providing traceability to national standards for Air Force and Air Force contractor calibration and metrology activities, and describes selected ongoing metrology research projects at NBS, many of which are jointly funded by the Air Force.

NATURAL RESOURCES & EARTH SCIENCES

Geology & Geophysics

701,329
PB87-157160 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Fracture Mechanics and Non-Destructive Evaluation Investigation of the Subcritical-Fracture Process in Rock.
 Final rept.,
 P. L. Swanson. 1986, 19p
 Pub. in Fracture Mechanics of Ceramics 8, p299-317 1986.

Keywords: *Cracking(Fracturing), *Rocks, Nondestructive tests, Fracture properties, Reprints, *Rock fracture.

Results of subcritical-fracture experiments performed in air on five different rock types are presented. A non-unique relationship between calculated stress-intensity factor and crack velocity suggests violations of the assumptions made when using conventional fracture testing techniques. To obtain a better understanding of fracture propagation in rock without regard to single-parameter characterizations of the fracture process several non-destructive testing techniques were employed in conjunction with subcritical crack-growth experiments on Westerly granite. The size and shape of the fracture process zone is estimated from (1) 2-dimensional surface-deformation maps obtained using holographic interferometry, (2) the location of acoustic-emission events, and (3) the spatial distribution of ultrasonic-wave attenuation. By focusing attention in the areas shown to be of importance in the NDT experiments, in-situ microscope observations are used to identify several micromechanisms of fracture.

701,330
PB87-218301 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Theoretical Analysis of Cation Ordering in Binary Rhombohedral Carbonate Systems.
 Final rept.,
 B. P. Burton. 1987, 8p
 Pub. in American Mineralogist 72, p329-336 1987.

Keywords: *Carbonate minerals, *Calcite, *Dolomite(Mineral), Thermodynamics, Trigonal lattices, Clustering, Cations, Reprints.

A three-parameter version of the tetrahedron approximation in the cluster-variation method is used to model cation ordering in rhombohedral carbonate systems. The model is sufficient to calculate theoretical phase diagrams that are in complete qualitative agreement with high-temperature phase-equilibrium data and with experimental composition and temperature dependence of the excess heats that are associated with cation ordering. In addition, the many-body interaction parameters that are required to obtain appropriate phase-diagram topologies at high temperature lead to the prediction of an ordered ground-state with stoichiometry $\text{Ca}_3\text{Mg}(\text{CO}_3)_2$. Cation ordering in this 3:1 phase yields a trigonally distorted analogue of the Cu_3Au or Al_3Ti structure.

701,331
PB87-224085 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Liquid-Supported Torsion Balance as Gradiometer.
 Final rept.,
 P. T. Keyser, and J. E. Faller. 1987, 23p
 Pub. in Proceedings of Gravity Gradiometer Conference (14th), Colorado Springs, CO, February 11-12, 1986.

Keywords: Variometers, Sensitivity, *Gradiometers, *Gravity gradiometers, Torsion balances.

The authors use a liquid-supported torsion balance as a fixed-site long-term curvature variometer. The traditional torsion fiber is replaced by liquid support and electrostatic positioning. Thus the torsion constant is adjustable by varying the voltage applied to the torque electrodes, while the centering voltage remains constant. The sensitivity of this type of gradiometer is discussed, along with critical parameters for success. Preliminary data is presented.

701,332
PB87-224093 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Results of the International Comparison of Absolute Gravimeters in Sevres (2nd), 1985.
 Final rept.,
 Y. Boulanger, J. Faller, and E. Groten. 1986, 15p
 Pub. in Bureau Gravimetric International, n59 p89-103 1986.

Keywords: *Gravimeters, Gravity, Comparison, Reprints.

The results of the second international comparison of absolute gravimeters in Sevres 1985 are discussed.

Mineral Industries

701,333
PB87-152344 PC A05/MF A01
 National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Qualitative Analysis of the Inherent Fire Safety/Fire Risk in a Coal Mine.
 H. E. Nelson. Dec 86, 83p NBSIR-86/3502
 See also report dated Aug 86, PB87-103271. Sponsored by Bureau of Mines, Pittsburgh, PA.

Keywords: *Coal mines, *Fire safety, Fire hazards, Fire protection, Underground mining, Evaluation.

This is a quantitative description of a fire safety analysis system for a coal mine. An event-logic tree and a state transition model are presented. The report is also presented as Appendix D of NBSIR 86-3425, The Development of a Fire Evaluation System for Underground Coal Mines.

701,334
PB87-161477 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.
Electromagnetic Wave Propagation in an Asymmetrical Coal Seam.
 Final rept.,
 D. A. Hill. Feb 86, 4p
 Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation AP-34, n2 p244-247 Feb 86.

Keywords: *Electromagnetic wave transmission, Medium frequencies, Coal mines, Remote sensing, Propagation, Radio communication, Reprints, *Coal seams.

Electromagnetic wave propagation in a coal seam is analyzed for the case where the surrounding floor and roof rocks have different electrical properties. Numerical results are presented for the attenuation rate and field distribution of the dominant mode. Even when the roof and floor conductivities are different, the vertical electric field and the horizontal magnetic field are the dominant components, and they are nearly constant within the coal seam. The results have application to mine communication and remote sensing of coal seams.

701,335
PB87-191185 Not available NTIS
 National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Experimental Determination and Modeling of the Heat Capacity of Coal in Various Atmospheres.
 Final rept.,
 J. E. Callanan, S. A. Sullivan, and R. A. MacDonald. Jan 87, 13p
 Pub. in International Jnl. of Thermophysics 8, n1 p133-145 Jan 87.

Keywords: *Coal, *Specific heat, Helium, Argon, Carbon monoxide, Desorption, Models, Reprints.

During the development of transferable measurement techniques for the heat capacity of raw coal, it was observed that the atmosphere in sealed sample cells affected the thermal behavior, particularly during the initial measurements. The model which had been used to represent the specific heat of coal did reproduce the results in air but failed to reproduce the deep exotherm of the thermograms obtained in nitrogen. The specific heat of coal has been determined in helium, argon, and carbon monoxide to provide insight into possible modifications to the model. The results of initial and repeat runs in the five different atmospheres and the impact of these results on the modeling are presented and discussed. The agreement between the experimental heat capacity and that predicted by the model, up to 500K, is excellent and supports Merrick's predictions for the heat capacity of coal.

NAVIGATION, GUIDANCE, & CONTROL

Navigation Systems

701,336
PB87-161725 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Position Location with the NBS/GPS (National Bureau of Standards/Global Positioning System) Time Transfer System.
 Final rept.,
 M. Weiss. 1984, 5p
 Pub. in Proceedings of Symposium on IEEE (Institute of Electrical and Electronics Engineers) PLANS (Position Location and Navigation System) '84, San Diego, CA, November 26-29, 1984, p175-179.

Keywords: *Position finding, Time standards, Frequency stability, Ephemerides, Precision, Global positioning system.

The NBS/GPS time transfer system is a low-cost receiver of the GPS C/A code for anyone with a high quality clock interested in referencing that local clock to UTC(NBS) at state-of-the-art time and frequency accuracies using the common-view technique. In particular it is used in comparing primary time standards around the world for generating the international UTC. In order to do these things the local user must know the coordinates of the receiver antenna within the GPS coordinate system. For this purpose the receiver has a position location program. The ability of the receiver to perform absolute and differential positioning was evaluated in experiments over three baselines: short (26m - 77m), medium (131 km), and long (240 km). Solutions from the receiver were compared with WGS-72 first order survey points. Absolute positioning error varied from 4.1 m to 10.2 m except during periods where the GPS was having trouble with the space vehicle clocks.

701,337
PB88-138979 Not available NTIS
 National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Position Location Using Sequential GPS Measurements.
 Final rept.,
 M. Weiss. 1982, 4p
 Pub. in Proceedings of Symposium on IEEE (Institute of Electrical and Electronics Engineers) PLANS (Position Location and Navigation), Atlantic City, NJ., December 6-9, 1982, p275-278.

Keywords: *Correction, *Position(Location), *Coordinates, Global positioning system, Reprints, *Foreign technology.

The paper reports the development of a program to derive a first order correction to initial estimates of local coordinates and local clock bias from GPS time using a single channel GPS receiver of the C/A code. The program measures sequentially the local minus

GPS time via four different satellites based on an initial estimate of local coordinates. Then using these measurements along with known locations of the satellites the first order corrections to the X, Y, and Z coordinates and the local time bias from GPS time are obtained.

NUCLEAR SCIENCE & TECHNOLOGY

Fusion Devices

701,338
PB87-232575 PC A18/MF A01
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Materials Studies for Magnetic Fusion Energy Applications at Low Temperatures--X.
R. P. Reed. May 87, 418p NBSIR-87/3067
See also report dated 1980, PB85-115491. Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.

Keywords: *Superconducting magnets, Stainless steels, Aluminum alloys, Cryogenics, Mechanical properties, *Thermonuclear reactor materials, Steel 304, Steel 310, Steel 316, Aluminum alloy 2090.

The report contains the results of a research program to determine the properties of materials that may be used in cryogenic structures for the superconducting magnets of magnetic fusion energy power plants and prototypes. Its purpose is to facilitate their design and development. The program was developed jointly by the staffs of the National Bureau of Standards and the Office of Fusion Energy of the Department of Energy; it is managed by NBS and sponsored by DOE. Research is conducted at NBS and at other laboratories through subcontracts with NBS. Research results for 1986 are presented in technical papers under five headings that reflect the main program areas: Structural Alloys, Welding, Nonmetallics, Technology Transfer, and United States-Japan Cooperative Program. Objectives and research highlights are summarized in the introduction to each program area.

Isotopes

701,339
PB88-141023 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Standardization of Carbon-14 by 4 pi beta Liquid Scintillation Efficiency Tracing with Hydrogen-3.
Final rept.,
B. M. Coursey, W. B. Mann, A. Grau Malonda, E. Garcia-Torano, J. M. Los Arcos, J. A. B. Gibson, and D. Reher. 1986, 6p
Pub. in Appl. Radiat. Isot. 37, n5 p403-408 1986.

Keywords: *Carbon 14, *Standards, Tritium, Reprints, Liquid scintillation detectors.

Carbon-14 in the form of (14)C-tartaric acid solution has been standardized by means of 4(pi)beta liquid-scintillation efficiency tracing using the NBS (3)H-water standard. The method of computing the detector efficiency for a two-phototube counting system using a standard of (3)H is described. The combined uncertainty in the (14)C radioactivity concentration, which may be treated as if it were one standard deviation, is 0.20%.

Nuclear Explosions & Devices

701,340
PB87-224507 Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Statistical Engineering Div.

Continuous Time Series Models for Unequally Spaced Data Applied to Modeling Atomic Clocks.
Final rept.,
R. H. Jones, and P. V. Tryon. 1987, 11p
Pub. in SIAM Jnl. Sci. Stat. Comput. 8, n1 p71-81 Jan 87.

Keywords: Reprints, *Atomic clocks, Kalman filters, Missing observations, State space representations, Time series analysis, Unequally spaced data.

State space representations and Kalman filters used to calculate likelihoods have increased the ease and flexibility of fitting time series models to data. When data are unequally spaced with no underlying basic sampling interval, continuous time series models are more natural than discrete time series models. State space representations still provide the flexibility needed to include a large class of models. The paper gives a survey of state space methods for continuous time processes, discusses extensions to multivariate data at unequally spaced time points with missing data within the observation vector, and gives an example of estimating time and model parameters from an ensemble of atomic clocks.

Nuclear Instrumentation

701,341
PB87-151585 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
A-150 Plastic Radiometric Calorimeter for Charged Particles and Other Radiations.
Final rept.,
J. C. McDonald, and S. R. Domen. 1986, 6p
Pub. in Nuclear Instruments and Methods in Physics Research A252, p35-40 1986.

Keywords: *Calorimeters, Calibrating, Reprints, *Tissue-equivalent materials, Radiation doses.

A local absorbed dose calorimeter with certain novel features has been designed and constructed of A-150 tissue-equivalent (TE) plastic. The radiation absorption properties of this material and the relative absence of core impurities make the calorimeter suitable for use in a wide variety of radiation beams. The low thermal diffusivity of A-150 plastic led to the development of a unique spiral electrical calibration heater that has a mass of only 0.1% that of the core. The calorimeter can be calibrated in the quasiadiabatic or the heat-loss-compensated mode to test for possible effects caused by temperature gradients. The details of construction and operation are described.

701,342
PB87-157061 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Effect of Altitude on Beta-Ray Source Calibrations.
Final rept.,
J. S. Pruitt. 1985, 7p
Pub. in Radiation Protection Dosimetry 11, n3 p151-157 1985.

Keywords: Strontium 90, Altitude, Dosimetry, Reprints, *Beta sources, *Calibration, Promethium 147, Thallium 204, Yttrium 90.

A study has been made of the effect of altitude on beta-ray source calibrations, using commercially available (147)Pm, (204)Tl, and (90)Sr + (90)Y sources. The measurements were made in a large environmental chamber, from which air was removed to simulate several altitudes between sea level and 3.7 km (12,000 feet). The results show that the calibration does vary with altitude, most drastically for (147)Pm, much less for both (204)Tl and (90)Sr + (90)Y. It is shown that the change in source calibration for a given change in air density is almost the same as the change produced by addition of a plastic filter with the same thickness in mass per unit area.

701,343
PB87-199410 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.

Advances in Calorimetry for Radiation Dosimetry.
Final rept.,
S. R. Domen. 1987, 76p
Pub. in Dosimetry of Ionizing Radiation, v2 p245-320 1987.

Keywords: *Dosimetry, Portable equipment, Reviews, *Calorimetry, Radiation doses.

The chapter describes and discusses recent advances in absorbed dose calorimetry. Presented are new design details, operational procedures, and methods for rapid reduction and control of troublesome signals caused by temperature drifts. A portable absorbed dose graphite calorimeter is discussed in detail. An A-150 plastic calorimeter is also described along with significant results. A homogeneous water calorimeter is described with its simplicity of construction and operation. A simple modification produces a polystyrene-water calorimeter for comparison with the water calorimeter. A brief discussion is given on total absorption calorimetry and two calibrated ionization chambers, the NBS P2 and the Wilson quantimeter. Described is a transformer Wheatstone bridge which significantly improves the detection sensitivity. The chapter discusses the evolution of the absorbed dose calorimeter to the point of being a practical and portable field instrument of wide use. Numerous references are cited.

701,344
PB87-201414 PC A02/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
Calculated Response of A 5.5 x 5.5 cm High-Purity Ge Detector to Gamma Rays with Energies Up to 20 MeV.
S. M. Seltzer. Apr 87, 13p NBSIR-87/3548
Sponsored by Department of Energy, Washington, DC. Office of Health and Environmental Research.

Keywords: Gamma ray spectroscopy, Performance evaluation, Efficiency, *Ge semiconductor detectors, *Gamma detection, KeV range 100-1000, MeV range 1-10, MeV range 10-100, Response functions.

Monte Carlo calculations have been done of the energy and angular response of a 5.5 x 5.5 cm, high-purity Ge detector, for gamma rays incident with energies from 0.1 to 20 MeV. Results are given for the absolute probabilities of total energy absorption and of single and double annihilation escape, which relate the areas of the peaks in the measured pulse-height distribution to the intensities of incident gamma-ray lines.

701,345
PB87-227617 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Neutron Personnel Dosimetry.
Final rept.,
R. B. Schwartz. Jul 87, 47p NBS/SP-250/12
See also PB87-174041. Also available from Supt. of Docs as SN003-003-02811-8. Library of Congress catalog card no. 87-619842.

Keywords: *Neutron dosimeters, *Calibrating, Measurement, Standards, Services, Quality assurance, National Bureau of Standards.

Detailed procedures are given for calibration of neutron dosimeters and remmeters with californium neutron sources, both 'bare' and moderated. Corrections for scatter, room-return, anisotropic neutron emission, and deviation from the inverse square law are discussed, and specific examples given. The uncertainties in arriving at the final value for the calibration factor are also discussed.

701,346
PB88-123708 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Radioactivity Calibrations with the '4 pi' Gamma Ionization Chamber and Other Radioactivity Calibration Capabilities.
Special pub. (Final),
J. M. Calhoun. Oct 87, 45p NBS/SP-250/10
Also available from Supt. of Docs. as SN003-003-02824-0. See also PB88-123781, and PB88-123690. Library of Congress catalog card no. 87-619870.

NUCLEAR SCIENCE & TECHNOLOGY

Nuclear Instrumentation

Keywords: *Ionization chambers, *Radioactivity, Standards, *Calibration, *Gamma detection, Radioisotopes, US NBS, Uncertainty.

The paper describes the use of the NBS 4 pi gamma ionization chamber - an instrument which provides an indirect method of comparing the activity (decays per second) of gamma-ray-emitting radionuclides with national standards for a routine calibration service by the National Bureau of Standards Radioactivity Group. A description of the chamber's construction and characteristics, the operational procedure, and the associated equipment is included. A description of NBS capabilities for direct radioactivity calibrations is also presented. Many of these capabilities are used to establish calibration factors for the '4 pi' gamma ionization chamber.

701,347
PB88-124425

(Order as PB88-124409, PC A04/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Large-Area Alpha-Particle Counting Systems, J. M. R. Hutchinson, and S. J. Bright. 1987, 14p
Included in Jnl. of Research of the National Bureau of Standards, v92 n5 p311-324 Sep-Oct 87.

Keywords: *Alpha particle detectors, *Radiation counters, Proportional counters, Radioactivity, Standards, US NBS.

Two alpha-particle counting systems for the measurement of large-area sources have been developed at the National Bureau of Standards. The systems and their characteristics are described. One system uses an internal-source proportional counter and the other measures sources external to the counting volume through a thin aluminized mylar window. The 'internal' system is used to measure sources in the lower activity ranges. These calibrated sources are then used to establish the efficiency of the 'external' counter used to measure the higher-activity sources.

701,348
PB88-141064 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Development of the Dual Thin Scintillator (DTS) in the 1 + 2 Coincidence Configuration as a Neutron Spectrometer.
Final rept., K. C. Duvall, and R. G. Johnson. 1986, 1p
Pub. in Radiation Effects 95, n1-4 p319 1986.

Keywords: *Neutron spectrometers, Reprints, Neutron detectors, Proton recoil detectors, Response functions, Spectra unfolding.

The Dual Thin Scintillator (DTS) when operated in the 1 + 2 coincidence configuration, exhibits a peaked response centered at the incident neutron energy. This is a more favorable response to be used with spectrum unfolding techniques and should provide a significant improvement over spectral determinations with conventional proton recoil response functions.

Radiation Shielding, Protection, & Safety

701,349
PB87-149787 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Evaluation and Compilation of DOE (Department of Energy) Waste Package Test Data.
Rept. for Dec 85-Jul 86, C. Interrante, E. Escalante, A. Fraker, M. Kaufman, W. Liggett, and R. Shull. 30 Nov 86, 128p
Pub. in NUREG/CR-4735, v1 128p, 30 Nov 86.

Keywords: *Cans, Containment, Basalt, Borosilicate glass, Leaching, Corrosion, Alloys, *Radioactive waste facilities, *High-level radioactive wastes, Tuff, Salt caverns.

The report summarizes results to date of NBS evaluations of Department of Energy (DOE) activities in waste packages designed for containment of radioactive high-level nuclear waste (HLW). The waste pack-

age is a proposed engineered barrier that is part of a permanent repository for HLW. Candidate repository sites include three different media: tuff, basalt, and salt. Metal alloys are the principal barriers for the proposed canisters and overpacks. In addition, borosilicate glass and various packing materials have been proposed as components of the engineered system. Thus, the associated technical problems involve corrosion, leaching, dissolution and transport within the waste packages. The report gives status reports on waste package activities related to each of the three host media.

701,350
PB87-219143 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Automated Production Technology Div.
Nondestructive Evaluation of Monolithic Transportation Casks for Spent Nuclear Fuel.
Final rept., D. G. Eitzen, R. C. Placious, L. J. Swartzendruber, and L. Mordfin. 1987, 90p
Contract DE-AC04-76DP00789
Sponsored by Department of Energy, Washington, DC.
Pub. in Contractor Report SAND86-7158, p1-90 May 87.

Keywords: Nondestructive tests evaluations, *Spent fuel casks.

No abstract available.

701,351
PB88-122429 PC A07/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Evaluation and Compilation of DOE (Department of Energy) Waste Package Test Data. Biannual Report: December 1985-July 1986 (RE-ANNOUNCEMENT OF PB87-149787 - see notes field for explanation), C. Interrante, E. Escalante, A. Fraker, M. Kaufman, W. Liggett, and R. Shull. Mar 87, 128p
RE-ANNOUNCEMENT OF PB87-149787 with new releasability: Available from NTIS. See also PB88-122437. Sponsored by Nuclear Regulatory Commission, Washington, DC. Div. of Waste Management.
Pub. in NUREG/CR-4735, v1 128p, 30 Nov 86.

Keywords: *Cans, *Containers, *High-level radioactive wastes, *Radioactive waste facilities, Tuff, Basalt, Salt deposits, Alloys, Containment, Borosilicate glass, Corrosion, Leaching.

The report summarizes results to date of NBS evaluations of Department of Energy (DOE) activities in waste packages designed for containment of radioactive high-level nuclear waste (HLW). The waste packages is a proposed engineered barrier that is part of a permanent repository for HLW. Candidate repository sites include three different media: tuff, basalt, and salt. Metal alloys are the principal barriers for the proposed canisters and overpacks. In addition, borosilicate glass and various packing materials have been proposed as components of the engineered system. Thus, the associated technical problems involve corrosion, leaching, dissolution and transport within the waste packages. The report gives status reports on waste package activities related to each of the three host media.

Radioactive Wastes & Radioactivity

701,352
PB88-128160 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Vaporization of Simulated Nuclear Waste Glass.
Final rept., D. W. Bonnell, E. R. Plante, and J. W. Hastie. 1986, 8p
See also PB84-102128.
Pub. in Jnl. of Non-Crystalline Solids 84, n1-3 p268-275, 2 Jul 86.

Keywords: *Radioactive waste disposal, Borosilicate glass, Cesium, Spectrometry, Radioactive waste processing, Thermodynamics, Reprints.

Industrial development of nuclear waste glass processing requires basic data on glass vaporization ther-

modynamics. Detailed mass spectrometric experiments and thermodynamic estimates have been made for vaporization of a nonradioactive borosilicate glass containing representative nuclear waste isotopes. Alkali metaborates were observed to be dominant vapor species and their partial pressures indicate significant vapor transport under likely process conditions. The results indicate the following order of significance for vapor transport of radionuclide species, CS about equal to Re (about equal to TC) > Ru >> Sr.

Reactor Engineering & Nuclear Power Plants

701,353
PB88-139134 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.
Wide Plate Crack Arrest Testing.
Final rept., R. deWit, and R. J. Fields. 1987, 7p
Sponsored by Department of Energy, Washington, DC.
Pub. in Nuclear Engineering and Design 98, n2 p149-155 1987.

Keywords: *Pressure vessels, *Plates (Structural members), *Crack propagation, Thermal shock, Nuclear reactor materials, Steels, Tests, Reprints.

To predict the behavior of a nuclear pressure vessel undergoing pressurized thermal shock, certain information on dynamic crack propagation and arrest is required. The purpose of the work described here is to provide such data on wide plates fracturing at temperatures up to the upper shelf region. Four tests have been completed on the 26 MN Universal Testing Machine at NBS since the Twelfth Water Reactor Safety Information Meeting. The paper summarized the results of these most recent tests.

701,354
PB88-141379 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
National Bureau of Standards Reactor (NBSR).
Final rept., R. S. Carter, and T. M. Raby. 1984, 8p
Pub. in Use and Development of Low and Medium Flux Research Reactors, Chapter 2, Supplement 44, p180-187 1984.

Keywords: *NBSR reactor, US NBS.

The National Bureau of Standards Reactor (NBSR) is a heavy water moderated and cooled reactor operating at 10 MW. Reactor facilities and special features, experimental instrumentation, and reactor utilization are described.

701,355
PB88-147566 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Role of Reactor Characterization in NAA Quality Assurance.
Final rept., D. A. Becker. 1987, 9p
Pub. in Jnl. Radioanal. Nucl. Chem. 110, n2 p393-401 1987.

Keywords: Quality assurance, Neutron irradiation, Neutron flux, Radioactivation analysis, Reprints, *NBSR reactor, Irradiation reactors, Activation analysis.

As a result of the NBS reactor upgrade to 20 MW, an extensive program of recharacterization of the irradiation facilities was undertaken. These measurements were made to (1) evaluate the neutron flux density and its variability over the irradiation volume, which is important for assuring quality in neutron activation analysis using these facilities, and (2) help establish safe irradiation conditions for samples in the NBSR. Techniques used to measure various parameters are described.

Reactor Fuels & Fuel Processing

Reactor Fuels & Fuel Processing

701,356

PB87-153300

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.

Recent Research at the U.S. National Bureau of Standards on Measurement Methodology for Nuclear Safeguards.

Final rept.,

H. T. Yolken. 1979, 4p

Sponsored by European Safeguards Research and Development Association, Rome (Italy).

Pub. in Proceedings of Annual Symposium on Safeguards and Nuclear Materials Management (1st), Brussels, Belgium, April 25-27, 1979, p352-355.

Keywords: *Nuclear materials management, Accounting, Measurement, Standardization, *Safeguards.

The U.S. National Bureau of Standards (NBS) has an ongoing program to provide for the standardization of measurement methods used for nuclear materials accountability. Current NBS activities are in five major areas: (1) nondestructive assay, (2) destructive chemical and isotopic assay, (3) bulk measurements, (4) statistical methods and sampling, and (5) systems studies. The NBS program will be described with emphasis on the first three areas.

701,357

PB87-156998

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

NDE (Nondestructive Evaluation) of Residual Stress in Uranium by Means of Neutron Diffraction.

Final rept.,

H. J. Prask, and C. S. Choi. 1984, 8p

Pub. in Jnl. of Nuclear Materials 126, n2 p124-131 1984.

Keywords: *Uranium, *Stresses, Nondestructive tests, Neutron diffraction, Reprints.

In the present work, a neutron diffraction technique for the nondestructive measurement of subsurface residual stress gradients in textured metallurgical samples is described. Results for three sample types are presented: aluminum cylinder and steel calibration samples; and two, depleted uranium-alloy cylinders of differing thermo-mechanical histories. The results in all cases confirm the accuracy of the technique. Furthermore, neutron diffraction, now appears to be the only technique by which nondestructive characterization of subsurface residual stress in uranium is possible.

701,358

PB87-203014

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.

Book Review of 'Nuclear Safeguards Analysis: Nondestructive and Analytical Chemical Techniques.'

Final rept.,

H. T. Yolken. 1981, 1p

Pub. in Medical Physics 8, n1 p127 Jan/Feb 81.

Keywords: Nondestructive tests, Chemical analysis, Reprints, *Nuclear materials management, *Safeguards.

The paper is a book review of the American Chemical Society Symposium Series, 79, 'Nuclear Safeguards Analysis Nondestructive and Analytical Chemical Techniques' for the journal Medical Physics.

Reactor Physics

701,359

PB88-139126

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.

Examination of (10)B(n,He) and (6)Li(n,He) Cross Section Measurements in Reactor Physics Benchmarks.

Final rept.,

J. A. Grundl. 1986, 6p

Pub. in Radiation Effects 93, n1-4 p135-140 1986.

Keywords: *Nuclear cross sections, Helium, Reprints, Reactor physics, Boron 10, Lithium 6, Benchmarks.

Helium production cross sections measurements for (10)B and (6)Li in five reactor physics benchmarks are examined, with emphasis on neutron fluence scale and benchmark spectrum uncertainties.

OCEAN TECHNOLOGY & ENGINEERING

Biological Oceanography

701,360

PB88-147657

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Mercury Transformation by Heterotrophic Bacteria Isolated from Cinnabar and Other Metal Sulfide Deposits in Italy.

Final rept.,

F. Baldi, G. J. Olson, and F. E. Brinckman. 1987, 16p

Pub. in Geomicrobiol. Jnl. 5, n1 p1-16 1987.

Keywords: *Mercury(Metal), *Sulfide minerals, *Bacteria, *Aquatic microbiology, *Resistance, *Geochemistry, Mercury organic compounds, Italy, Reprints, *Mediterranean sea.

Several mercury-resistant bacteria were isolated from sites in Italy surrounding natural mercury deposits. Bacterial strains resistant to 5 mg/L mercuric chloride reduced Hg(2+) to elemental mercury by an inducible process. One bacterial strain was resistant to methylmercuric chloride, and produced elemental mercury when incubated with several organomercurial compounds. No methylmercury was detected in bacterial cultures growing in the presence of 2 mg/L mercuric chloride. Mercury reduction is the major mercury transformation in mercury-resistant bacteria isolated from these environments.

Marine Engineering

701,361

PB87-171500

PC A08/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Building Technology.

Mat Foundations for Offshore Structures in Arctic Regions.

F. Y. Yokel, and R. G. Bea. Feb 87, 152p NBSIR-86/3419

Prepared in cooperation with PMB Systems Engineering, Inc., San Francisco, CA. Sponsored by Minerals Management Service, Reston, VA.

Keywords: *Offshore structures, *Mats, *Foundations, Offshore drilling, Platforms, Exploration, Oil recovery, Production, Chukchi Sea, Beaufort Sea.

Design limit states for offshore gravity structures in the Alaskan Beaufort and Eastern Chukchi continental shelves are discussed. The report contains a description of geological conditions, design loads, and type of structures used. Three foundation types are considered: foundations for artificial islands; foundations for caisson retained island with sand cores; and rigid foundations for various types of gravity structures which are positioned on the ocean floor with a minimum of preparation. Design limit states for these foundations are identified and the required reliability against the occurrence of these limit states is discussed. The authors ability to determine foundation resistance is assessed.

701,362

PB88-155759

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Analysis of the Pressure Rise in Sealed Magazine Fires.

H. R. Baum. Nov 87, 29p NBSIR-87/3557

Sponsored by Naval Weapons Center, China Lake, CA.

Keywords: *Ship fires, *Propellants, Mathematical models, Room fires.

A mathematical model for the pressure and temperature rise in sealed ship magazines caused by propellant fires is developed. The model is a simplified version of several existing zone fire models, modified to consider sealed compartments. The equations describing the model are solved exactly. Sample results are shown for a variety of magazine geometries.

Oceanographic Vessels, Instruments, & Platforms

701,363

PB88-100680

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Structures Div.

Assessment of Uncertainties and Risks Associated with the Dynamic Behavior of Compliant Offshore Structures.

Final rept.,

E. Simiu. 1984, 9p

Sponsored by Minerals Management Service, Reston, VA.

Pub. in Technology Assessment and Research Program for Offshore Minerals Operations, Outer Continental Shelf Report MMS 84-0001, p211-219 1984.

Keywords: *Loads, *Ocean engineering, Structural engineering, Structural reliability, Waves, Wind engineering, Reprints.

The paper describes NBS activities within the framework of the project 'Dynamics and Reliability of Compliant Offshore Platforms' sponsored by the Minerals Management Service. The objective of these activities is to estimate uncertainties and errors in the modeling of compliant structure behavior with a view to developing techniques for the assessment of their structural reliability. A brief presentation is included of an NBS investigation into the dynamic effects of turbulent winds upon the surge response of tension leg platforms in the presence of current and waves.

Physical & Chemical Oceanography

701,364

PB87-164109

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.

High Nitrite Levels off Northern Peru: A Signal of Instability in the Marine Denitrification Rate.

Final rept.,

L. A. Codispoti, G. E. Friederich, T. T. Packard, H. E. Glover, P. J. Kelly, R. W. Spinrad, R. T. Barber, J. W. Ekins, B. B. Ward, F. Lipschultz, and N. Lostaunau. 12 Sep 86, 3p

Sponsored by National Science Foundation, Washington, DC.

Pub. in Science 233, p1200-1202, 12 Sep 86.

Keywords: *Nitrification, *Nitrites, *Coasts, Accumulation, Cooling, Abnormalities, Sea water, Oxygen, Ocean temperature, South Pacific Ocean, *Denitrification, El Nino.

During February and March 1985, nitrite levels along the northern (approximately 7 to 10 degrees S) Peruvian coast were unusually high. These accumulations occurred in oxygen-deficient waters, suggesting intensified denitrification. In a shallow offshore nitrite maximum, concentrations were as high as 23 micromoles per liter (a record high). Causes for the unusual conditions may include a cold anomaly that followed the 1982-83 El Nino. The removal of combined nitrogen (approximately 3 to 10 trillion grams of nitrogen per year) within zones of new or enhanced denitrification observed between 7 to 16 degrees S suggests a significant increase in oceanic denitrification.

ORDNANCE

Underwater Construction & Habitats

Underwater Construction & Habitats

701,365
PB87-225454 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Robot Systems Div.

Extraction of Topographic Features in Support of Autonomous Underwater Vehicle Navigation.

Final rept.,
D. J. Orser, and M. Roche. 1987, 13p
Sponsored by Defense Advanced Research Projects
Agency, Arlington, VA.
Pub. in Proceedings of International Symposium on
Unmanned Untethered Submersible Technology (5th),
Merrimack, NH., June 22-24, 1987, p1-13.

Keywords: *Autonomous navigation, *Underwater vehicles, Topographic features, Bathymetry, Reprints.

The authors describe in an expository manner ongoing research concerned with the identification and extraction of topographic features relevant to automated navigation algorithms for an autonomous underwater vehicle. These features are presented within the framework of the external point topography network (EPTN), an idea going back to Arthur Cayley and J. Clerk Maxwell. The computational problems addressed here are the reconstruction of the surface terrain from irregular spaced bathymetric data and the subsequent extraction of the EPTN. While clearly no single best method exists for this latter step, the authors present here a description of several methods they have tried with some success. The data used for this research is that for a selected area of Lake Winnepesaukee, New Hampshire.

General

701,366
PB87-150512 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Structures Div.
Amplification of Wind Effects on Compliant Platforms.

Final rept.,
G. Cook, T. Kumarasena, and E. Simiu. 1986, 12p
Sponsored by Minerals Management Service, Reston, VA.
Pub. in Proceedings of Conference on Wind Effects on Compliant Offshore Structures, New Orleans, LA., September 15-18, 1986, p59-70.

Keywords: *Wind pressure, *Offshore structures, Turbulence, Water waves, Structural engineering, *Offshore platforms, Wind engineering.

A brief review is presented of recent information on the estimation of hydrodynamic damping. Results of simplified calculations are then presented, which indicate that typical tension leg platforms do not appear to experience significant amplification of wind-induced dynamic surge motions. This is the case not only for platforms in extreme environments, for which earlier investigations have been reported, but for non-extreme environments as well. It is noted that smaller values of the drag coefficient in the Morison equation result in increased amplifications of the fluctuating wind-induced response.

ORDNANCE

General

701,367
PB87-173712 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Center for Electronics and Electrical Engineering.
Metrology Challenges of the Strategic Defense Initiative.

Final rept.,
B. C. Belanger. 1987, 11p
Pub. in Proceedings of 1987 Measurement Science Conference, Irvine, CA., January 29-30, 1987, p1-11.

Keywords: *Metrology, *Measurement, Standards, Military strategy, Defense system, Microwaves, Strategic Defense Initiative.

As the nation's standards laboratory, the National Bureau of Standards (NBS) has a responsibility to monitor new technological developments in order to identify emerging requirements for national measurement reference standards and measurement services. During the past two years, NBS has been working with the Strategic Defense Initiative Office (SDIO), the Military Services, and industrial contractors to determine what new or improved measurement capabilities will be required to support the SDI. The paper provides an indication of the metrology challenges in selected technical areas by citing several specific examples.

PHOTOGRAPHY & RECORDING DEVICES

Photographic Techniques & Equipment

701,368
PB87-151882 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Robot Systems Div.

Calibration of a Camera and Light Source by Fitting to a Physical Model.

Final rept.,
P. Mansbach. 1986, 20p
Pub. in Computer Vision, Graphics, and Image Processing 35, p200-219 1986.

Keywords: *Cameras, *Calibrating, *Graphic methods, *Robots, Images, Model, Distance, Data processing, *Light sources, Image processing, Computer vision, National Bureau of Standards.

The paper describes the calibration of a camera-and-plane-of-light ranging system. Equations are derived which relate the image coordinates in the camera to the external coordinate system. These equations contain coefficients which are functions of the geometrical parameters of the camera/light-source system (focal length, pixel spacing, camera-to-plane-of-light distance, etc.). Several pictures are taken of a test block at different distances, and the geometrical parameters in the equations are varied to achieve a best (least squares) fit to the data. The resulting equations have a remaining error of less than one pixel, and have been used successfully on a parts-acquisition robot.

701,369
PB87-210225 PC A04/MF A01
National Bureau of Standards (IMSE), Gaithersburg,
MD. Metallurgy Div.

Wear Due to Printing Inks.

Final rept. Oct 84-Sep 86,
L. K. Ives, M. Peterson, A. W. Ruff, J. S. Harris, and P. A. Boyer. Jun 87, 69p NBSIR-87/3574
Sponsored by Bureau of Engraving and Printing, Washington, DC.

Keywords: *Printing inks, *Wear, Inks, Abrasive, Electroplating, Polishing, Polyvinylchloride.

The principal modes of wear during currency and stamp printing by the intaglio method were identified. Three laboratory test methods were developed and applied to a study of different ink materials and different chromium platings. The importance of abrasive particles in the inks was established. Recommendations for continued research, both fundamental and applied, were made.

PHYSICS

Acoustics

701,370
PB87-149803 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg,
MD. Metallurgy Div.

Reconstructing Spatially Incoherent Random Sources in the Near Field: Exact Inversion Formulas for Circular and Spherical Arrays.

Final rept.,
S. J. Norton, and M. Linzer. 1984, 7p
Pub. in Jnl. of the Acoustical Society of America 76, n6 p1731-1737 1984.

Keywords: *Ultrasonic radiation, Reprints, Inverse problems, Near field.

The authors consider the inverse problem for a 2-dimensional, spatially-incoherent random source. Under these assumptions, the authors show that an exact inversion formula can be derived for recovering the source spectral intensity, as a function of position, from near-field measurements of the emitted radiation recorded on the circumference of a circle enclosing the source region. Although solutions to the inverse random source problem have been reported in the past, these results have almost employed far-field approximations. After deriving the inversion formula in two dimensions. The authors discuss an efficient method for numerically evaluating this formula using the fast Fourier transform algorithm. Finally, a generalization of the inverse problem to a 3-D source enclosed by a spherical recording surface is given.

701,371
PB87-233334 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Measurement of RF Signal Generator Phase Noise Using a One-Generator Delay-Line Method.

Final rept.,
R. T. Adair, R. L. Ehret, and E. M. Livingston. 1986, 7p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-35, n4 p496-502 Dec 86.

Keywords: Reprints, *Delay line, *Frequency stability, Phase modulation, Phase noise, RF signal generators, Spectral density.

A technique is described which utilizes a single generator and a delay line for the measurement of frequency-domain phase noise in synthesized signal generators. Terms are defined and equations developed for theory and calculations of normalized phase-noise sideband power in a 1-Hz bandwidth offset 20 kHz from signal frequencies of interest. The system described covers the range from 0.45 to 2000 MHz. The function and contribution of each component in the measurement system is presented. Advantages of the method are discussed and a brief error analysis is given.

701,372
PB87-233649 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Automated Production Technology Div.

Comments on 'Speed of Sound in Standard Air' (Journal of the Acoustical Society of America 79, p1359-1366 1986).

Final rept.,
M. Greenspan. Jul 87, 3p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Jnl. of the Acoustical Society of America 82, n1 p370-372 Jul 87.

Keywords: *Acoustic velocity, Equations of state, Air, Correction, Reprints.

In the subject paper, Wong recommended that the commonly used value for the speed of sound in air at STP be revised. The method he used to allow for gas imperfection, which is the only question at issue, is in-

correct; the correct method, which has been described in many papers, texts, and reference books, is here briefly summarized. Wong's problem is used as an example. The 'old' value (C sub 0, sup 1) = 331.44 m/s, is correct.

Fluid Mechanics

701,373
PB87-153656 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Early Applications of Vacuum, from Aristotle to Langmuir.
Final rept.,
T. E. Madey. 1984, 8p
Pub. in Jnl. of Vacuum Science and Technology A-Vacuum Surfaces and Films 2, n2 p110-117 1984.

Keywords: *Vacuum, Vacuum apparatus, Vacuum pumps, History, Reprints.

Highlights of the development of vacuum science and technology from ancient times to the early twentieth century are reviewed. The view of the Greek philosophers that vacuum was an impossibility hampered understanding of the basic principles of vacuum until the mid 17th century. Verifiable vacua were first produced in Italy by Berti and Toricelli; von Guericke's dramatic experiments vividly demonstrated atmospheric pressure. Serious scientific developments of the 19th century which necessitated vacuum included Crooke's and Faraday's gaseous discharge measurements, the first sputtering experiments by Grove, the isolation of the rare gases by Ramsey, the standards work of Miller, the discovery of the electron by Thomson and of X-rays by Rontgen. The development of the incandescent light by Edison provided a background for the remarkable achievements of Langmuir in vacuum and surface science at the dawn of the 20th century. An appendix is included which lists museums containing vacuum-related exhibits.

701,374
PB87-153854 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.
Fluid Metering Research at NBS (National Bureau of Standards): New Research Tools and New Opportunities.
Final rept.,
G. E. Mattingly. 1984, 25p
Pub. in Advances in Instrumentation 39, Part 2 p1145-1169 1984.

Keywords: *Fluid flow, *Metrology, Measurements, Flow rate, Reprints, Laser doppler velocimeters.

As the value of the scarce fluid resources increases in today's market places and process industries so does the need for improved fluid quantity and flowrate measurements. Both buyers and sellers of fluid products are increasingly concerned about accurate custody transfer. Designers and operators of industrial processes are increasingly concerned about the repeatability of their fluid measurements to optimize the performance of their continuous production technologies. To satisfy these expressed needs for improved fluid measurements, in the wide range of fluids and conditions required, is a considerable task. Currently desired levels of fluid measurement generally exceed existing metering capabilities. Anticipated future measurement requirements will be even more demanding. To meet these levels using existing metering techniques or to establish new metering technologies to meet them will require full use of the fluid research tools and capabilities now available for these purposes. A description of several of the new fluid metering research tools and capabilities established at NBS will be given. Several examples of how these capabilities have been (and are) being used will also be shown.

701,375
PB87-157004 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.
Performance Evaluation of the Longwave Acoustic Flowmeter.
Final rept.,
J. Potzick. 1984, 1p
Pub. in Review of Scientific Instruments 55, n7 p1173 1984.

Keywords: *Flowmeters, Gas flow, Acoustics, Reprints.

The NBS Longwave Acoustic Flowmeter has been tested on room-temperature airflow in a closed pipe to 1.4 kg/s and found to have a sensitivity error of -0.8% and an offset of 2.3 g/s.

701,376
PB87-157129 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.
Numerical Computation of 3-D Fire-Induced Flows and Smoke Coagulation.
Final rept.,
R. G. Rehm, and H. R. Baum. 1985, 6p
Pub. in Proceedings of International Conference on Numerical Methods in Fluid Dynamics (9th), Saclay, France, June 25-29, 1984, p453-458 1985.

Keywords: *Smoke, Fire tests, Convection, Buoyancy, Finite difference theory, Computational fluid dynamics.

In the previous conference the authors proposed a convective model which eliminates all small-scale phenomena and concentrates on predicting the large-scale buoyant convection without empirical parameters (such as occur in turbulence models). The numerical scheme, computational results and comparison of the large-scale features with experiments were presented for a thermally expandable fluid in the two-dimensional case. In the present paper, the numerical scheme is generalized to three-dimensional, time-dependent flows and specialized to a Boussinesq fluid. It is also shown how the small-scale phenomenon of smoke coagulation can be imbedded in the large-scale flow field. The authors suggest that this simple model, coupling a small-scale phenomenon to large-scale convective features, can be regarded as a prototype for more general and more complicated couplings which occur during combustion, heat transfer along walls and other physical phenomena, including turbulence.

701,377
PB87-201836 PC A08/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.
Effects of Global Density and Reynolds Number Variations on Mixing in Turbulent, Axisymmetric Jets.
Internal rept.,
W. M. Pitts. Mar 86, 173p NBSIR-86/3340
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Keywords: *Turbulent flow, *Jet mixing flow, Flow visualization, Density measurement, Shadowgraph photography, Axisymmetric flow, Reynolds number, Rayleigh scattering, Light scattering, Quantity ratio.

Shadowgraphy and laser-induced Rayleigh light scattering measurements of centerline concentration have been utilized to investigate the effects of global density and Reynolds number variations on the mixing behavior of a turbulent, axisymmetric jet. The shadowgraph measurements give a qualitative indication of the variations in average mixing behavior and turbulent structure which occur when the jet/coflow density ratio and the Re are varied. These trends are quantified by the Rayleigh scattering concentration measurements which give measurements of average centerline concentration fluctuations. The results of the study have led to the proposal of a simple, qualitative theory based on reasonable assumptions concerning the flow behavior which gives predictions which are in agreement with the experimental findings.

701,378
PB87-225413 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Effects of Global Density and Reynolds Number Variations on Mixing in Turbulent, Axisymmetric Jets - Implications for Turbulent Jet Diffusion Flames.
Final rept.,
W. M. Pitts. 1987, 13p
See also PB87-201836. Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Proceedings of American Society of Mechanical Engineers/JSME Thermal Engineering Joint Conference (1987), Honolulu, HI., March 22-26, 1987, v1 p123-135.

Keywords: *Turbulent flow, *Jet mixing flow, Axisymmetric flow, Density measurement, Isotherms, Mixing,

Fluid dynamics, Reynolds number, Diffusion flames, Jets, Reprints.

Recent experiments by Pitts have characterized the effects of global density ratio and Reynolds number on mixing in isothermal, turbulent, axisymmetric jets. The results are summarized and implications for turbulent jet diffusion flames are discussed. The findings of the isothermal study are directly applicable to flame lift-off and blow out for which it is shown that these properties can be predicted based on the known isothermal mixing behavior. This analysis requires that these processes be dependent only on mixing in large scale eddies. Conditions are identified for which the isothermal results can be extended to turbulent mixing within the combustion regions of jet flames. Magnitudes of local Reynolds numbers in either isothermal or combustor jets are shown to have a negligible effect on time-averaged jet fluid concentration or unmixedness as long as they are large enough to insure the development of large scale turbulent structures.

701,379
PB88-122056 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Chemical Process Metrology Div.
Measurement of Solids Fraction in Two-Component Slurries.
Final rept.,
W. G. Cleveland, and A. K. Gaigalas. 1987, 8p
Contract DE-AI01-85CE40748
Sponsored by Department of Energy, Washington, DC. Office of Industrial Programs.
Pub. in Sensors Expo Proceedings 1987, Detroit, MI., September 15-19, 1987, p41-48.

Keywords: *Slurries, *Two phase flow, Solids, Pipe flow, Dielectric properties, Reprints, *Foreign technology.

An important parameter in many industrial processes involving slurries is the mass fraction of solids being carried by the liquid phase. A technique is described to measure the solids fraction in a two-component slurry, such as cellulose-water, sand-water, or coal-water. The method determines the effective dielectric constant of the slurry and then utilizes a mixture rule and the dielectric constants of the two individual components to extract the solids fraction. The greatest sensitivity is attained when there is a large difference in the dielectric properties of the two components, which is the case for most slurries with water as the carrier liquid.

701,380
PB88-138896 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Thermophysics Div.
Analysis of a Laminar Vortex Shedding Behind a Circular Cylinder by Computer-Aided Flow Visualization.
Final rept.,
B. E. Eaton. 1987, 29p
Pub. in Jnl. of Fluid Mechanics 180, p117-145 Jul 87.

Keywords: *Flow visualization, Navier-Stokes equations, Numerical analysis, Vortices.

Streamline, streakline, and material line flow visualization techniques have been numerically simulated in the vortex shedding flow field from a finite element simulation of the 2-D Navier-Stokes equations at Reynolds number 110. The results have been used (1) to characterize the wake in terms of its critical point trajectories, and (2) to verify that the 2-D Navier-Stokes model predicts the mechanism of vortex shedding experimentally observed by Gerrard (1978). A technique for determining vorticity balances in the flow field is also presented.

701,381
PB88-138912 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Viscous Flow in the Stress Ensemble.
Final rept.,
D. J. Evans, and J. F. Ely. 1986, 6p
Pub. in Molecular Physics 59, n5 p1043-1048, 10 Dec 86.

Keywords: *Fluid flow, *Viscous flow, *Shear stress, Simulation, Constraints, Reprints.

The stress ensemble has advantages for studying shear flow in highly viscous media. The authors derive

PHYSICS

Fluid Mechanics

a simple method for performing NEMD simulations in the ensemble. The authors also derive the associated equilibrium fluctuation expressions for the zero frequency shear viscosity. These expressions relate the reciprocal of the shear viscosity to strain rate fluctuations in the zero stress equilibrium ensemble. The authors analysis is based upon the Nose-Hoover method of treating non-holonomic constraints. They show that for generating the stress ensemble, the Nose-Hoover method is much simpler to implement than the corresponding Gaussian approach.

701,382
PB88-152210 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Chemical Process Metrology Div.
Algorithm for Ascertaining Linear Range of Turbine Flow Meters.
Final rept.,
F. E. Jones. 1985, 2p
Pub. in Review of Scientific Instruments 56, n9 p1829-1830 Sep 85.

Keywords: *Flowmeters, *Turbine instruments, Fluid flow, Algorithms, Range(Extremes), Calibrating, Reprints.

The conventional practice of expressing the relationship between volume flow rate, Q , and frequency, f , (or pulse rate) for turbine flow meters by the 'K factor' is examined. Curvature in plots of K against f due to the existence of a non-zero intercept in the linear equation relating f to Q is illustrated using calibration (water and Type II hydrocarbon) data. An algorithm which enables the actual linear range of turbine flow meters to be simple and easily ascertained is presented. The very significant improvement in linearity accomplished by the use of the algorithm is illustrated for the calibration data.

701,383
PB88-152418 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.
Transfer Leak Studies and Comparisons of Primary Leak Standards at the National Bureau of Standards and Sandia National Laboratory.
Final rept.,
R. W. Hyland, C. D. Ehrlich, C. R. Tilford, and S. Thornberg. 1986, 4p
Pub. in Jnl. of Vacuum Science and Technology A 4, n3 p1 p334-337 May/Jun 86.

Keywords: *Leakage, *Standards, Calibrating, Helium, Temperature coefficient, Nitrogen, Argon, Flow rate, Sintering, Transferring, Reprints.

Primary leak standards are being developed at the National Bureau of Standards (NBS), and a cooperative NBS - Sandia National Laboratory (SNL) program is underway to compare their different primary standards and investigate the properties of transfer leaks. Initial results of comparisons of the primary standards at the two laboratories, accomplished via sintered metal transfer leaks in the range 5e-12 to 5e-9 moles/sec, show that the calibration methods used in the two laboratories agree to within a few percent for nitrogen, argon, and helium. Significant instabilities with time have been observed for one of the two leaks used in the comparison. Temperature coefficient data for helium diffusion leaks are presented which illustrate the possibility of significant errors when a linear temperature dependence is assumed over too wide a temperature range.

Optics & Lasers

701,384
PATENT-4 700 150 Not available NTIS
Department of Commerce, Washington, DC.
External Laser Frequency Stabilizer.
Patent,
J. L. Hall, and T. W. Hansch. Filed 14 Jun 85, patented 13 Oct 87, 6p PB88-146816, PAT-APPL-6-745 309
This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 \$1.50.

Keywords: *Laser beams, *Frequency stability, *Patents, Frequency control, Stabilization, Electrooptics,

Phase modulation, Frequency shift, Transducers, Tunable lasers, Dye lasers, Acoustooptics, PAT-CL-332-751.

An external laser frequency stabilizer combines an acousto-optic frequency shifter and a fast electro-optic phase modulator. A compensating electronic delay line in a crossover network provides a near-ideal transducer response while keeping the voltage across the electrooptic crystal away from the amplifier limits.

701,385
PB87-149878 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.
Fizeau Wavemeter for Pulsed Laser Wavelength Measurement.
Final rept.,
M. B. Morris, T. J. McIlrath, and J. J. Snyder. 1984, 7p
Pub. in Applied Optics 23, n21 p3862-3868 1984.

Keywords: *Wavemeters, *Wavelengths, Optical measurement, Light pulses, Laser beams, Reprints, *Laser radiation, *Pulsed lasers.

The authors have developed and characterized a Fizeau wavelength meter, optimized for use with pulsed laser sources, which demonstrates a CW resolution of a few parts in 10 and a pulsed resolution within 1 part in 10. The static optical design is based on a Fizeau wedge interferometer, which together with spatial filtering and collimating optics is used to produce a pattern of parallel fringes which are imaged on a linear photodiode array and analyzed by a mini-computer. The authors describe a series of CW and pulsed measurements of various narrow-band laser sources and examine the particular difficulties involved in pulsed laser measurements with the wavemeter.

701,386
PB87-152294 PC A07/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Building Physics Div.
Safety Color Appearance under Selected Light Sources.
B. L. Collins, B. Y. Kuo, S. E. Mayerson, J. A. Worthey, and G. L. Howett. Jan 87, 140p NBSIR-86/3493
Sponsored by Occupational Safety and Health Administration, Washington, DC.

Keywords: *Colors, *Illumination, *Safety, Fluorescent lamps, Mercury lamps, Incandescent lamps, Sodium lamps, Specifications, Chromaticity coordinates, Luminance, *ANSI standard safety colors.

The present report provides data on the color appearance and physical measurements of 58 safety color samples viewed under each of seven light sources. The seven light sources included incandescent, cool white fluorescent, clear mercury, metal halide, metal halide-high pressure sodium mix, high pressure sodium, and low pressure sodium. Color samples included ones for safety red, orange, yellow, green, blue, purple (magenta), brown, white, gray, and black of several different types including ordinary, fluorescent, retroreflective, and retroreflective fluorescent. Analysis of the data indicated that the standard ANSI (American National Standards Institute) samples were often not identified accurately under many of the sources studied, with particularly poor performance for the two sodium sources and clear mercury. Specifications are given for a new set of samples that were identified more accurately under all seven sources and which showed a greater gamut of coloration in a uniform color space for all sources. Chromaticity and luminance coordinates for all 58 color samples are presented for both CIE x,y,Y and CIE L*a*b* values. In addition, the psychophysical data are compared with the CIELAB data.

701,387
PB87-153623 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Perturbation Correction for Refraction in Ultrasonic and Optical Tomography.
Final rept.,
S. J. Norton. 1983, 7p
Pub. in Proceedings of Conference on Inverse Optics, Arlington, Virginia, April 6-8, 1983, p25-31 1983.

Keywords: *Refraction, Ultrasonic frequencies, Optical tests, Perturbation, Correction, *Tomography, Refractive index.

Tomographic algorithms have been used to generate cross-sectional images of sound velocity in the human body from time-of-flight measurements of ultrasonic pulses. Similar algorithms have been employed to reconstruct optical refractive index fields, in which optical path lengths are measured interferometrically rather than transit times. Using a ray propagation model, an ultrasonic transit time or optical path length measurement is proportional to the line integral of the ultrasonic (or optical) refractive index over the ray path. Under the assumption that the propagation paths are straight, conventional computerized tomography (CT) algorithms have been used to perform the reconstructions. In real media, ray refraction introduces a time-of-arrival (or optical path length) error in the measurement, leading to image degradation. To date, only iterative techniques based on numerical ray tracing have been proposed to correct for the effects of refraction. In the paper, the authors present a perturbation approach to this problem which, for relatively small refractive-index fluctuations, requires neither iteration nor ray tracing.

701,388
PB87-153714 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Optical Bistability and Polarization Switching Utilizing Two-Level Atoms with Lower-Level Degeneracy.
Final rept.,
W. J. Sandle, C. Parigger, and R. J. Ballagh. 1986, 6p
Pub. in Society of Photo-Optical Instrumentation Engineers 667, p62-67 1986.

Keywords: Optical pumping, Atoms, Reprints, *Optical bistability, *Polarization switching.

The physics behind magnetically-induced polarization switching for atoms undergoing a $J(\text{lower})=1 - J(\text{upper})=0$ transition in a polarization degenerate cavity is discussed. The authors present preliminary theoretical results for self-pulsing between sigma (+) and sigma (-) modes.

701,389
PB87-151733 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Frequency Measurement of the Solitary Ethyl Alcohol Laser Line.
Final rept.,
E. C. C. Vasconcellos, D. A. Jennings, and K. M. Evenson. 1986, 2p
Sponsored by National Science Foundation, Washington, DC, and Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil).
Pub. in International Jnl. of Infrared and Millimeter Waves 7, n2 p291-292 1986.

Keywords: *Frequency measurement, Carbon dioxide lasers, Far infrared radiation, Infrared lasers, Optical pumping, Reprints, *Ethyl alcohol lasers.

The authors measured the frequency, the relative polarization, and the pump frequency offset of the single FIR laser line obtained by optically pumping ethyl alcohol C₂H₅OH with a cw CO₂ laser.

701,390
PB87-162277 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.
Automated Radiometric Linearity Tester.
Final rept.,
R. D. Saunders, and J. B. Shumaker. 15 Oct 84, 3p
Pub. in Applied Optics 23, n20 p3504-3506, 15 Oct 84.

Keywords: *Radiometers, Test equipment, Near infrared radiation, Near ultraviolet radiation, Automation, Linearity, Reprints, Visible radiation, Response functions.

A description is given of an automated beam conjoiner which is suitable for use in the near UV, visible, and near IR. The instrument uses filters to permit rapid, repeatable flux-level changes. The operation and data reduction techniques are outlined, and the results of the application of the instrument to the measurement of the response function of a radiometer are shown.

701,391
PB87-165676 Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Line Shapes of Laser Intracavity Absorption.

Final rept.,
H. Schroder, K. Schultz, and P. E. Toschek. 1 Nov 86, 7p
Pub. in Optics Communications 60, n3 p159-165, 1 Nov 86.

Keywords: *Spectral lines, Lasers, Absorption, Spectroscopy, Reprints, Multimode.

Laser intracavity absorption has been afflicted by the appearance of highly complex lineshapes, which seriously limit the applicability of this sensitive spectroscopic technique. The authors demonstrate these lineshapes to emerge from the interplay of linear absorber dispersion and resonator diffraction. They can be avoided by tuning the resonator to a relative minimum of its diffraction loss.

701,392
PB87-167656 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.
Laboratory Intercomparison Study of Pressed Polytetrafluoroethylene Powder Reflectance Standards.

Final rept.,
V. R. Weidner, J. J. Hsia, and B. Adams. 1985, 6p
Pub. in Applied Optics 24, n14 p2225-2230 1985.

Keywords: *Reflectance, *Standards, Reprints, *Poly(ethylene/tetrafluoro), Interlaboratory comparisons, Intercomparison.

The object of the paper is to present the results of several experiments relating to the preparation and use of pressed polytetrafluoroethylene (PTFE) powder as a diffuse reflectance standard for the spectral range 200 to 2500 nm. These experiments include two round-robin intercomparisons involving nine laboratories. These round-robin experiments provided data on the variability of the reflectance of pressed PTFE reflectance standards prepared in different laboratories. The results of these measurements provided insight into the problems associated with the PTFE standards and helped to establish what practices needed to be standardized in order to improve interlaboratory agreement for diffuse reflectance measurements.

701,393
PB87-167664 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
Intensity Fluctuations in Multimode Pulsed Dye Lasers.
Final rept.,
L. A. Westling, M. G. Raymer, and J. J. Snyder. 1984, 1p
Pub. in Jnl. of the Optical Society of America A-Optics and Image Science 1, n12 p1319 1984.

Keywords: Spectrum analyzers, Intensity, Reprints, *Dye lasers, Multimode, Pulsed lasers.

Statistical properties of a multimode pulsed dye laser have been studied by measuring the cross correlation coefficients between mode intensities in individual pulses and the intensity autocorrelation function of the total output intensity.

701,394
PB87-173753 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Semiconductor Electronics Div.
Film Thickness and Refractive Index Standard Reference Material Calibrated by Ellipsometry and Profilometry.
Final rept.,
G. A. Candela, D. Chandler-Horowitz, D. B. Novotny, T. V. Vorburger, and C. H. W. Giauque. 1986, 6p
Pub. in Proceedings of SPIE - The International Society for Optical Engineering, Quebec City, Canada, June 3-6, 1986, p402-407.

Keywords: *Dimensional measurement, *Thickness, Silicon, Silicon dioxide, Polarimetry, Calibrating, *Standard reference materials, *Refractive index, Ellipsometry.

A Standard Reference Material (SRM) has been designed and fabricated and will be certified for thickness and refractive index using a highly accurate ellipsometer. The SRM consists of a three-inch diameter silicon wafer with a silicon dioxide film of uniform thickness.

The design and preparation of the SRM are discussed and the ellipsometric measurement results and their comparisons with stylus profilometry are presented, along with the precision of the measurements. The ellipsometric accuracy depends upon the wafer oxide film, the model that represents the film-interface-substrate system, and the methods used to make the measurements. When the optical thickness, as determined by the ellipsometer, is compared with the mechanical thickness, as determined by the stylus profilometer, both the correct sample preparation and correct model are important in order to obtain high accuracy. The SRM will be available initially in three nominal oxide film thicknesses of 50, 100, and 200 nm. The SRM can be used to calibrate many different optical and mechanical thickness monitoring instruments as well as ellipsometers for which it was specifically designed.

701,395
PB87-174314 PC A03/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Building Environment Div.
Geometry and Amplitude of Veiling Reflections.
J. A. Worthey. Mar 87, 38p NBSIR-87/3525

Keywords: *Illuminating, *Visual perception, *Reflection, Color, Surface properties, *Veiling reflection.

The problem of veiling reflections in flat reading matter is examined in three theoretical analyses. These assumptions are made: (1) The surface is shiny, so that surface reflections can be treated as creating a mirror image; (2) The light source has a non-zero area; (3) Insofar as it matters, the reading material has non-zero area also. The first analysis assumes that the reader can tilt the reading material. The extent to which a larger luminaire forces him to tilt farther from his line of sight and from the incident light is then computed. The second analysis assumes that the luminaire image is not avoided. Then, the smaller the luminaire is, the brighter its image will be, relative to a diffuse white surface; this effect is expressed in a formula and in graphs. The overall implication of the first two analyses is that while veiling reflections are not negligible with spherical illumination, the worst light sources are those of intermediate size, whose image is hard to avoid, yet brighter than in the spherical case. The final analysis shows that when veiling reflections cannot be avoided, they desaturate colored objects. For instance, spherical illumination reduces the accessible volume in the CIELAB uniform color space by 37%.

701,396
PB87-179438 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Standard Measurement Procedures for Characterizing Single-Mode Fibers.
Final rept.,
D. L. Franzen. 1986, 8p
Pub. in Test and Measurement World, p70-77 Oct 86.

Keywords: *Fiber optics, Optical dispersion, Attenuation, Wavelengths, Diameters, Reprints, *Optical fibers, Cut-off.

Parameters that describe single-mode optical fibers include attenuation, cut-off wavelength, mode-field diameter, and dispersion. Some measurement results depend on test -fiber condition and testing methods.

701,397
PB87-179883 PC A04/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Spectral Radiance Calibrations.
Final rept.,
J. H. Walker, R. D. Saunders, and A. T. Hattenburg. Jan 87, 74p NBS/SP-250/1
See also PB87-174041. Also available from Supt. of Docs as SN003-003-02792-8. Library of Congress catalog card no. 87-619800.

Keywords: *Radiance, *Standards, Spectroradiometers, Blackbody radiation, Optical measurement, Errors, *Calibration, US NBS.

The report describes the measurement methods and instrumentation used in the realization and transfer of the NBS scale of spectral radiance. The application of the basic measurement equation to both blackbody and tungsten strip lamp sources is discussed. The determinations of the spectral responsivity function, response linearity, polarizance and 'size-of-source

effect' of the spectroradiometer are described. The analysis of sources of error and estimates of uncertainty are presented. The assigned uncertainties in spectral radiance range from about 1.75% at 225 nm to 0.25% at 2400 nm.

701,398
PB87-191078 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Measurement and Research Div.
Measurement Technique for Determining the Temperature Distribution in a Transparent Solid Using Holographic Interferometry.
Final rept.,
A. Ito, and T. Kashiwagi. Mar 87, 5p
Pub. in Applied Optics 26, n5 p954-958, 1 Mar 87.

Keywords: *Polymethyl methacrylate, *Silicon dioxide, Refractive index, Holography, Interferometers, Reprints.

Temperature distributions in transparent solids have been determined by measurements of changes in the refractive index of the sample using a holographic interferometry technique. The steady-state temperature distributions within two samples, fused silica and polymethyl methacrylate (PMMA), were measured to demonstrate the technique. Various errors in the measured temperature distribution caused by refraction and heat losses from the sample are discussed and estimated.

701,399
PB87-193587 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Laser Power and Energy Measurements and the NBS (National Bureau of Standards) Laser Measurement Assurance Program (MAP).
Final rept.,
W. E. Case, and A. A. Sanders. 1985, 5p
Pub. in Proceedings of IMTC/85 held at Tampa, FL., March 20-22, 1985, IEEE (Institute of Electrical and Electronics Engineers) Catalog No. 85CH2159-2, p281-285.

Keywords: *Power measurement, *Standards, Laser beams, Energy, *Laser radiation, US NBS, Instrumentation, Measurement assurance programs.

The paper describes the national standards for laser power and energy measurements maintained by the National Bureau of Standards, and how the measurement services based on these standards are disseminated. Particular emphasis is devoted to the procedures and instrumentation used in these measurements. The Laser Measurement Assurance Program (MAP) is discussed in detail. The paper also presents a detailed procedure for the user to choose proper instrumentation and procedures to implement a measurements program in the laboratory.

701,400
PB87-198024 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Intracavity Frequency Doubling for the Generation of Squeezed States of Light.
Final rept.,
H. J. Kimble, and J. L. Hall. 1986, 12p
Sponsored by National Science Foundation, Washington, DC., and Office of Naval Research, Arlington, VA. Pub. in Proceedings of International Symposium on Quantum Optics (4th), Hamilton, New Zealand, February 1986, p58-69.

Keywords: Frequency multipliers, Compressing, *Second harmonic generation, Nonlinear optics.

The authors experiments attempt to produce squeezed states of light by second harmonic generation within an optical cavity resonant at both fundamental and harmonic frequencies. They begin in Section II with an overview of the relevant theoretical predictions before turning in Section III to the actual experiment.

701,401
PB87-198032 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

PHYSICS

Optics & Lasers

Floquet-Liouville Supermatrix Approach: Time Development of Density-Matrix Operator and Multi-photon Resonance Fluorescence Spectra in Intense Laser Fields.

Final rept.,

T. S. Ho, K. Wang, and S. I. Chu. 1986, 19p
Sponsored by Department of Energy, Washington, DC.
Pub. in *Physical Review A* 33, n3 p1798-1816 Mar 86.

Keywords: Fluorescence, Reprints, *Multi-photon processes, Floquet function, Matrices, Laser radiation.

A Floquet-Liouville supermatrix (FLSM) approach is presented for nonperturbative treatment of the time development of the density-matrix operator of atoms and molecules exposed to intense polychromatic fields. By extending the many-mode Floquet theory (MMFT) recently developed, the time-dependent Liouville equation for the density matrix of quantum systems undergoing relaxations (due to radiative decays and collisional dampings, etc.) can be transformed into an equivalent time-independent non-Hermitian FLSM eigenvalue problem. This yields a numerically stable and computationally efficient approach for the unified treatment of nonresonant and resonant, one- and multiple-photon, steady-state and transient phenomena in nonlinear optical processes, much beyond the conventional rotating-wave-approximation (RWA) method. Connections of the FLSM approach to the MMFT in the limit of zero relaxations are also made, providing the understanding of the physical significance of FLSM supereigenvalues and eigenvectors.

701,402

PB87-198040 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Stabilizing Lasers for Applications in Quantum Optics.

Final rept.,

J. L. Hall. 1986, 12p
Sponsored by Office of Naval Research, Arlington, VA., and National Science Foundation, Washington, DC.

Pub. in *Proceedings of International Symposium on Quantum Optics (4th)*, Hamilton, New Zealand, February 1986, p273-284.

Keywords: *Lasers, *Frequency stability, Stabilization, Laser outputs.

Servo stabilization of laser output parameters, such as intensity and frequency, are considered. The intrinsic noise of the laser may be strongly reduced by such techniques, in principle to negligible values. However, noise of the measurement process and noise and drift of the discriminator are directly imposed onto the laser's output by the servo process. Results and problems are discussed for both intensity and frequency stabilization systems.

701,403

PB87-202958 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.

Optical Sampling with Gain-Switched, Pulse-Compressed, Distributed Feedback Laser Diodes.

Final rept.,

D. L. Franzen, Y. Yamabayashi, and T. Kanada.

1987, 2p
Pub. in *Electronics Letters* 23, n6 p289-290, 12 Mar 87.

Keywords: *Waveforms, Optical measurement, Sampling, Infrared lasers, Near infrared radiation, Reprints, Distributed feedback lasers, Picosecond pulses.

Chirped pulses from gain-switched, distributed feedback laser diodes at a wavelength of 1.3 micrometers are compressed to 8.7 ps FWHM by the linear dispersion properties of single-mode fibre. These pulses are used to optically sample fast waveforms from other 1.3 micrometers laser diodes. The high time resolution sampling system uses a fibre coupler to combine beams; this eliminates critical alignment and results in a practical design.

701,404

PB87-219069 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Efficient Electro-Optic Modulator for Optical Pumping of Na Beams.

Final rept.,

J. F. Kelly, and A. Gallagher. 1987, 4p
Sponsored by Department of Energy, Washington, DC.

Pub. in *Review of Scientific Instruments* 58, n4 p563-566 Apr 87.

Keywords: *Optical pumping, *Sodium, Electrooptics, Reprints, *Optical modulators, Lithium tantalates.

An electro-optic modulator using LiTaO₃ is described which yields 34% of the carrier intensity in each of the first-order sidebands with rf phase modulation frequencies from about 1.0 GHz and about or < 1.0 W input power. The modulator makes use of a lumped resonator with Q about 200 to obtain efficient production of the sidebands. It is shown that the device can be scaled for operation at about 2 GHz. Applications of this modulator include optical pumping of the lighter alkali atoms, FM sideband spectroscopy, and laser phase/frequency stabilization using rf modulation techniques.

701,405

PB87-219127 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.

Spectral Irradiance Scales Based on Filtered Absolute Silicon Photodetectors.

Final rept.,

R. J. Bruening. 1987, 7p

Pub. in *Applied Optics* 26, n6 p1051-1057, 15 Mar 87.

Keywords: *Irradiance, *Radiometry, Photodetectors, Silicon, Reprints, Visible radiation.

A scale of spectral irradiance has been realized for the 400-700-nm wavelength range based on absolute silicon photodetectors, with the wavelength selected by interference filters. From these data, a photometric scale of luminous intensity has been realized. The results were compared to scales based on blackbodies.

701,406

PB87-220521 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Quantum-Mechanical Noise in an Interferometer: Intrinsic Uncertainty versus Measurement Uncertainty.

Final rept.,

W. T. Ni. 15 May 87, 6p

Pub. in *Physical Review D* 35, n10 p3002-3007, 15 May 87.

Keywords: *Optical interferometers, Measurement, Reprints, *Michelson interferometers, Quantum mechanics, Uncertainty.

In many quantum-mechanical measurements, the total uncertainties (sigma) are greater than or equal to the intrinsic uncertainties (sigma₁) of the quantities to be measured; the differences are due to the particular measurement processes chosen. In each of these situations, a measurement uncertainty (sigma_M) can be defined as (sigma_M) = square root of (sigma squared - (sigma₁) squared). A question to ask is whether (sigma_M) is independent of the initial quantum state of the system to be measured, i.e., whether (sigma_M) is only dependent on the measurement process chosen. For a Michelson interferometer, the authors extend Loudon's model to show that in the model (sigma_M) is only dependent on the measurement process chosen for the case with small radiation-pressure fluctuation. When the intensity and radiation-pressure fluctuation are high, there are cross-correlated terms. Some of these terms are negative and give hope to the possibility of uncertainty reductions for appropriate schemes.

701,407

PB87-224549 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.

Method for First-Order Design of a Transfer Optics System to Throughput Match a Fourier Transform Spectrometer to a Sample Cell Without Use of a Field Lens at the Cell Input.

Final rept.,

W. B. Olson. 1987, 5p

Pub. in *Applied Optics* 26, n12 p2441-2445, 15 Jun 87.

Keywords: Reprints, *Fourier transform spectrometers, *Throughput matching, *FTIR, Ray transfer matrices, Absorption cells, White cells.

The realization that the usual optical geometry of an absorption cell is the frustrum of a cone and that a requirement can be put on any transfer optics system that eliminates the need for a field lens at the cell input leads to a powerful method of first-order optical

system design through (1) determination of a required ray transfer matrix, unique except for sign, which requires a single concave spherical mirror (or lens) to implement and (2) getting additional degrees of freedom to make the system more practical at the expense of additional spherical mirrors (or lenses). Two successful applications of the method are described.

701,408

PB87-233326 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Fields Div.

Waveform Standards for Electrooptics: A Pulse Duration Comparison.

Final rept.,

R. A. Lawton, and K. Meyer. 1987, 4p

Pub. in *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Microwave Theory and Techniques* MTT-35, n4 p450-453 Apr 87.

Keywords: *Waveforms, Standards, Measurements, Reprints, *Electrooptic samplers, *Pulse measurement system.

A transfer standard has been developed for use in comparing the measurement capability of the Automatic Pulse Measurement System (APMS) at the National Bureau of Standards to that of the recently developed electrooptic samplers. The transfer standard is a comb generator driven by a 90-MHz sine wave. Using the standard, measurements were made of the pulse waveform of a comb generator output with both the APMS and an electrooptic sampler. A comparison was then made of the pulse duration (full width at half maximum) obtained in the two waveform measurements. The result was a duration of 102 ps as measured by the APMS and 112 ps as measured by the electrooptic sampler. The signal-to-noise ratio at the comb generator input was improved over that of previous measurements, and a correction for pulse broadening was made to achieve the result. The pulse broadening was caused by the impedance mismatch between the sampler and the transmission system (50 ohms).

701,409

PB87-233359 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.

Optically Pumped (13)CH₂F₂ Laser: Wavelength and Frequency Measurements.

Final rept.,

A. Scalabrin, J. Tomaselli, D. Pereira, E. C. C.

Vasconcellos, K. M. Evenson, F. R. Petersen, L.

Zink, and D. A. Jennings. 1985, 7p

Sponsored by Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil), and National Science Foundation, Washington, DC.

Pub. in *International Jnl. of Infrared and Millimeter Waves* 6, 10 p973-979 1985.

Keywords: *Far infrared radiation, *Millimeter waves, *Infrared lasers, Optical pumping, Polarization(Waves), Wavelengths, Reprints, Carbon 13, Phosphonic difluoride/methyl.

The authors have obtained laser action in carbon 13 difluoromethane, (13)CH₂F₂, pumping with CO₂ cw laser lines from 10R4 to 9R44. They have found 65 lines ranging from 106 to 1220 micrometers. They have performed wavelength, polarization, and intensity measurements. The frequencies of 57 of these lines were measured by the synthesis of two frequency stabilized CO₂ lasers in a MIM diode. Most of these lines have intensities comparable to those of the well known (12)CH₂F₂ laser.

701,410

PB87-233367 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.

Measurements of New FIR Laser Lines in CD3OD.

Final rept.,

D. Pereira, E. C. C. Vasconcellos, A. Scalabrin, K. M.

Evenson, F. R. Petersen, and D. A. Jennings. 1985,

6p

Sponsored by Conselho Nacional de Pesquisas, Rio de Janeiro (Brazil), and National Science Foundation, Washington, DC.

Pub. in *International Jnl. of Infrared and Millimeter Waves* 6, n9 p877-882 1985.

Keywords: *Far infrared radiation, *Millimeter waves, *Infrared lasers, Carbon dioxide lasers, Optical pump-

ing, Deuterium compounds, Masers, Reprints, *Methyl alcohol lasers.

The authors report the measurement of 80 new FIR laser lines in CD3OD optically pumped by a regular continuous wave CO2 laser. These lines are in the spectral range of 79 micrometers to 2.9 nm.

701,411
PB87-233656 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Electromagnetic Technology Div.
Microscope Objectives, Cover Slips, and Spherical Aberration.
Final rept.,
C. W. Oates, and M. Young. 1987, 1p
Pub. in Applied Optics 26, n11 p2043, 1 Jun 87.

Keywords: *Fiber optics, Microscopes, Reprints, *Optical fibers, *Microscope objectives, Spherical aberration, Numerical aperture.

Microscope objectives, with powers of 20X and higher, will display significant spherical aberration when used to examine an optical fiber without a cover slip.

701,412
PB87-233730 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Depolarization of Near-Resonance Rayleigh Scattering by Barium Ions.
Final rept.,
G. Chen, and T. J. A. Nee. 1987, 3p
Pub. in Jnl. of the Optical Society of America B4, n8 p1303-1305 Aug 87.

Keywords: *Barium, *Depolarization, Plasma, Rayleigh, Scattering, Reprints.

The polarization ratio of near-resonance Rayleigh scattering (NRRS) from barium ions in a resonant laser-driven plasma has been measured. The Ba+ resonance transition involved in the NRRS originates from a state with angular momentum $J = 0$. It has been deduced from the experimental results that the resonance scattering is completely depolarized, which is in good agreement with theory.

701,413
PB87-234019 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.
Simple Stray-Light Test for Spectrophotometers.
Final rept.,
K. D. Mielenz, V. R. Weidner, and R. W. Burke. Jan 82, 9p
Pub. in Optical Radiation News, n38 p1-9 Jan 82.

Keywords: *Spectrophotometers, Tests, Reprints.

The Newsletter contains descriptions of technical procedures and results of the NBS program in radiometry, photometry, and spectrophotometry, and reports of significant meetings in the field.

701,414
PB87-234027 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.
Absolute Spectral Response Intercomparison.
Final rept.,
E. F. Zalewski. Apr 82, 3p
Pub. in Optical Radiation News, n39 p1-3 Apr 82.

Keywords: Reprints, *Spectral response.

The Newsletter contains descriptions of technical procedures and results of the NBS program in radiometry, photometry, and spectrophotometry, and reports of significant meetings in the field.

701,415
PB88-108550 PC A04/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Regular Spectral Transmittance.
Final rept.,
K. L. Eckerle, J. J. Hsia, K. D. Mielenz, and V. R. Weidner. Jul 87, 65p NBS/SP-250/6
Also available from Supt. of Docs. as SN003-003-02805-3. Library of Congress catalog card no. 87-619840.

Keywords: *Transmittance, Optical measurement, Spectrophotometers, Near ultraviolet radiation, Near

infrared radiation, Wavelengths, Accuracy, Visible radiation, Calibration, US NBS, Uncertainty.

The documentation describes measurement services, instrumentation, standards, and measurement techniques for regular spectral transmittance over the spectral range of 200 to 2500 nm. It is divided into three parts. Part I describes the services and standards that are available and the guiding philosophy behind the efforts to provide a primary laboratory for spectral transmittance measurements. Part II describes the high accuracy reference spectrophotometer. Part III describes the high precision transfer spectrophotometer. The transfer instrument relies on master standards that are periodically calibrated using the reference spectrophotometer.

701,416
PB88-109905 PC A07/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Spectral Reflectance.
Special pub. (Final),
V. R. Weidner, and J. J. Hsia. Jul 87, 146p NBS/SP-250/8
Also available from Supt. of Docs. as SN003-003-02812-6. Library of Congress catalog card no. 87-619843.

Keywords: *Spectrophotometers, *Reflectance, Spectrophotometry, Ultraviolet radiation, Near infrared radiation, Standards, Optical measurement, *Spectral reflectance, Visible radiation, US NBS.

The report describes the instrumentation, standards, and techniques used in the measurement of spectral reflectance over the ultraviolet, visible, and near infrared spectral ranges. The report is divided into three parts. Part I describes the guiding philosophy for maintaining reference and transfer spectrophotometers for spectral reflectance measurements, and standards and services that are available. Part II describes the NBS high accuracy reference spectrophotometer including specially developed accessory reflectometers. The instrument provides the basis for the development of absolute NBS standards of diffuse and specular reflectance. Part III describes the NBS transfer spectrophotometer, a high precision commercial spectrophotometer used for calibrating Standard Reference Materials (SRMs) such as diffuse reflectance and specular reflectance standards.

701,417
PB88-111158 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Piezooptic and Elastic Constants.
Final rept.,
A. Feldman. 1986, 13p
Pub. in CRC (Chemical Rubber Company) Handbook of Laser Science and Technology, Chapter 1.1.1.4, v4 p255-67 1986.

Keywords: *Laser materials, Elastic properties, *Laser windows, Piezooptic effect.

Piezo-optic and elastic constants of window materials have been tabulated.

701,418
PB88-117460 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
New Far UV Detector Calibration Facility at the National Bureau of Standards.
Final rept.,
L. R. Canfield. 1987, 7p
Pub. in Applied Optics 26, n18 p3831-3837, 15 Sep 87.

Keywords: *Ultraviolet detectors, *Standards, Far ultraviolet radiation, Synchrotron radiation, Monochromators, Photodiodes, Reprints, *Calibration, SURF II storage ring, US NBS.

A description is given of a new facility, located at the NBS (Gaithersburg) Synchrotron Ultraviolet Radiation Facility (SURF-II), in which the absolute calibration of working standard detectors for the 5-50-nm spectral region, and the subsequent calibration of outgoing transfer standard detectors is performed. A dual toroidal grating monochromator, with diffraction gratings optimized for 3-13 and 12-52 nm, disperses synchrotron radiation from the electron storage ring into tandem experimental chambers in which a rare gas ionization chamber determines the absolute magni-

tude of the incident radiant flux and hence the efficiency of the photoemissive photodiodes.

701,419
PB88-117601 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Guided-Wave Reflectometry with Micrometer Resolution.
Final rept.,
B. L. Danielson, and C. D. Whittenberg. 1987, 7p
Pub. in Applied Optics 26, n14 p2836-2842, 15 Jul 87.

Keywords: *Reflectometers, Reprints, Optical time domain reflectometry, Michelson interferometers.

The authors describe a new type of optical reflectometry which is useful in testing single-mode lightguide systems. The technique uses a scanning Michelson interferometer in conjunction with a broadband illuminating source and cross-correlation detection. High resolution is achieved through the limited coherence of the backscattered radiation. With this approach it is possible to distinguish scattering centers separated by only a few micrometers. In some cases loss may be estimated for components in the transmission path of a test lightguide. The basic principles of the diagnostic technique, along with some performance characteristics, are illustrated for an all-fiber reflectometer. They also discuss several laboratory applications which serve to demonstrate the resolution capabilities of the measurement concept.

701,420
PB88-120985 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Population Inversions in C IV in a Recombing Theta-Pinch Plasma.
Final rept.,
R. U. Datla, J. R. Roberts, W. T. Silfvast, and O. R. Wood. 1987, 3p
Pub. in Optics Letters 12, n9 p675-677 Sep 87.

Keywords: *Plasmas(Physics), Electron transitions, Line spectra, Far ultraviolet radiation, Carbon, Lasers, Ultraviolet spectra, Reprints, *Population inversion, Theta pinch.

Population inversions on the 5g-4f and 4f-3d transitions of C IV at 253.0 and 116.9 nm have been observed in the recombination phase of a theta-pinch plasma initially containing 14 m Torr of acetylene and 0.5 m Torr of hydrogen gas. Population ratios of 17:11:1 for the 5g, 4f, and 3d levels were deduced from measured absolute line intensities of the 5g-4f and 4f-3d, and 3d-2p transitions at 253.0, 116.9, and 38.4 nm. The resulting gain-length product for a single pass through the 23-cm-long plasma column, based on the measured Doppler-broadened linewidth, is 2.3% at 116.9 nm and 5.8% at 253.0 nm.

701,421
PB88-121025 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.
Review of Frequency Measurements of Optically Pumped Lasers from 0.1 to 8 THz.
Final rept.,
M. Inguscio, G. Moruzzi, K. M. Evenson, and D. A. Jennings. 1986, 32p
Pub. in Jnl. of Applied Physics 60, n12 pR161-R192, 15 Dec 86.

Keywords: *Infrared lasers, *Frequency measurement, *Far infrared radiation, Line spectra, Optical pumping, Reviews, Reprints.

A list is presented of more than 800 far-infrared laser lines emitted by optically pumped molecular lasers whose frequencies have been measured. For each line, frequency, wavelength, wave number, lasing molecule, CO2 pump line, and, if available, the assignment of the lasing transition, are given. The list is accompanied by a survey of the techniques of frequency measurement in the far infrared. Accuracies and limitations of the various techniques are also discussed.

701,422
PB88-121108 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

PHYSICS

Optics & Lasers

Response of a Fabry-Perot Cavity to Phase Modulated Light.

Final rept.,
D. Hils, and J. L. Hall. 1987, 7p
Contract NGL-06-003-057
Sponsored by National Science Foundation, Washington, DC., and National Aeronautics and Space Administration, Washington, DC.
Pub. in Review of Scientific Instruments 58, n8 p1406-1412 Aug 87.

Keywords: Optical measurement, Light(Visible radiation), Phase modulation, Responses, Reprints, *Fabry-Perot cavities.

A solution is given to the lock-in detection method, which is valid for arbitrary values of the modulation frequency. The solutions agree with the results of the quasistatic theory, in the limit of small modulation frequency compared to the resonance linewidth.

701,423
PB88-123674 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Radiance Temperature Calibrations. Special pub. (Final),
W. R. Waters, J. H. Walker, and A. T. Hattenburg. Oct 87, 46p NBS/SP-250/7
Also available from Supt. of Docs. as SN003-003-02827-4. See also PB88-123781. Library of Congress catalog card no. 87-619850.

Keywords: *Temperature measurement, *Radiance, Optical measurement, Blackbody radiation, *Calibration, Pyrometers, US NBS, Uncertainty, High temperature.

The report describes the measurement methods and instrumentation used in the realization and transfer of the International Practical Temperature Scale (IPTS-68) above the temperature of melting gold. The determination of the ratios of spectral radiance of tungsten-strip lamps to a gold-point blackbody at a wavelength of 654.6 nm is detailed. The response linearity, spectral responsivity, scattering error, and polarization properties of the instrumentation are described. The analysis of sources of error and estimates of uncertainty are presented. The assigned uncertainties (three standard deviations) in radiance temperature range from plus or minus 2 deg K at 2573 deg K to plus or minus 0.5 deg K at 1073 K. K.

701,424
PB88-123682 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, January 1970-December 1986,
K. E. Kline, and M. E. DeWeese-Bishop. Jun 87, 62p NBSIR-87/3074
Supersedes PB87-125738.

Keywords: *Metrology, *Fiber optics, *Superconductors, *Josephson junctions, *Bibliographies, Lasers, Magnetic measurement, Optical communication, *Cryoelectronics, Optical fibers, SQUID devices, SQUID (Detectors), Laser radiation.

This bibliography lists the publications of the personnel of the Electromagnetic Technology Division of NBS in the period from January 1970 through December 1986. A few earlier references that are directly related to the present work of the Division are included. Fields covered include the following: Optical electronic metrology, Cryoelectronic metrology, Superconductor and magnetic measurement.

701,425
PB88-123781 PC A06/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Spectral Irradiance Calibrations. Special pub. (Final),
J. H. Walker, R. D. Saunders, J. K. Jackson, and D. A. McSparron. Sep 87, 106p NBS/SP-250/20
Also available from Supt. of Docs. as SN003-003-02829-1. See also PB88-123674, and PB88-123708. Library of Congress catalog card no. 87-619862.

Keywords: *Irradiance, *Radiometry, Optical measurement, Spectroradiometers, Blackbody radiation, Standards, *Calibration, Spectral sensitivity, US NBS, Uncertainty.

The report describes the measurement methods and instrumentation used in realization and transfer of the NBS scale of spectral irradiance. The basic measurement equation for the irradiance realization is derived. The spectral responsivity function, linearity of response, and 'size of source effect' of the spectroradiometer are described. The analysis of sources of error and estimates of uncertainty are described. The analysis of sources of error and estimates of uncertainty are described. The assigned uncertainties (3-sigma level) in spectral irradiance range from 2.2% at 250 nm to 1.0% at 654.6 nm to 6.5% at 2400 nm.

701,426
PB88-124441 (Order as PB88-124409, PC A04/MF A01)
National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.
International Intercomparisons of Photometric Base Units,
K. D. Mielenz. 1987, 3p
Included in Jnl. of Research of the National Bureau of Standards, v92 n5 p335-337 Sep-Oct 87.

Keywords: *Photometry, *Luminous intensity, *Candela, Interlaboratory comparisons.

In order to evaluate the worldwide consistency of practical implementations of 1979 redefinition of the candela, the Consultative Committee for Photometry and Radiometry (CCPR) has conducted an international intercomparison of photometric base units. The intercomparison showed 0.8% agreement (one standard deviation) of independent luminous-intensity scale realizations by 15 national laboratories, and 0.6% agreement of luminous-flux scale realizations by 11 laboratories. The NBS candela and lumen agreed with the world mean within quoted uncertainty limits, and were shown to be consistent with one another within 0.5%.

701,427
PB88-129838 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Principles of Optical Phase-Locking: Application to Internal Mirror He-Ne Lasers Phase-Locked via Fast Control of the Discharge Current.
Final rept.,
J. L. Hall, M. Long-Sheng, and G. Kramer. 1987, 11p
Contracts NSF-PHY86-04504, N00014-85-0816
Sponsored by National Science Foundation, Washington, DC., and Office of Naval Research, Arlington, VA. Pub. in IEEE (Institute of Electrical and Electronics Engineers) Jnl. of Quantum Electronics QE-23, n4 p427-437 Apr 87.

Keywords: *Frequency control, *Phase locked systems, Helium neon lasers, Reprints, *Laser radiation, Visible radiation.

While phase-locking techniques have long been in routine use in the microwave frequency domain, the ten-thousand-fold increase of the carrier frequency in the visible domain brings new problems for effective optical phase control. Particularly robust locks can be based on combining phase-locking under quiescent conditions with an outer frequency-control loop which takes control when phase lock is lost. Electronic strategies for implementing the process are discussed. Diagnostic techniques to allow characterization of phase-lock performance of optical oscillators are presented and discussed, using, as an example, the phase-locking of a low-cost internal mirror He-Ne laser tube. Effectively complete phase lock was possible, using small variations of the discharge current to provide fast frequency control.

701,428
PB88-140926 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Doppler-Free Lineshapes.
Final rept.,
A. Gallagher. 1987, 20p
Grant NSF-PHY82-00805
Sponsored by National Science Foundation, Washington, DC.
Pub. in Proceedings of the International Conference on Spectral Line Shapes (8th), Hampton, VA., July 1986, p215-234 1987.

Keywords: *Spectral lines, *Sodium, Line width, Line broadening.

An experiment on two-wavelength excitation of Na in the presence of inert gas perturbers is described and

analyzed in terms of spectral redistribution line-broadening theory and velocity-changing kernels. It is noted that the results yield velocity dependent line-broadening coefficients for various pairs of the three atomic states, and that new issues in line-shape theory are raised by such Doppler-free experiments.

701,429
PB88-141395 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
XUV Radiometric Standards at NBS (National Bureau of Standards).
Final rept.,
W. R. Ott, L. R. Canfield, S. C. Ebner, L. R. Hughey, and R. P. Madden. 1986, 10p
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in X-ray Calibration: Techniques, Sources, and Detectors, v689 p178-187 1986.

Keywords: *Far ultraviolet radiation, *Radiometry, *Standards, Ionization chambers, Photodiodes, X ray spectrometers, Ultraviolet spectrometers, Synchrotron radiation, Reprints, *Soft x radiation, Calibration, Surf II storage ring.

The National Bureau of Standards supports a research and development program in the vacuum ultraviolet and soft x-ray region of the spectrum with the goal of providing radiometric source and detector standards for measurement applications. The report will review the instrument and detector calibration services, and also will describe several soft x-ray measurement-related research projects where NBS staff and visiting scientists have been active.

701,430
PB88-147376 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Characteristics and Performance of Miniature NBS (National Bureau of Standards) Passive Hydrogen Masers.
Final rept.,
F. L. Walls. 1987, 8p
Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement IM-36, n2 p596-603 Jun 87.

Keywords: *Masers, Frequency stability, Sensitivity, Time measurement, Reprints, *Hydrogen masers.

Recent data on the miniature (30 kg) passive hydrogen masers developed at the National Bureau of Standards (NBS) in cooperation with the Naval Research Laboratory (NRL) indicate a frequency stability of $(\sigma_{\text{sub}})^2 / \text{squared}(\tau) = \text{or} < (1.5 \times 10^{-12} \text{ power} / (\tau \text{ to the } 1/2 \text{ power}))^2 + (5 \times 10^{-15} \text{ power})^2$, $1 \text{ s} < \tau < 500,000 \text{ s}$. These masers also have extremely low sensitivity to changes in the external magnetic field or temperature. The sensitivity to barometric pressure and or humidity, although very small, does dominate the residuals in one of the miniature masers for times beyond about a week. Frequency drift is so small as to be hidden in the present measurement precision. The fractional reproducibility under all changes, excluding the storage bulb, appears to be better than 5×10^{-13} to the -13th power. The concepts behind the physics and the electronics that made these advances possible as well as present limitations are explained in some detail.

701,431
PB88-152053 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Refractive Index.
Final rept.,
M. J. Dodge. 1986, 27p
Pub. in CRC Handbook of Laser Science and Technology, v4 pt2 p21-47 1986.

Keywords: *Laser materials, Infrared radiation, Ultraviolet radiation, Tables(Data), *Refractive index.

The section defines refractive index, gives the general form of the Cauchy, Sellmeier, and Hertzberger dispersion equations, and discusses the environmental factors that must be considered in the determination and use of refractive index values for a particular material. Tables are included that give the refractive index and the temperature coefficient of refractive index for crystals that are of particular interest for the fabrication of optical components to be used in laser systems. Dis-

person equations and equation parameters are also given for some of the materials.

701,432
PB88-152129 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Amplitude-Modulated Heterodyne Polarization Spectroscopy.
Final rept.,
M. Raab, and A. Weber. 1985, 4p
Pub. in Jnl. of the Optical Society of America B 2, n9 p1476-1479 Sep 85.

Keywords: *Spectroscopy, Amplitude modulation, Sodium, Polarization(Waves), Transition probabilities, Reprints, Forbidden transitions, Two photon absorption, Multi-photon processes, High sensitivity.

Amplitude-modulated heterodyne polarization spectroscopy was applied for detecting spectral features with small transition probabilities. The intrinsic sensitivity of Doppler-free polarization spectroscopy can be enhanced toward the shot-noise limit, using a frequency-offset saturating beam together with high-frequency chopping. Heterodyne detection of weak transitions with absorption in the one millionth range was achieved. Examples are given of spin-forbidden transitions in Na2 and of two-photon transitions in Na2 and Na.

701,433
PB88-153747 PC A05/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
NBS (National Bureau of Standards) Measurement Services: Photometric Calibrations.
Final rept.,
R. L. Booker, and D. A. McSparron. Oct 87, 88p
NBS/SP-250/15
Also available from Supt. of Docs. as SN003-003-02835-5. Library of Congress catalog card no. 87-619878.

Keywords: *Photometry, *Luminous intensity, *Color temperature, *Standards, *Calibration, Procedures, US NBS.

The National Bureau of Standards supplies calibrated standards of luminous intensity, luminous flux, and color temperature on a routine basis. The procedures, equipment, and techniques used to perform these calibrations as of July 1986 are described. Details of the uncertainty information currently available, including estimates and procedures for determining uncertainties of the reported values, are also presented.

701,434
PB88-154596 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Possibilities for Achieving X-ray Lasing Action by Use of High-Order Multiphoton Processes.
Final rept.,
C. W. Clark, M. G. Littman, T. J. McIlrath, R. Miles, C. H. Skinner, S. Suckewer, and E. Valeo. 1986, 8p
See also DE86005034.
Pub. in Jnl. of the Optical Society of America B 3, n3 p371-378 Mar 86.

Keywords: Optical pumping, Excitation, Reprints, *X ray lasers, Multi-photon processes, Krypton fluoride lasers, Multicharged ions, Population inversion, Isoelectronic sequence.

The authors consider some possible mechanisms for producing gain in the 10 nm spectral region. They involve the creation of a population inversion in a confined plasma column by selective excitation of multi-charged ions via absorption of many (>10) ultraviolet photons. Specific treatment is made of Kr-like ions pumped by a KrF excimer laser.

701,435
PB88-154612 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Semiconductor Electronics Div.
Band Structure and Density of States Changes in Heavily Doped Silicon.
Final rept.,
H. S. Bennett. 1986, 8p
See also PB85-206324.
Pub. in Jnl. of Applied Physics 59, n8 p2837-2844, 15 Apr 86.

Keywords: *Silicon, Interactions, Reprints, *Band structure, *Correlation energy, Density of states, Exchange energy.

The Klauder self-energy method is applied to calculating the effects of the one-body interactions among the dopant ions and the carriers in heavily doped silicon at 300 K. The many-body interactions of exchange energy for majority carriers and of the correlation energy for minority carriers are estimated by interpreting optical absorption measurements and by calculations based on degenerate theory. When densities exceed 5 times 10 to the 19 power per cubic centimeter, one-body and many-body terms become of the same order of magnitude and should be included in calculations of band structure changes and of properties such as carrier transport which depend on the density of states.

Plasma Physics

701,436
PB87-153870 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Excitation Rate Coefficient Measurements of Cu XIII and Cu XVII ions.
Final rept.,
R. U. Datla, J. R. Roberts, W. L. Rowan, and J. B. Mann. 1986, 6p
Contracts DOE-EA-77-A-01-6010, DE-AC05-78ET53043
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review A 34, n6 p4751-4756 Dec 86.

Keywords: *Electron transitions, *Excitation, Ultraviolet spectra, Reprints, *Copper ions, Plasma, Tokamak devices.

The absolute excitation rate coefficients for Cu XIII and Cu XVII optically allowed transitions have been measured using the Texas Experimental Tokamak (TEXT) tokamak. Cu is injected by the laser-ablation method at a time when the plasma has attained steady-state temperature and density profiles. The absolute intensities of the magnetic-dipole-forbidden transitions within the Cu XIII 3s(2) 3p(5) and the CuXVII 3s(2) 3p ground configurations are measured.

701,437
PB87-180824 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Overview of Electron-Ion Collisions.
Final rept.,
G. H. Dunn. 1986, 4p
Pub. in Dynamic Processes of Highly Charged Ions, p20-23 1986.

Keywords: Reviews, Reprints, *Electron-ion collisions.

The consequential roles of electron-ion collisions in a variety of plasmas - astrophysical, fusion, laser, etc. - have been responsible in substantial measure for a keen interest in these kinds of collisions in the past two decades. Elastic scattering, excitation, ionization, and recombination are all conceptually simple processes that have been studied and considered in electron-atom collisions for more than 70 years. Yet, these same processes, when pertaining to electron-ion collisions, continue to challenge the creative efforts of many to gain a detailed understanding.

701,438
PB87-180881 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Experiments on Dielectronic Recombination. A Review.
Final rept.,
G. H. Dunn. 1986, 13p
Contract DOE-EA-01-77-6010
Sponsored by Department of Energy, Washington, DC. Office of Fusion Energy.
Pub. in Atomic Processes in Electron-Ion and Ion-Ion Collisions, p93-115 1986.

Keywords: Reviews, *Dielectronic recombination, Beam-plasma systems, Colliding beams.

Experimental results and methods of study are reviewed for investigation of dielectronic recombination

(DR). Implications of experimental findings to understanding DR phenomena are discussed. Experiments discussed include: coincidence measurements using crossed beams, Rydberg product observations using crossed beams, beam-gas experiments observing resonance transfer and excitation, photon observations using beam-plasma interactions, measurements on satellite line intensities, in plasmas, and analysis of temporal evolution of charge species in a plasma. Extrinsic fields and other environmental effects have a large impact on DR.

701,439
PB87-203824 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Local Measurement of Ba(1+) Density Temporal Evolution.
Final rept.,
G. Chen, and T. J. A. Nee. 1987, 4p
Pub. in Jnl. of Applied Physics 61, n9 p4707-4710, 1 May 87.

Keywords: Density(Number/volume), Rayleigh scattering, Reprints, *Barium ions, *Barium plasma, Laser applications.

The local temporal evolution of the Ba(1+) number density in a resonant laser-driven barium plasma has been measured for the first time by using near-resonance Rayleigh scattering. This local temporal evolution is quite different from other measurements, where spatially integrated absorption methods were employed.

701,440
PB87-224572 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Ne-Like CaXI-MnXVI 2p(5)3l-2p(5)4l Transition Arrays and Energy Levels.
Final rept.,
C. Juppen, U. Litzen, V. Kaufman, and J. Sugar. 1987, 15p
Sponsored by Department of Energy, Washington, DC. Office of Magnetic Fusion Energy.
Pub. in Physical Review A 35, n1 p116-130, 1 Jan 87.

Keywords: *Atomic energy levels, Spectra, Reprints, *Laser-produced plasma, *Calcium plasma, *Scandium plasma, *Titanium plasma, *Vanadium plasma, *Chromium plasma, *Manganese plasma.

Spectra from laser-produced plasmas of Ca, Sc, Ti, V, Cr and Mn have been recorded in the grazing-incidence region, and the transition arrays 3s-4p, 3p-4s, 3p-4d, and 3d-4f of the neonlike ions have been identified. The measured wavelengths together with the previously observed 3-3 transitions have been used for deriving energy levels of the 2s(2) 2p(5) 3l and 2s(2) 2p(5) 4l configurations. The term structure has been analyzed by means of ab initio and parametric calculations and isoelectronic relations. Coupling conditions have been studied and eigenvectors have been derived. Significant perturbations caused by the 2s2p(6)nl configurations have been investigated.

701,441
PB87-233375 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
High Gamma Strongly-Coupled, Non-Neutral Ion Plasma.
Final rept.,
L. R. Brewer, J. D. Prestage, J. J. Bollinger, and D. J. Wineland. 1987, 12p
Sponsored by Office of Naval Research, Arlington, VA., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Strongly Coupled Plasma Physics, p53-64 1987.

Keywords: *Plasmas(Physics), Reprints, *Beryllium ions, *Penning ion sources, Beryllium 9, Laser cooling.

The authors have produced a strong coupled non-neutral (9)Be(1+) ion plasma with a coupling parameter of approximately 100 or greater. The ions were spatially confined by a Penning trap and cooled and compressed using laser cooling. Measurements were made of the plasma shape, rotation frequency, density and temperature. In the paper the authors describe the experimental confinement geometry, the laser cooling of ions and the experimental data which are compared with theoretical predictions. Future experiments to

PHYSICS

Plasma Physics

measure the plasma static structure function, measure ion diffusion, and improve the temperature measurement are discussed.

701,442

PB88-138953 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Calculation of Helium Plasma Satellites in Turbulent Plasmas.
Final rept.,
T. J. A. Nee. 1987, 12p
Pub. in Jnl. of Quantitative Spectroscopy and Radiative Transfer 38, n3 p213-224 1987.

Keywords: Spectral lines, Turbulence, Reprints, *Helium plasma.

Neutral helium line profiles (2P-4D), under the influence of suprathermal electric field fluctuations, are calculated with the use of a relaxation line-broadening theory. First-order plasma satellites at the nearby forbidden component (2P-4F) are investigated for various turbulent plasma conditions. The spectral energy densities of the suprathermal electric field fluctuations are analytically modeled to infer quantitative relations between the plasma satellites and the enhanced electric field. It is found that the far satellite can grow stronger than the near satellite and both satellites will split into doublets as the turbulent electric field increases. The theory is generalized to higher order to describe the second harmonic plasma satellites near the allowed transition.

Radiofrequency Waves

701,443

PB87-152849 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Precision Engineering Div.
Neighboring-Patch Integrals in Transient Electromagnetic Scattering.
Final rept.,
E. Marx. 1985, 6p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation AP-33, n7 p768-773 Jul 85.

Keywords: *Electromagnetic scattering, *Integral equations, Reprints, Transients.

The integrals over patches that are close to the self-patch are calculated by expanding the factors in the integrand in power series. The values are computed analytically to first order in the linear size of the patch. This procedure applies to patches for which the distance between the centers is of the same order of magnitude as the size of the patch. The same formulas apply to monochromatic waves.

701,444

PB87-152880 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Precision Engineering Div.
Self-Patch Integrals in Transient Electromagnetic Scattering.
Final rept.,
E. Marx. 1985, 5p
Pub. in Institute of Electrical and Electronics Engineers Transactions on Antennas and Propagation AP-33, n7 p763-767 Jul 85.

Keywords: *Electromagnetic scattering, *Integral equations, Reprints, Transients.

The self-patch integrals that arise in the integral equations of electromagnetic scattering are evaluated analytically for general orthogonal coordinate systems to first order in the linear size of the patch. There are terms that contain spatial derivatives of the surface fields, and these terms may not be negligible. Although the formulas are derived for transient waves, the same integrals appear for monochromatic waves.

701,445

PB87-172029 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Electromagnetic Fields Div.

Radio-Wave Propagation from a Forest to a Clearing.

Final rept.,
D. A. Hill. 1986, 12p
Pub. in Electromagnetics 6, p217-228 1986.

Keywords: *Radio waves, Wave propagation, High frequencies, Integral equations, Reprints, Forests.

Kirchhoff integration over a vertical aperture is used to obtain a simple expression for radio-wave propagation from a forest to a clearing. Numerical results are presented for a frequency of 10 MHz, and the classical recovery effect is observed. Numerical comparisons are made with a previous integral equation solution, and the agreement is good.

Solid State Physics

701,446

PB87-122545 Not available NTIS
Effects of Crystal Field and Exchange Interactions on the Spin Excitations in Rare Earth Laves-Phase Compounds.
Final rept.,
J. J. Rhyne, and N. C. Koon. 1983, 9p
Pub. in Proceedings of International Conference on Magn. Rare-Earths Actinides, v1 p9-16 1983.

Keywords: Rare earth compounds, Iron intermetallics, Cobalt intermetallics, Neutron scattering, Magnons, *Spin waves, Exchange interactions, Magnetism.

Inelastic neutron scattering techniques have been used to probe the spin excitations of a series of Laves-phase compounds RT₂ of rare earths (R) with Fe, Co, and Al (T). In these compounds, the dispersion of the various magnetic modes provides information on the rare earth crystal field interactions, and on the exchange couplings between (1) T elements (T-T), (2) T and R elements (T-R), or (3) between the R elements alone (R-R).

701,447

PB87-149480 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
High Resolution Electron Microscopy Study of Irradiation Induced Defects in the B²⁺-Phase of Potassium Ferrite.
Final rept.,
Y. Matsui, Y. Bando, Y. Kitami, and R. S. Roth. 1985, 6p
Pub. in Acta Crystallographica, Section B, Structure Science B41, n1 p27-32 1985.

Keywords: *Crystal defects, *Ferrites, Electron microscopy, Reprints, *Potassium ferrites, *Physical radiation effects, High resolution.

A high resolution 1 MV electron microscope study of the B²⁺-type of potassium ferrite, with an ideal formula K₂O.4FeO.15Fe₂O₃, was performed. The compound is beam sensitive and easily suffers from structural degradations during TEM observations, while the isostructural aluminate (B³⁺-alumina) is much more stable under similar irradiation conditions. The mechanisms of structural changes are discussed based on 1 MV high resolution structure images of electron induced defect blocks.

701,448

PB87-149563 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Polarized Electron Probes of Magnetic Surfaces.
Final rept.,
R. J. Celotta, and D. T. Pierce. 1986, 8p
Pub. in Science 234, p333-340, 17 Oct 86.

Keywords: Reprints, *Electron spin polarization, Polarized beams, Magnetism.

The magnetic properties of surfaces are now being explored with electron spectroscopies that use electron spin polarization techniques. The increased activity in surface magnetic measurements with polarized electron beams is spurred by new scientific and technological challenges and is made feasible by recent advances in the technology of sources and detectors of polarized electrons. The ability to grow thin films and to engineer artificial structures permits new phenomena

to be investigated at magnetic surfaces and interfaces. For such investigations, spin-polarized electron techniques such as polarized electron scattering, polarized photoemission, polarized Auger spectroscopy, and scanning electron microscopy with polarization analysis have been and will probably continue to be used to great advantage.

701,449

PB87-150785 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD.
Elastic Interaction of a Wedge Crack with a Screw Dislocation.
Final rept.,
S. M. Ohr, S. J. Chang, and R. Thomson. 15 Mar 85, 5p
Sponsored by Oak Ridge National Lab., TN.
Pub. in Jnl. of Applied Physics 57, n6 p1839-1843, 15 Mar 85.

Keywords: *Screw dislocations, *Cracks, Crack propagation, Reprints, *Wedge cracks, Stress intensity factors.

The elastic field of a semi-infinite wedge crack and its interaction with a screw dislocation under mode III loading conditions are examined. The stress field around the wedge crack is expressed in terms of a wedge stress intensity factor. The rate of falloff of the stress field with distance from the crack tip is found to be a function of the wedge angle. The relationship between the stress intensity factors for the wedge and sharp cracks is derived and used to estimate the magnitude of stress relaxation occurring at the crack tip due to crack blunting. It is found that the emission of dislocations from the crack tip is more difficult when the crack is blunting.

701,450

PB87-151049 PC A08/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
NBS (National Bureau of Standards) Reactor: Summary of Activities July 1985 through June 1986.
Technical note,
F. J. Shorten. Dec 86, 166p NBS/TN-1231
See also report for Jul 81-Jun 82, PB83-218636.

Keywords: *Neutron beams, *Research projects, Nuclear research and test reactors, Neutron irradiation, Neutron activation analysis, Materials test, Crystal structure.

The report summarizes all those programs which depend on the NBS reactor. It covers the period from July 1985 to June 1986. 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.

701,451

PB87-153664 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Quasiparticle States in the Fractional Quantum Hall Effect.
Final rept.,
A. H. MacDonald, and S. M. Girvin. 1986, 15p
Pub. in Physical Review B 34, n8 p5639-5653, 15 Oct 86.

Keywords: *Hall effect, Wave functions, Reprints, *Fractional quantum Hall effect, Quantum Hall effect, Quasi particles.

The authors propose new trial wave functions for the quasielectron and quasihole states relevant to the fractional quantum Hall effect. The wave functions have the virtue that their charge densities and pair distribution functions can be simply expressed in terms of the distribution functions for the uniform-density ground state. Comparisons are made with other proposed trial wave functions for the quasiparticle states and with existing estimates of their densities and energies. Estimates are also given of quasielectron and quasihole energies in higher-orbital Landau levels which suggest that the relative strengths of the effect at different fractional fillings may be strongly Landau-level dependent.

701,452
PB87-157020 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
**Small-Angle Neutron Scattering Evidence for the
 Absence of Long-Range Magnetic Order in Amor-
 phous Fe₉₁Zr₉.**
 Final rept.,
 J. J. Rhyne, and G. E. Fish. 15 Apr 85, 3p
 Pub. in Jnl. of Applied Physics 57, n8 p3407-3409, 15
 Apr 85.

Keywords: Neutron scattering, Reprints, *Iron zirconium, *Magnetic ordering, Exchange interactions, Amorphous materials.

Small angle neutron scattering studies of an amorphous Fe₉₁Zr₉ alloy have shown that there is no transition to long-range magnetic order in contrast to previous bulk magnetization results which indicated a transition to a ferromagnetic state at 220 K followed by a re-entrant spin glass state near 60 K. The scattering lineshape is Lorentzian in Q down to below 150 K and yields a spin correlation length which reaches a maximum of only 27 Å at the transition ($T_{\text{sub f}} = 210$ K) and exhibits an essentially constant plateau of 23 Å down to helium temperature, with no evidence of a second transition in the 60-80 K range. The absence of ferromagnetic order in Fe₉₁Zr₉ at Fe concentrations far above the percolation threshold suggests the presence of a very broad distribution of exchange fields arising from the random Fe site coordinates.

701,453
PB87-157079 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Radiation Physics Div.
Low-Energy Diffuse Scattering Electron-Spin Polarization Analyzer.
 Final rept.,
 J. Unguris, D. T. Pierce, and R. J. Celotta. Jul 86, 10p
 Sponsored by Office of Naval Research, Arlington, VA. Pub. in Review of Scientific Instruments 57, n7 p1314-1323 Jul 86.

Keywords: *Analyzers, Polarimeters, Metal films, Gold, Reprints, *Electron spin polarization.

A new, compact (approximately fist sized), efficient electron-spin analyzer is described. It is based on low-energy (150 eV) diffuse scattering from a high-Z target, for example, an evaporated polycrystalline Au film opaque to the incident electron beam. By collecting a large solid angle of scattered electrons, a figure of merit ($S^2/(I(0)) = 0.0001$) is achieved with an analyzing power $S = 0.11$. The figure of merit degrades only marginally (<10%) for beams with an energy width of 40 eV or after one month of operation at 10 to the -8th power Torr. The electron optical acceptance is of order 100 (mm squared) sr eV. The details of the design and construction are discussed and its performance is compared to six other spin analyzers. Illustrative results are presented from an application to scanning electron microscopy with polarization analysis (SEMPA) to image magnetic microstructure.

701,454
PB87-161584 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Metallurgy Div.
Predictive Modeling of Quantitative Acoustic Emission Waveforms.
 Final rept.,
 H. N. G. Wadley, J. A. Simmons, and C. Turner. 1984, 15p
 Pub. in Proceedings of Annual Review of Progress in Quantitative Nondestructive Evaluation (10th), Sanata Cruz, CA., August 7-12, 1983, p683-697 1984.

Keywords: *Crack propagation, Crystal defects, Ultrasonic radiation, Fractures (Materials), *Acoustic emissions, Elastodynamics, Laser applications.

The general elastodynamic theory for acoustic emission from defect sources is reviewed. A multipolar approximation is used to predict the epicenter waveforms for two models of cracking and thermoelastic generation by a laser pulse. The crack waveforms, while qualitatively unaffected by the crack model, exhibit quantitative differences, particularly at the leading edge. These differences indicate the potential of the acoustic emission method as a means of measuring crack growth microdynamics. The laser waveforms contain

the effects of thermal diffusion for the first time. They are in excellent agreement with the experiment in two metals confirming the validity of the approach. The approach may provide a possible basis for a new quantitative method of thermal wave microscopy.

701,455
PB87-161600 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Metallurgy Div.
**Nuclear Gamma-Ray Resonance Observations in a
 Aluminum-Based Icosahedral Quasi-Crystal.**
 Final rept.,
 L. Swartzendruber, D. Shechtman, L. Bendersky, and J. W. Cahn. 1985, 3p
 Pub. in Physical Review B-Condensed Matter 32, n2 p1383-1385 1985.

Keywords: *Aluminum alloys, Iron alloys, Manganese alloys, Mossbauer effect, Crystal structure, Reprints, *Quasicrystals.

Nuclear gamma-ray resonance (Mossbauer effect) results are presented from rapidly solidified Al-(Mn,Fe) alloys which contain the orientationally ordered phase with icosahedral point group symmetry. Detailed analysis of the spectra obtained are consistent with an icosahedral quasi-crystalline model for the structure of this phase.

701,456
PB87-161832 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Thermophysics Div.
**Coherent Inelastic Neutron Scattering Study of
 Solid Orthodeuterium at High Pressure.**
 Final rept.,
 J. W. Schmidt, M. Nielsen, and W. B. Daniels. 1984, 12p
 Pub. in Physical Review (Section) B: Condensed Matter 30, n11 p6308-6319 1984.

Keywords: *Deuterium, Solidified gases, Neutron scattering, Thermal neutrons, Phonons, Inelastic scattering, Cryogenics, Reprints, *Solid hydrogen, *Solid deuterium, High pressure.

The phonon spectrum of solid deuterium has been measured using coherent inelastically scattered thermal neutrons. Measurements were conducted at a pressure range up to 4.5 kbar and a temperature range between 4K and 50K. Force constants of a harmonic model were calculated from the phonon energies at two densities 15.87 cc/mole and 14.4 cc/mole. Most bulk thermodynamic properties calculated from the force constants are in good agreement with directly measured values. Phonon energy shifts and linewidth increases were measured as functions of temperature.

701,457
PB87-161865 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Semiconductor Electronics Div.
Comment on 'Local Structure at Mn Sites in Icosahedral Mn-Al Quasicrystals'.
 Final rept.,
 E. A. Stern, Y. Ma, and C. E. Bouldin. 29 Sep 86, 2p
 Pub. in Physical Review Letters 57, n13 p1658-1659, 29 Sep 86.

Keywords: *Crystal structure, Solidification, Silicon, Reprints, *Quasicrystals, *Aluminum manganese.

EXAFS measurements were made on icosahedral MnAl and MnSiAl and on the standards alpha-phase of MnSiAl and orthorhombic phase of MnAl₆. Experimental evidence is presented that a cage of Mn atoms at the vertices of an icosahedron is the structural unit in the icosahedral MnSiAl and MnAl phases. The connections among these icosahedral units and between them and the Al atoms are different in the icosahedral phases and in the alpha-phase. As in the alpha-phase, the Mn icosahedra do not share vertices in the icosahedral phases; i.e., they are separated from one another. It is suggested that the i-phase grows by randomly nucleating together Mn icosahedra along their 20 threefold directions, as allowed by local steric constraints.

701,458
PB87-162129 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.

Suppression of Long-Range Order by Random Fields in Tb(x)Fe(1-x) Alloys.

Final rept.,
 M. L. Spano, and J. J. Rhyne. 1985, 3p
 Pub. in Jnl. of Applied Physics 57, n8 p3303-3305 1985.

Keywords: Iron intermetallics, Neutron scattering, Reprints, *Iron terbium, *Magnetic ordering, Amorphous materials, Terbium intermetallics.

The effect of random anisotropy and exchange fields on the 'phase transitions' in amorphous magnets has been examined in Tb₂Fe₉₈ and Tb₇₅Fe₂₅ using small wave-vector (Q) neutron scattering. These two alloys represent opposite extremes in relative magnitude of random anisotropy fields. The neutron results for the spin correlation lengths show that neither alloy exhibits long-range magnetic order well below its freezing temperature of 210K for Tb₇₅Fe₂₅ and approximately 245K for Tb₂Fe₉₈.

701,459
PB87-163648 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Semiconductor Electronics Div.
Electrical Transport Properties of Silicon.
 Final rept.,
 W. R. Thurber, and J. R. Lowney. 1985, 14p
 Pub. in VLSI Handbook, Chapter 14, p177-190 1985.

Keywords: *Silicon, Semiconductor doping, Transport properties, Electrical resistivity, Carrier mobility, Electric fields, Integrated circuits, Very large scale integration, Temperature dependence, Minority carriers, Carrier lifetime, Metal oxide semiconductors.

This short review of the electrical transport properties of silicon was written as a chapter for a VLSI handbook. The titles of the seven sections are: (1) Definition of transport, transport equation; (2) Conversion between resistivity and dopant density; (3) Mobility of charge carriers; (4) Temperature dependence of resistivity and mobility; (5) Dependence of drift velocity on electric field; (6) Minority-carrier mobility, lifetime, and diffusion length; and (7) Mobility in a MOS inversion layer. The chapter includes five tables, seven figures, and thirty-five references.

701,460
PB87-163655 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Semiconductor Electronics Div.
High Dopant and Carrier Concentration Effects in Gallium Arsenide: Band Structure and Effective Intrinsic Carrier Concentrations.
 Final rept.,
 H. S. Bennett. 15 Oct 86, 9p
 Pub. in Jnl. of Applied Physics 60, n8 p2866-2874, 15 Oct 86.

Keywords: *Gallium arsenides, *Semiconductor doping, Band structure of solids, Concentration (Composition), Energy gap, Reprints, Density of states.

The quality and reliability of predictions from numerical simulations of GaAs/AlGaAs devices, such as heterojunction bipolar transistors, depend on model parameters. These parameters include the variations with doping and carrier concentrations of the valence- and conduction-band edges and of the effective intrinsic carrier concentrations for heavily doped p- and n-type gallium arsenide. The Klauder self-energy method is used to calculate the effects of interactions among carriers and dopant ions in heavily doped GaAs at 300 K. The carrier-carrier interactions of exchange and correlation are estimated by interpreting optical absorption measurements and by calculations based on degenerate theory.

701,461
PB87-165783 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
Spin Density Wave Magnetism in Copper-Manganese Alloys.
 Final rept.,
 S. A. Werner, J. J. Rhyne, and J. A. Gotaas. 1985, 4p
 Pub. in Solid State Communications 56, n5 p457-460 1985.

PHYSICS

Solid State Physics

Keywords: *Copper manganese alloys, Neutron scattering, Inelastic scattering, Reprints, *Spin waves, Spin glass state, Magnetism, Magnetic ordering.

Extensive neutron diffraction and inelastic scattering experiments on Cu(1-x)Mn(x) single crystals, have been performed with special attention being given to the incommensurate magnetic peaks occurring at $(1.05 \pm \delta, 0)$ and equivalent positions in reciprocal space. The authors have examined these peaks as a function of composition ($x = 0.10, 0.15, 0.20, 0.25$), temperature, and energy transfer. Experiments performed under continuously higher resolution conditions show that the elastic component of the scattering cross-section approaches zero in the vicinity of the freezing temperature, and has a temperature behavior closely resembling that expected for an order parameter approach to a critical point.

701,462
PB87-167672 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.
Properties of Ion Implanted Polycrystalline Si Layers Subjected to Rapid Thermal Annealing.
Final rept.,
S. R. Wilson, R. B. Gregory, W. M. Paulson, S. J. Krause, J. D. Gressett, A. H. Hamdi, F. D. McDaniel, and R. G. Downing. 1985, 8p
Pub. in Jnl. of the Electrochemical Society 132, n4 p922-929 1985.

Keywords: *Semiconducting films, *Silicon, Semiconductor doping, Polycrystalline, Annealing, Reprints, Ion implantation, Laser applications.

Polycrystalline silicon films have been deposited on thermally oxidized wafers. The films have been implanted with As, B, or BF₂ and annealed with a rapid thermal annealer. The system uses infrared radiation from a resistively heated sheet of graphite to heat the entire wafer to temperatures in excess of 1000 degrees C for times on the order of a few seconds. The effects on sheet resistance, sheet carrier concentration and mobility due to exposure time, heater temperature and dopant species and resultant grain size are discussed.

701,463
PB87-172730 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Problems Associated with the Measurement of X-ray Attenuation Coefficients. I. Silicon Report on the International Union of Crystallography X-ray Attenuation Project.
Final rept.,
D. C. Creagh, and J. H. Hubbell. 1987, 11p
Pub. in Acta Crystallographica A43, p102-112 1987.

Keywords: *Silicon, Single crystals, Cross sections, Reprints, *X ray attenuation, Interlaboratory comparisons, KeV range 01-10, KeV range 10-1000.

X-ray attenuation coefficient measurements made on single-crystal silicon specimens by participants in the International Union of Crystallography X-ray Attenuation Project are presented for the energy range 8-60 keV. Twelve laboratories using eight different experimental configurations have provided data for analysis. A comparison is made between measurements using the different techniques at those characteristic wavelengths of interest to crystallographers. No basis was found for preferring one of three current theoretical tabulations of photoelectric absorption cross section over the others.

701,464
PB87-173746 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Semiconductor Electronics Div.
Conversion-Electron Extended X-ray-Absorption Fine-Structure Measurement of Ion-Damaged GaAs.
Final rept.,
C. E. Bouldin, R. A. Forman, and M. I. Bell. 15 Jan 87, 4p
Pub. in Physical Review B 35, n3 p1429-1432, 15 Jan 87.

Keywords: *Gallium arsenides, Conversion electrons, Reprints, *Physical radiation effects, Ion implantation, Extended x ray absorption fine structure.

Extended x-ray-absorption fine-structure (EXAFS) measurements of ion-implanted GaAs have been

made using conversion-electron detection. This total-electron-yield detection technique (termed CEEEXAFS) allows near-surface sensitivity with a sampling depth of 700-1000 Å. The sampling depth of CEEEXAFS has been measured for the first time, using standards with known depth-dependent structure. The CEEEXAFS technique greatly reduces Bragg-peak contamination of the EXAFS signal from single-crystal materials, and allows measurement of a variety of samples which cannot be fabricated as thin layers for conventional transmission or fluorescence EXAFS measurements. The method permits examination of the local environment of host atoms (in this case Ga) in the near-surface region without interference from the underlying bulk and without the distortions found in fluorescence EXAFS measurements of concentrated samples.

701,465
PB87-179453 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.
Simple Model for the Dynamics Towards Metastable States.
Final rept.,
P. H. E. Meijer, M. Keskin, and E. Bodegom. 1986, 18p
Pub. in Statistical Physics 45, n1/2 p215-232 1986.

Keywords: *Quenching(Cooling), *Supercooling, *Metastable state, Reprints, Order parameters.

Circumstances under which a quenched system will 'freeze' in a metastable state are studied in simple systems with long-range order. The model used is the time-dependent pair approximation based on the most probable path (MPP) method. The time dependence of the solution is shown by means of flow diagrams. The fixed points and other features of the differential equations in time are independent of the choice of the rate constants. It is explained qualitatively how the system behaves under varying descending temperature, the role of the initial conditions, the dependence on the quenching rate, and the response to precooling.

701,466
PB87-179461 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
Observations of the Diffraction of Evanescent X Rays at a Crystal Surface.
Final rept.,
P. L. Cowan, S. Brennan, T. Jach, M. Bedzyk, and G. Materlik. 10 Nov 86, 4p
Pub. in Physical Review Letters 57, n19 p2399-2402, 10 Nov 86.

Keywords: *X ray diffraction, *Crystal structure, Single crystals, Germanium, Reprints, *Crystal surfaces.

Diffraction of x rays from a crystal during total external reflection imposes structure on the x-ray wave field in three dimensions. Standing-wave interference modulates the x-ray intensity parallel to the surface, while boundary effects damp the intensity with distance normal to the surface both within the crystal and in the region above the surface. Experiments on carefully prepared Ge single crystals show that x-ray wave field can be manipulated to provide model-independent information on the structure of surfaces.

701,467
PB87-181814 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Symmetry and Supersymmetry in Crystals.
Final rept.,
L. H. Bennett, and R. E. Watson. Jan 87, 3p
Contract DE-AC02-76CH00016
Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review B 35, n2 p845-847, 15 Jan 87.

Keywords: *Crystal symmetry, Reprints, Supersymmetry, Disclinations, Wigner-Seitz method.

An examination of the disclination network associated with hexagon faces of Wigner-Seitz polyhedra provides new insight into the supersymmetry associated with the three-dimensional space-group representation of centered crystals having nonunique asymmetric units in their description.

701,468
PB87-183117 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Isotope Effects in the PdH System: Lattice Dynamics of PdT(0.7).

Final rept.,
J. M. Rowe, J. J. Rush, J. E. Schirber, and J. M. Mintz. Dec 86, 4p
Pub. in Physical Review Letters 57, n23 p2955-2958, 8 Dec 86.

Keywords: *Lattice vibrations, *Isotope effect, Electron phonon interactions, Neutron scattering, Dispersion relations, Superconductivity, Tritium compounds, Reprints, *Palladium hydrides.

The quasi-harmonic phonon dispersion relation of PdT(0.7) has been determined by coherent neutron scattering. Calculation of the phonon terms entering the current models for superconductivity in PdH, PdD, and PdT shows conclusively that the magnitude of the measured anharmonic frequency shifts is not sufficient to explain the reverse isotope effect in these systems. The effect of the large zero-point motion of the hydrogen isotopes on both the electronic structure and the electron-phonon interaction is estimated, and shown to be necessary to explain the experimental data.

701,469
PB87-191169 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Nuclear-Magnetic-Resonance Powder Patterns in Al₆Mn, Al₄Mn, and Al₁₂Mn Polycrystals.
Final rept.,
G. H. Stauss, M. Rubinstein, E. J. Friebele, L. B. Bennett, and R. J. Schaefer. 1987, 5p
Pub. in Physical Review B35, n6 p2700-2704, 15 Feb 87.

Keywords: *Nuclear magnetic resonance, Polycrystalline, Reprints, *Aluminum manganese, Aluminum intermetallics, Manganese intermetallics, Knight shift, Quasicrystals.

The room-temperature nuclear-magnetic-resonance (NMR) spectra of polycrystalline Al(12)Mn, Al(6)Mn, and Al(4)Mn have been obtained. A resonance line-shape simulation computer program was used to obtain the Hamiltonian parameters which characterize these powder patterns. These three compositions were chosen for study because various workers have suggested that a relationship exists between the quasiperiodic icosahedral Al-Mn structure and one or another of these three Al-Mn compounds. After acquiring the NMR spectra of these three compounds, and obtaining the quadrupole coupling and Knight-shift parameters, the authors conclude that, based on the NMR data, the microscopic structure of quasiperiodic Al-Mn bears little resemblance to any of the compounds studied.

701,470
PB87-193553 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Influence of Individual Reflections on the Precision of Parameter Estimates in Least Squares Refinement.
Final rept.,
E. Prince, and W. L. Nicholson. 1985, 13p
See also report dated Aug 84, DE85-000830.
Pub. in Structure and Statistics in Crystallography, p183-195 1985.

Keywords: *Crystallography, Crystal structure, Least squares method, Precision, Reprints, Parameter estimation.

A formula is derived for determining the effect of additional measurements on the precision of refined parameter estimates when a correct structure model has been established. This formula is used in an analysis of the multiple refinements based on the data from the Single Crystal Intensity Project of the International Union of Crystallography, and it is shown that the weighting scheme used in previous studies places a very heavy emphasis on a small number of weak reflections. It is also shown that, if integrated intensities or values of (absolute value of F)² are used as the observations, weak reflections have little or no influence on the refinement. An approach to the proper utilization of weak reflections is suggested, and a procedure for improving the precision of parameter estimates when experimental time is limited is proposed.

701,471
PB87-193561 Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Long-Range Icosahedral Symmetry in a Metallic Phase Observed by Field Ion Microscopy.
 Final rept.,
 A. J. Melmed, and R. Klein. Mar 86, 4p
 Pub. in Jnl. de Physique 47, pC2-287-C2-290 Mar 86.

Keywords: *Aluminum alloys, *Crystal symmetry, *Manganese containing alloys, Reprints, *Quasicrystals, Field ion microscopy.

Direct observations by Field Ion Microscopy of an Al-12 at. % alloy confirm the earlier determination, by diffraction techniques, of icosahedral long range orientational order. Additionally, a large amount of local disorder, replete with defects or antiphase boundaries, is found. There is no evidence for systematic twinning which might account for the observed orientational symmetry.

701,472
PB87-196358 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Properties of Electrodeposited Co-Cu Multilayer Structures.
 Final rept.,
 M. Dariel, L. H. Bennett, D. S. Lashmore, P. Lubitz, M. Rubinstein, W. L. Lechter, and M. Z. Harford.
 1987, 3p
 Pub. in Jnl. of Applied Physics 61, n8 p4067-4069, 15 Apr 87.

Keywords: *Electrodeposited coatings, *Metal films, *Cobalt, *Copper, Face centered cubic lattices, Magnetic anisotropy, Laminates, Reprints.

Alternate layers of Co and Cu of individual layer thicknesses from 1.5 to 8.0 nm and total thickness of about 100 layers and of Co bilayers separated by Cu have been electroplated from an electrolyte having a low concentration of Cu and a high concentration of Co atoms. The properties of the resulting structures have been analyzed using SEM, x-ray diffraction, VSM, and FMR methods. X-ray diffraction patterns indicate only the fcc structure. Assuming the Co thickness to be that deduced from the plating charge, the authors infer 4(pi)M values in the range 6.0-14.5 kG from VSM and FMR. Some uniaxial anisotropy is apparent in the system. These results are similar to those of earlier work on thin fcc Co layers in the same range of thicknesses, where the room-temperature moment was reduced but depended only slightly on layer thickness, and where the uniaxial anisotropy was observed to be small.

701,473
PB87-196374 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Where Are the Iron Atoms and Iron Moments in RFe(n)Al(12-n). A Wigner-Seitz Analysis.
 Final rept.,
 M. Melamud, L. H. Bennett, and R. E. Watson. 15 Apr 87, 3p
 Pub. in Jnl. of Applied Physics 61, n8 p4246-4248, 15 Apr 87. See also DE87-001459.

Keywords: *Aluminum alloys, *Iron containing alloys, *Rare earth containing alloys, *Magnetic moments, Crystal structure, X ray diffraction, Neutron diffraction, Mossbauer effect, Reprints, Magnetic ordering, Wigner-Seitz method.

The ternary compounds $R\text{Fe}(n)\text{Al}(12-n)$ ($n=4,5,6$; ThMn12 structure) form an extensive family of alloys having complicated magnetic structures, with the rare earths (R) and Fe ordering at different temperatures. The magnetic ordering has been inferred from magnetization, Mossbauer and neutron diffraction measurements. X-ray results are in disagreement with the magnetic measurements as to which sites are occupied by the Fe, and it is not clear at which of the sites iron has the largest magnetic moment. Recently, the authors have suggested that the occurrence of a substantial magnetic moment at an atomic site in certain magnetic systems can be related to the occurrence of - 72 degree disclination lines connecting atoms on the site. These disclinations are bond lines joining two near-neighbor atoms which have six nearest neighbors and can be recognized by a sixfold face appearing on the Wigner-Seitz polyhedra of the two atoms. The Wigner-Seitz construction and its use in the analysis of this and related problems are presented.

701,474

PB87-197901 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Oxygen Measurements in Thin Ribbon Silicon.
 Final rept.,
 S. L. Hyland, D. G. Ast, and A. Baghdadi. 1987, 6p
 Pub. in Jnl. of Crystal Growth 82, p191-196 1987.

Keywords: *Silicon, *Oxygen, Measurement, Reprints, Fourier transform infrared spectroscopy, Ribbons.

The oxygen content of thin silicon ribbons grown by the dendritic web technique was measured, using a modification of the ASTM method based on Fourier transform infrared spectroscopy. Web silicon was found to have a high oxygen content, ranging from 13 to 19 ppm, calculated from the absorption peak associated with interstitial oxygen and using the new ASTM conversion coefficient. The oxygen concentration changed by about 10% along the growth direction of the ribbon. In some samples, a shoulder was detected on the absorption peak. A similar shoulder in Czochralski grown material has been variously interpreted in the literature as due to a complex of silicon, oxygen, and vacancies, or to a phase of SiO_2 developed along dislocations in the material. In the case of web silicon, it is not clear which is the correct interpretation.

701,475

PB87-197976 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Moment Distribution in Amorphous Magnetic Ribbons by Mossbauer Measurements.
 Final rept.,
 M. Melamud, L. J. Swartzendruber, L. H. Bennett, J. Cullen, and M. Wun-Fogle. 1987, 3p
 Pub. in Jnl. of Applied Physics 61, n8 p3644-3646, 15 Apr 87.

Keywords: *Magnetic moments, Mossbauer effect, Reprints, *Iron boride silicides, Amorphous materials, Ribbons.

Mossbauer effect measurements were obtained on smooth-surface Fe(78)B(13)Si(9) amorphous ribbons annealed in a transverse magnetic field at high temperature. Absorption spectra were obtained with the ribbon plane tilted at several angles with respect to the direction of the gamma rays, in an external field ranging from 0 to 10 Oe. Intensity ratios were analyzed to obtain the magnetization as a function of field. A large zero-field spread was deduced, and excess scatter near the anisotropy field was observed.

701,476

PB87-197984 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Initial Susceptibility Studies of Rapidly Solidified Monel.
 Final rept.,
 L. J. Swartzendruber, L. H. Bennett, and H. Ettinger. 1987, 3p
 Pub. in Jnl. of Applied Physics 61, n8 p3991-3993, 15 Apr 87.

Keywords: *Monel, *Nickel alloys, Copper containing alloys, Alternating current, Reprints, *Magnetic susceptibility, Temperature dependence, Magnetism, Rapid solidification.

The temperature dependence of the ac susceptibility for a Cu-Ni alloy near the monel composition (28 at. % Cu) has been measured as a function of temperature for melt-spun material, both in the as-spun condition and after various isothermal anneals. The initial susceptibility of the as-spun material, in the form of a thin ribbon, is significantly affected by the small microscopic compositional inhomogeneity and microstructural defects present after the rapid quenching. Using Curie temperatures estimated from magnetization measurements, the results are compared to a simple model for the ac susceptibility.

701,477

PB87-197992 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Disclinations and Magnetism in Rare-Earth-Transition-Metal Hard Magnets.

Final rept.,
 R. E. Watson, M. Melamud, and L. H. Bennett. 15 Apr 87, 3p
 Contract DE-AC02-76CH00016
 Pub. in Jnl. of Applied Physics 61, n8 p3580-3582, 15 Apr 87. See also DE87-001373. Sponsored by Department of Energy, Washington, DC.

Keywords: Rare earth containing alloys, Crystal structure, Magnetic properties, Magnets, Intermetallics, Reprints, *Iron neodymium, *Iron neodymium borides, *Magnetism, Disclinations, Wigner-Seitz method.

An important class of magnets, involving rare-earth and 3d transition metals and sometimes metalloids, includes $\text{Nd}_2\text{Fe}_{14}\text{B}$ and $\text{Nd}_2\text{Fe}_{17}$. The authors have noted a correlation between the local site magnetism in these two compounds and whether those sites lie on nets of so-called major ligand lines or disclinations, i.e., bond lines shared by six common nearest neighbors. They propose that a criterion for choosing candidate alloys with strong 3d moments is the occurrence of such disclination nets. They have developed a computer program for the calculation of these nets, and using this, several structures having 3d sites with this characteristic have been found.

701,478

PB87-198065 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Antiferromagnetic Structure of the Cubic Superconductor ErPd_2Sn .
 Final rept.,
 H. B. Stanley, J. W. Lynn, R. N. Shelton, and P. Klavins. 1987, 3p
 Pub. in Jnl. of Applied Physics 61, n8 p3371-3373, 15 Apr 87.

Keywords: *Superconductors, Neutron diffraction, Intermetallics, Reprints, *Erbium palladium tin, *Antiferromagnetic materials, Cubic lattices, Magnetism, Crystal field, Heusler alloy.

Elastic and inelastic neutron scattering measurements have been made on the cubic Heusler alloy ErPd_2Sn , which becomes superconducting at $T(s) = 1.17\text{K}$. Antiferromagnetic correlations are found to develop for $T > T(s)$, with an antiferromagnetic transition occurring at T about 1.0 K. The magnetic structure is found to be type II, in which the fcc Er unit cell doubles along all three crystallographic directions. However, there are additional satellites of the allowed reflections which indicate a modulated component of the magnetization density.

701,479

PB87-198073 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Neutron Scattering Study of the Vibrational Density of States in Icosahedral and Crystalline Al(0.80)Mn(0.20) .
 Final rept.,
 P. F. Miceli, S. E. Youngquist, D. A. Neumann, H. Zabel, J. J. Rush, and J. M. Rowe. 1986, 4p
 Contract DE-AC02-76ER01198, Grant NSF-DMR83-04890
 Sponsored by Department of Energy, Washington, DC, and National Science Foundation, Washington, DC.
 Pub. in Physical Review B 34, n12 p8977-8980, 15 Dec 86.

Keywords: Neutron scattering, Phonons, Reprints, *Aluminum manganese, *Quasicrystals, Density of states, Icosahedral phase.

An inelastic neutron scattering study was performed of the vibrational density of states, $(g \text{ bar})(E)$, for the icosahedral and crystalline phases of Al(0.80)Mn(0.20) . At low energy transfers the authors found nearly identical $(g \text{ bar})(E)$ varies as E squared dependences indicating that the two materials are elastically similar. In the intermediate energy range, 20-35 meV, the crystalline $(g \text{ bar})(E)$ shows weak structure while that of the icosahedral phase remains smooth. Above 40 meV there is an excess of the icosahedral $(g \text{ bar})(E)$ compared with that of the crystalline material. These results provide a direct test for models of the interatomic forces and dynamics of the icosahedral phase.

PHYSICS

Solid State Physics

701,480
PB87-198099 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
**Absolute Measurement of the Ordered Magnetic
 Moment in Holmium-Rich $(\text{Er}(1-x)\text{Ho}(x))\text{Rh}_4\text{B}_4$.**
 Final rept.
 Q. Li, J. W. Lynn, and J. A. Gotaas. 1987, 9p
 Pub. in Physical Review B 35, n10 p5008-5012, 1 Apr
 87.

Keywords: *Magnetic moments, *Holmium, Neutron
 diffraction, Ferromagnetic materials, Superconductors,
 Reprints, *Erbium holmium rhodium borides, Form fac-
 tors, Magnetic ordering.

Powder neutron diffraction measurements have been
 performed on ferromagnetic $(\text{Er}(1-x)\text{Ho}(x))\text{Rh}_4\text{B}_4$
 for concentrations $x=1.0, 0.89, 0.84$, and 0.75 to deter-
 mine the ordered magnetic moment and form factor for
 holmium. The magnetic scattering intensities have
 been put on an absolute basis by comparison with
 pure copper-powder Bragg peaks in order to avoid sys-
 tematic errors that might be associated with the eval-
 uation of the nuclear structure factors of the samples
 themselves. For HoRh_4B_4 the saturated magnetic
 moment was determined to be $(\mu \supset Z)=(8.61 + \text{or}$
 $- 0.06) (\mu \text{ sub B})$, which is in good agreement with our
 previous determination. The measurements on the
 alloys gave the same holmium moment within experi-
 mental error.

701,481
PB87-198107 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
Magnetic Field-Induced Transition In $\text{Y}(1-x)\text{Gd}(x)$.
 Final rept.,
 J. A. Gotaas, J. J. Rhyne, L. E. Wenger, and J. A.
 Mydosh. 1987, 3p
 Grant NSF-DMR84-00711
 Sponsored by National Science Foundation, Washing-
 ton, DC.
 Pub. in Jnl. of Applied Physics 61, n8 p3415-3417, 15
 Apr 87.

Keywords: Rare earth alloys, Magnetic fields, Neutron
 diffraction, Phase transformations, Magnons, Reprints,
 *Gadolinium yttrium, Spin waves.

The magnetic field dependence of the spin structure in
 single crystals of $\text{Y}(1-x)\text{Gd}(x)$ has been studied by
 neutron diffraction. In zero field, these dilute alloys ex-
 hibit long-range helical order with the propagation
 vector along the c axis and the magnetic moments
 lying in the basal plane. On applying a magnetic field in
 the basal plane, the modulation wave vector remains
 fixed at $0.28c^*$, and in fields up to 7 T there is no evi-
 dence for the development of higher harmonics. At a
 higher field H_c which depends on concentration and
 temperature, there is an abrupt reduction by a factor of
 2 in the intensity for reflections along the c^* axis, with
 no corresponding change in the intensity of basal
 plane reflections. This is consistent with a change in
 magnetic structure from the helical state to a linear
 modulated state in which the moments are collinear
 with the applied field in the basal plane but undergo a
 sinusoidal modulation along the c axis.

701,482
PB87-198123 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
**Neutron Diffraction and Electron Microscopy Ex-
 amination of Barium Bromide-Barium Chloride (2/
 1).**
 Final rept.,
 H. A. Eick, and E. Prince. 1986, 3p
 Pub. in Acta Crystallographica C42, p915-917 1986.

Keywords: *Crystal structure, Neutron diffraction,
 Electron microscopy, Reprints, *Barium bromides,
 *Barium chlorides.

$2\text{BaBr}_2 \cdot \text{BaCl}_2$, $\text{BaBr}(1.333)\text{Cl}(0.667)$. $M(r)=282.312$,
 $Pnma$, $a=8.2031$, $b=4.8606$, $c=9.6359$ Å, $V=384.20$
 Å^3 , $Z=4$, $D(x)=4.880\text{ Mg m}^{-3}$, $\lambda=1.5500$ Å,
 $\mu=0.023\text{ mm}^{-1}$, $T=298\text{ K}$; $wR=0.0773$ for 330
 reflections. The anions occupy two crystallographic
 sites in an arrangement such that the larger square-
 pyramidal site is filled only with bromine atoms; the
 smaller tetrahedral site is occupied randomly by both
 chlorine and bromine atoms. No evidence for ordering
 of the chlorine and bromine atoms in the tetrahedral
 site was found.

701,483
PB87-198131 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
Spin Dynamics of Amorphous $\text{Fe}(90-x)\text{Ni}(x)\text{Zr}10$.
 Final rept.,
 J. A. Fernandez-Baca, J. W. Lynn, J. J. Rhyne, and
 G. E. Fish. 1987, 3p
 Pub. in Jnl. of Applied Physics 61, n8 p3406-3408, 15
 Apr 87.

Keywords: Neutron scattering, Inelastic scattering,
 Magnons, Reprints, *Iron nickel zirconium, *Spin
 waves, Amorphous materials, Spin glass state.

Neutron inelastic scattering experiments have been
 performed in order to study the long wavelength spin
 dynamics of the amorphous Invar system $\text{Fe}(90-x)$
 $\text{Ni}(x)\text{Zr}10$ (for $x=5, 10$). Spin waves were observed
 over the entire range of wave vectors ($0.05-0.15/\text{Å}$)
 and temperatures ($0.3-0.9\text{ Tc}$) under study. The spin-
 wave energies are well described by the quadratic dis-
 persion relation $(E \text{ sub } q) = s(q \text{ squared} + \Delta^2)$,
 where Δ is a small gap due primarily to dipolar
 interactions. The findings suggest that there might be
 relevant spin-wave broadening mechanisms, perhaps
 due to the magnetic disorder in the system, in addition
 to magnon-magnon interactions.

701,484
PB87-208559 PC A04/MF A01
 National Bureau of Standards (NEL), Boulder, CO.
 Electromagnetic Technology Div.
**Development of Standards for Superconductors,
 Interim Report January-December 1985,**
 L. F. Goodrich, S. L. Bray, W. P. Dube, E. S. Pittman,
 and A. F. Clark. Apr 87, 61p NBSIR-87/3066
 Contract DE-AL01-76PR06010
 See also PB86-128733. Sponsored by Department of
 Energy, Washington, DC.

Keywords: *Superconductors, *Standards, Intermetal-
 lics, Measurement, Stability, *Critical current, Standard
 reference materials, Niobium tin, Niobium titanium,
 Aspect ratio.

A cooperative program with the Department of Energy,
 the National Bureau of Standards, and private industry
 is in progress to develop standard measurement prac-
 tices for use in large scale applications of supercon-
 ductivity. The goal is the adoption of voluntary stan-
 dards for the critical parameters and other characteriza-
 tions of practical superconductors. Progress for the
 period January through December 1985 is reported.
 The major effort was the measurement of large con-
 ductor critical current. Other work reported here in-
 cludes stability and a discussion of possible future
 Standard Reference Materials.

701,485
PB87-218319 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Metallurgy Div.
**Magnetic Properties of Electrodeposited Copper-
 Nickel Composition-Modulated Alloys.**
 Final rept.,
 L. H. Bennett, D. S. Lashmore, M. P. Dariel, M. J.
 Kaufman, M. Rubinstein, P. Lubitz, O. Zadok, and J.
 Yahalom. 1987, 7p
 Pub. in Jnl. of Magnetism and Magnetic Materials 67,
 p239-245 1987.

Keywords: *Copper nickel alloys, Electrodeposited
 coatings, Magnetic properties, Reprints, Transmission
 electron microscopy.

Pulsed potentiostatic deposition offers a new technol-
 ogy for the production and stabilization of composition-
 modulated alloy (CMA) structures. Using this new
 technology, a series of Cu-Ni-modulated structures
 with layer thickness in the 1.4 to 6 nm range were pre-
 pared. The first transmission electron micrographs of
 electrodeposited CMA are presented, showing the ex-
 istence of sharp interfaces. Magnetic properties of the
 CMA structures were measured by vibrating sample
 and SQUID magnetometers, and by ferromagnetic res-
 onance.

701,486
PB87-219119 Not available NTIS
 National Bureau of Standards (NML), Gaithersburg,
 MD. Surface Science Div.

**Off-Diagonal Long-Range Order, Oblique Confine-
 ment, and the Fractional Quantum Hall Effect.**
 Final rept.,
 S. M. Girvin, and A. H. MacDonald. 1987, 4p
 Pub. in Physical Review Letters 58, n12 p1252-1255,
 23 Mar 87.

Keywords: *Hall effect, Ground state, Wave functions,
 Reprints, *Fractional quantum Hall effect, *Quantum
 Hall effect.

The authors demonstrate the existence of a novel type
 of off-diagonal long-range order in the fractional-quantum-
 Hall-effect ground state. This is revealed for the
 case of fractional filling factor $\nu=1/m$ by appli-
 cation of Wilczek's 'anyon' gauge transformation to
 attach m quantized flux tubes to each particle. The
 binding of the zeros of the wave function to the parti-
 cles in the fractional quantum Hall effect is a $(2+1)$ -
 dimensional analog of oblique confinement in which a
 condensation occurs, not of ordinary particles, but
 rather of composite objects consisting of particles and
 gauge flux tubes.

701,487
PB87-224523 Not available NTIS
 National Bureau of Standards (IMSE), Gaithersburg,
 MD. Reactor Radiation Div.
**Diffraction Patterns from Tilings with Fivefold
 Symmetry.**
 Final rept.,
 E. Prince. 1987, 8p
 Pub. in Acta Cryst. A43, p393-400 1987.

Keywords: Alloys, Reprints, *Crystal structure, Diffraction
 intensities, Five fold symmetry, Penrose tilings,
 Quasicrystals.

A procedure involving projection from six-dimensional
 to three-dimensional space to describe objects that
 give sharp diffraction with fivefold symmetry can be re-
 duced to the easier problem of projection from two di-
 mensions to one dimension. This result is used to
 derive an explicit formula for the quasilattice contribu-
 tion to the diffracted intensity for an arbitrary size and
 shape of the selection region. The predictions of this
 formula are compared with the electron diffraction pat-
 terns obtained from rapidly solidified aluminium-mang-
 anese alloys, and it is concluded that the edges of the
 rhombic faces of the three-dimensional objects from
 which models for these alloy structures may be con-
 structed is larger than that used in previous analyses
 by a factor of $\tau(3)$, where τ is the golden mean. It is
 shown that the quasilattice density is proportional to
 the volume of the selection region in the complemen-
 tary three-dimensional space into which a lattice point
 in six-dimensional space must project in order for the
 point to be included in the direct space; this results in
 important constraints on the possible structures of
 these alloys.

701,488
PB87-224598 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Thermophysics Div.
**Relaxation of Anisotropic Correlations in (Two-
 Component) Supercooled Liquids.**
 Final rept.,
 D. Thirumalai, and R. D. Mountain. 1987, 7p
 Sponsored by National Science Foundation, Washing-
 ton, DC.
 Pub. in Jnl. of Physics C: Solid State Physics 20,
 pL399-L405 1987.

Keywords: *Supercooling, Liquids, Glass, Anisotropy,
 Phase transformations, Reprints, Binary mixtures.

The dynamics of the anisotropic correlations in two-
 component supercooled liquids and glasses is exam-
 ined using molecular dynamics. The correlation func-
 tions describing the local anisotropy are found to
 decay very slowly as the temperature is lowered. It is
 shown that the slow decay of these functions also re-
 sults in long temporal correlations in the velocity auto-
 correlation functions. The implications of the study for
 the dynamical theories of glass transition are outlined.

701,489
PB87-225389 Not available NTIS
 National Bureau of Standards (NEL), Gaithersburg,
 MD. Center for Applied Mathematics.

Ising Spin Exchange Simulations on the MPP (Massively Parallel Processor).

Final rept.,
F. E. Sullivan, and R. D. Mountain. 1987, 5p
Sponsored by National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
Pub. in Proceedings of International Phoenix Conference on Computers and Communications (6th), Scottsdale, AZ., February 25-27, 1987, p74-78.

Keywords: Computerized simulation, Parallel processors, Computation, Algorithms, *Ising model.

The main purpose is to describe a very efficient MPP algorithm for performing one important class of Ising spin simulations. Results and physical significance of MPP calculations using the method described here will be discussed elsewhere. However, the authors will make a few comments on the problem under study and report briefly on results so far.

701,490

PB87-230926 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

Variable Radius Curved Crystal Mount.

Final rept.,
A. Henins. 1987, 4p
Pub. in Review of Scientific Instruments 58, n7 p1173-1176 Jul 87.

Keywords: *Mountings, *X ray spectrometers, *X ray diffraction, Reprints.

A crystal mount has been developed which permits adjustment of the radius of curvature of the diffracting crystal in a curved crystal spectrometer without changing the crystal's orientation with respect to the instrument. This mount simplifies x-ray spectrometer design permitting a fixed crystal-to-detector distance. The scale of the instrument is readily changed by changing only this parameter.

701,491

PB87-230934 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

Crystal Reflectivity for Bent Crystal Spectrometers.

Final rept.,
E. Kaerts, P. H. M. Van Assche, G. L. Greene, and R. D. Deslattes. 1987, 6p
Pub. in Nuclear Instruments and Methods in Physics Research A256, p323-328 1987.

Keywords: *Gamma spectrometers, *Silicon, *Diffraction, Reflectivity, Crystals, Reprints.

The reflectivity properties of a bent silicon crystal, used as the diffraction crystal in a transmission type Bent-Crystal Diffraction (BCD) spectrometer, were investigated. In particular the energy dependence of the integrated reflecting power was studied. It was found that the integrated reflecting power stayed constant up to unexpectedly high energies, depending on the diffraction order and on the quality of the crystal bending. Beyond an inflexion point this reflecting power decreased with only 1/E instead of 1/E squared with quartz crystals. Both this diffraction behavior and the improved energy resolution extend the usefulness of bent-crystal diffraction spectrometers beyond 1 MeV gamma ray energy. The results are discussed and interpreted in terms of the diffraction theory for perfect crystals.

701,492

PB87-232021 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Theoretical Aspects of the Quantum Hall Effect.

Final rept.,
S. M. Girvin. 1987, 7p
Pub. in Proceedings of the National Academy of Sciences 84, p4698-4700 Jul 87.

Keywords: *Hall effect, Quantum theory, Reprints, *Quantum Hall effect.

The talk focuses on the fractional quantum Hall effect which is a remarkable many-body phenomenon occurring in the two-dimensional electron gas at high magnetic fields and low temperatures. The Hall conductance of a real, macroscopic device is quantized in the form: $\sigma_{xy} = \nu e^2/h$, where ν is a rational fractional quantum number. Associated with

this are vortex-like excitations which have fractional charge and other bizarre features. There are deep connections between the phenomenon and superfluidity and analogies with models of current interest in high-energy physics. The essence of the effect is that electrons in a magnetic field can turn into bosons by attaching themselves to flux tubes.

701,493

PB87-233383 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.

Models for Heavy Doping Effects in Gallium Arsenide.

Final rept.,
H. S. Bennett, and J. R. Lowney. 1987, 7p
Pub. in Jnl. of Applied Physics 62, n2 p521-527, 15 Jul 87.

Keywords: *Gallium arsenides, *Semiconductor doping, Charge carriers, Reprints, Doped materials, Density of states.

Klauder's self-energy method is used in a self-consistent calculation of the effects due to the interactions between carriers and dopant ions in GaAs at 300K. The many-body effects due to the interactions among the carriers themselves, exchange, and correlation, are estimated by evaluating expressions similar to those of Abram et al. at 300K. When densities exceed about 5×10^{18} to the 16th power/cc in n-type GaAs and 10 to the 18th power/cc in p-type GaAs, carrier-dopant ion interactions and carrier-carrier interactions become significant and should be included in calculations of band structure changes and of properties which depend on the density of states such as carrier transport, effective intrinsic carrier concentrations, and coefficients for optical absorption.

701,494

PB87-233466 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

BCC (Body-Centered Cubic) and FCC (Face-Centered Cubic) Forms of Eu Epitaxially Grown on Re Surfaces.

Final rept.,
A. J. Melmed, V. Maurice, O. Frank, and J. H. Block. 1987, 3p
Pub. in Jnl. of Crystal Growth 84, p123-125 1987.

Keywords: *Crystal growth, *Epitaxy, Reprints, Field electron microscopy, Rare earths, Thin films.

Europium, a body-centered cubic metal, nucleates and grows generally in that form when vapor deposited onto a tungsten or rhenium field electron emitter surface, with no field present. However, on one special planar region of the (curve) rhenium substrate, europium nucleates and grows into a face-centered cubic crystal which is metastable. Field ion microscopy shows that the special surface consists of well-ordered parallel rows of atoms in a small facet which forms a template for epitaxy of (011)FCC Fe.

701,495

PB87-234035 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

New Developments in Neutron Powder Profile Analysis.

Final rept.,
A. Santoro. 1982, 6p
Pub. in God. Jugosl. Cent. Kristalogr. 17, p127-132 1982.

Keywords: *Neutron diffraction, Reprints, *Foreign technology.

No abstract available.

701,496

PB87-234076 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Thermophysics Div.

Low-Gravity Experiments in Critical Phenomena.

Final rept.,
M. R. Moldover. 1986, 23p
Pub. in Opportunities for Academic Research in a Low-Gravity Environment, v108, Chapter 2B, p57-79 1986.

Keywords: *Phase transformations, Separation, *Reduced gravity, Microgravity applications.

The opportunities for experiments in the area of critical phenomena which exploit low-g environments are reviewed.

To test modern theories, sophisticated experiments are required. These experiments must be accompanied by ground-based research and detailed characterization of the low-g environment.

701,497

PB87-234092 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Electronics and Electrical Engineering.

Challenge of Semiconductor Metrology.
Final rept.,
J. C. French, K. F. Galloway, and R. I. Scace. 1983, 18p
Pub. in Proceedings of Measurement Science Conference (1983), Palo Alto, CA., January 20-21, 1983, p1-18.

Keywords: *Semiconductor devices, *Metrology, Integrated circuits, Measurement, Standards, *Semiconductor materials, Calibration, US NBS.

Semiconductor technology has placed challenging demands on the metrologist to provide state-of-the-art capabilities for measurements of dimensional, electrical, thermal, and other physical properties of semiconductor materials, devices, and circuits in a form suitable for meeting the practical needs of science and of industry and its customers. The National Bureau of Standards is responding to these demands by providing generic new measurement methods, physical standards, and services, highlighted by examples given in the paper.

701,498

PB88-109053 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Matrix Approach to Symmetry.
Final rept.,
V. L. Himes, and A. D. Mighell. 1987, 10p
Pub. in Acta Crystallographica A43, p375-384 1987.

Keywords: *Crystal symmetry, *Matrices(Mathematics), Reprints.

In sharp contrast to other methods which focus on the consequences of symmetry (such as dot products, d spacings etc.), the matrix approach deals with symmetry in its most abstract form-represented as matrices. The basis of the matrix approach is to generate the matrices that transform the lattice into itself. The resulting group of matrices defines the holohedry of the lattice. These matrices may be used both theoretically and practically to analyze symmetry from any cell defining the lattice. The mathematics and algorithms used to analyze symmetry become simple as they are based on manipulating integers and simple rational numbers using elementary linear algebra.

701,499

PB88-110424 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

Squeezable Junctions for Electron Tunneling and Surface Electric Field Experiment.

Final rept.,
J. Moreland. 1986, 7p
Pub. in Physics Teacher, p405-411 Oct 86.

Keywords: *Junctions, *Electron tunneling, Superconductors, Surfaces, Electric fields, Electrical measurement, Reprints, Scanning tunneling microscopy, Semiconductors.

Mechanically adjustable junctions can be used for electron tunneling or surface electric field measurements. The article conceptualized their application to semiconductors, superconductors, and surface physics of conducting materials.

701,500

PB88-110648 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.

Electron Tunneling Measurement of the Energy Gap in a La-Sr-Cu-O Superconductor.

Final rept.,
J. Moreland, A. F. Clark, H. C. Ku, and R. N. Shelton. May 87, 2p
Contract N00014-86-F-0109
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Cryogenics 27, p227-228 May 87.

PHYSICS

Solid State Physics

Keywords: *Superconductors, *Electron tunneling, *Energy gap, Copper oxides, Strontium oxides, Critical temperature, Reprints, *Copper lanthanum strontium oxides, Lanthanum oxides.

The authors have used the break junction technique to determine the energy gap of lanthanum-strontium-copper-oxide, one of the new high critical temperature superconductors. The current-voltage characteristics demonstrated a variety of tunneling behaviors. The best characteristic indicating quasiparticle tunneling between superconducting electrodes implied an energy gap of 7.0 plus or minus 0.1 meV. Derivatives of other characteristics showed weak structure indicating possible energy gaps up to 9 meV.

701,501
PB88-110655 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Josephson Effect above 77 K in a YBaCuO Break Junction.
Final rept.,
J. Moreland, L. F. Goodrich, J. W. Ekin, T. E. Capobianco, A. F. Clark, A. I. Braginski, and A. J. Panson. 1987, 2p
Contracts N00014-86-F-0109, DE-A101-84ER52113
Sponsored by Office of Naval Research, Arlington, VA., and Department of Energy, Washington, DC.
Pub. in Applied Physics Letters 51, n7 p540-541, 17 Aug 87.

Keywords: *Superconductors, Barium oxides, Copper oxides, Yttrium oxides, Critical temperature, Reprints, *Barium copper yttrium oxides, *Josephson effect, Critical current.

The authors have observed the Josephson effect in a YBaCuO break junction. Critical currents as high as 10 mA were measured at 4 K for break junctions with a point contact within the fracture of a sample. The junction was susceptible to microwave radiation showing Shapiro steps with the ratio of V/f of 2.04 plus or minus 0.05 micro V/GHz compared to the pair tunneling value of $h/2e = 2.068$ micro V/GHz. These steps were clearly visible in the current-voltage characteristics at temperatures up to 85 plus or minus 5 K.

701,502
PB88-110762 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Fluorescent Emission Spectra of Lithium Fluoride with Use of Synchrotron Radiation.
Final rept.,
K. L. Tsang, C. H. Zhang, T. A. Calicott, E. T. Arakawa, and D. L. Ederer. 1987, 4p
Grant NSF-DMR84-03541, Contract DE-AC05-84OR21400
Sponsored by National Science Foundation, Washington, DC., and Department of Energy, Washington, DC.
Pub. in Physical Review B 35, n16 p8374-8377, 1 Jun 87.

Keywords: *Lithium fluorides, Synchrotron radiation, Single crystals, Emission spectra, Fluorescence, Excitons, Reprints, Soft x radiation.

The soft x-ray emission spectra of single-crystal LiF excited with synchrotron radiation are presented. The radiative decay of the lithium L_α core exciton is observed. Radiative transitions between the valence band and the core hole are also observed in undamaged samples. Spectra obtained with broadband synchrotron-light excitation are shown to be dominated by diffuse scattering from damaged sample surfaces. Excitation with photon energies between 100 and 150 eV generates true emission spectra. An important result is that electrons excited into the conduction band are frequently trapped in an exciton state before recombining with the core hole.

701,503
PB88-117437 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Free Electronlike Stoner Excitations in Fe.
Final rept.,
D. R. Penn. 1987, 3p
Pub. in Jnl. of Applied Physics 61, n8 p3700-3702, 15 Apr 87.

Keywords: *Iron, Free electrons, Electron beams, Reprints, *Stoner excitations.

Methods have recently developed to probe the Stoner excitation spectrum which has not been amenable to

study by neutron diffraction. The experiments have used energy loss spectroscopy combined with spin polarization of the incident electron beam or with spin polarization detection of the scattered beam, or both beam spin polarization and polarization detection. Due to the many possible scattering processes the experiments do not measure the Stoner excitation cross section directly but rather measure the magnitudes of combination of scattering amplitudes. To draw even semiquantitative conclusions regarding the Stoner spectrum requires theoretical analysis. Because Glazer and Tosatti (Solid State Commun. 52, 905 (1984)) give more complete information than previous experiments, it is possible for the first time to carry out a detailed theoretical analysis. The analysis concludes that free electronlike Stoner excitations (FESE) make a much larger contribution to the scattering than d electron Stoner excitations (DESE), the usual type.

701,504
PB88-117569 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Electron Tunneling Measurements of High Tc Compounds Using Break Junctions.
Final rept.,
J. Moreland, L. F. Goodrich, J. W. Ekin, T. E. Capobianco, and A. F. Clark. 1987, 2p
Sponsored by Office of Naval Research, Arlington, VA., and Department of Energy, Washington, DC.
Pub. in Japanese Jnl. of Applied Physics 26, Supplement 26-3, p999-1000 1987.

Keywords: *Superconductors, *Electron tunneling, Barium oxides, Yttrium oxides, Copper oxides, Josephson junctions, Reprints, *Copper lanthanum strontium oxides, *Barium copper yttrium oxides, Lanthanum oxides, Josephson effect.

The authors report on the break junction technique and its application to the high T_c superconductors LaSrCuO and YBaCuO. In the technique, bulk samples are fractured and the freshly fractured surfaces adjusted to form a tunneling junction with vacuum or liquid helium as the insulating barrier. Precise mechanical adjustment permits the study of electron tunneling phenomena between pieces of a bulk superconductor. The current voltage characteristics of these break junctions are variable indicating sample inhomogeneity. However, some junction settings result in the more familiar quasiparticle signatures in the current voltage characteristics. Low leakage junctions indicate the presence of a sharp superconductive energy gap as well as large variations in junction conductance above the gap edge in both materials.

701,505
PB88-117593 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO.
Electromagnetic Technology Div.
Evidence for Two Superconducting Components in Oxygen-Annealed Single-Phase Y-Ba-Cu-O.
Final rept.,
R. B. Goldfarb, A. F. Clark, A. I. Braginski, and A. J. Panson. 1987, 6p
Pub. in Cryogenics 27, p475-480 Sep 87.

Keywords: *Superconductors, Barium oxides, Yttrium oxides, Copper oxides, Critical temperature, Critical field, Alternating current, Reprints, *Barium copper yttrium oxides, Magnetic susceptibility.

The complex susceptibility of a sintered Y-Ba-Cu-O superconductor is strongly dependent on a.c. field amplitude, h. Annealing the material in oxygen gives rise to two distinct components, a relatively high-T_c (c) high-H_{c1} (l), (lower critical field) superconductor (denoted as 'G' or 'good') and a relatively low-T_c (c), low-H_{c1} (C) superconductor (denoted as 'B' or 'bad'). Two models might explain the susceptibility data. In the grain model, the G component consists of superconducting grains and the B component is either intergranular material, unfavorably orientated anisotropic grains, or oxygen-depleted grain boundaries. In the surface model, the G component is in the interior of the sample and the B component is at the sample's surface. This condition could arise if there was oxygen depletion at the surface subsequent to total enrichment during annealing.

701,506
PB88-117619 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Scanning Electron Microscopy with Polarization Analysis: High Resolution Images of Magnetic Microstructure.

Final rept.,
G. G. Hembree, J. Unguris, R. J. Celotta, and D. T. Pierce. 1987, 12p
Pub. in Scanning Microscopy Supplement 1, p229-240 1987.

Keywords: *Magnetic domains, Ferromagnetic materials, Microstructure, Gold, Reprints, *Scanning electron microscopy, *Electron spin polarization, Secondary electrons, Magnetic films, Domain walls.

Secondary electrons from a ferromagnet exhibit a spin polarization related to the net spin density of the valence electrons, i.e., directly proportional to the magnetization. Thus, secondary electron polarization analysis provides a direct measurement of the magnitude and direction of the magnetization in the area probed by the incident electron beam in the Scanning Electron Microscope (SEM). The polarization measurement is independent of topographic contrast and is obtained simultaneously with the conventional topographic image. A new, compact (approximately fist-sized), polarization analyzer utilizing low energy (150 eV) diffuse scattering from a polycrystalline Au target was specially developed for the application of Scanning Electron Microscopy with Polarization Analysis (SEMPA) to study closure domains in permalloy thin film recording heads and to observe the magnetic microstructure of a CoNi thin film recording high density media will be discussed. The variation of the spin within a domain wall of an Fe-based ferromagnetic glass is observed.

701,507
PB88-117684 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.
Thermodynamic Force on Line-Force Defects.
Final rept.,
J. P. Hirth, and I. H. Lin. 1987, 4p
Grant NSF-DMR83-11620
Sponsored by National Science Foundation, Washington, DC.
Pub. in Philosophical Magazine A 56, n1 p89-92 1987.

Keywords: *Dislocations (Materials), Crystal defects, Stresses, Elastic properties, Reprints, *Crystal dislocations, *Line defects.

The elastic fields of dislocation cores and cylindrical inclusions can be represented by line-force defects. The stress concentration at plate-like precipitates can be represented by pile-up arrays of such line-force defects. An expression is presented for the thermodynamic force on such a defect produced by stresses acting at its core. The result is convenient for treating pile-ups and other defect-interaction problems.

701,508
PB88-121934 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.
Front Material (Preface) for Proceedings of the 1982 NTD (Neutron Transmutation Doping) Conference.
Final rept.,
R. D. Larrabee. 1984, 326p
Pub. in Neutron Transmutation Doping of Semiconductor Materials, 326p 1984.

Keywords: *Semiconductor doping, *Meetings, *Neutron irradiation, *Transmutation.

No abstract available.

701,509
PB88-123716 PC A99/MF E04
National Bureau of Standards (NEL), Gaithersburg, MD. Semiconductor Electronics Div.
Results of the Monte Carlo Calculation of One- and Two-Dimensional Distributions of Particles and Damage: Ion Implanted Dopants in Silicon.
Special pub. (Final).
J. Albers. Sep 87, 675p NBS/SP-400/79
Also available from Supt. of Docs. as SN003-003-02821-5. Library of Congress catalog card no. 87-619864. Sponsored by Defense Advanced Research Projects Agency, Arlington, VA.

Keywords: *Silicon, Energy dissipation, Monte Carlo method, Frenkel defects, Semiconductor doping, Integrated circuits, Interstitials, Graphs (Charts), *Ion implantation, *Physical radiation effects, Doped materi-

als, Very large scale integration, TRIM computer program, One dimensional, Two dimensional.

The Transport of Ions in Matter (TRIM) Monte Carlo code was used to calculate the two-dimensional distributions of particles, primary damage, and electronic and nuclear energy loss for implantation of a line beam source into silicon targets. Approximate two-dimensional distributions of the Frenkel pairs (vacancy-interstitial) created by the primary displacement damage of the target atoms were calculated by means of the Kinchin-Pease equation. These particle, damage, and energy loss distributions allowed for the calculation of the one-dimensional distributions of these quantities for implantation into unmasked targets. A superposition technique was used to construct the two-dimensional particle and approximate Frenkel pairs distributions for implantation past a mask edge. The energetic ions used in the calculations were in two groups: those used as intentional dopants in silicon device fabrication and those which either limited lifetime or acted as gettering sites. The particle distributions were parameterized by means of standard polynomial fitting techniques.

701,510
PB88-129671 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
X-ray Crystallographic Studies of Pb Monolayers on Cu (110) Surfaces.
Final rept.,
S. Brennan, P. H. Fuoss, and P. Eisenberger. 1986, 6p
Pub. in Physical Review B 33, n6 p3678-3683, 15 Mar 86.

Keywords: *Lead(Metal), *Monomolecular films, *Crystal structure, Metal films, X ray diffraction, Copper, Substrates, Melting, Reprints, Grazing incidence.

Grazing incident x-ray crystallographic studies of Pb monolayers on Cu (110) surfaces have been performed, and the unit cells of the commensurate p(5x1) phase and the incommensurate phase have been determined. The authors find that the commensurate Pb phase forms a unit cell that consists of four Pb atoms, and the incommensurate Pb cell consists of two atoms with a slightly larger near-neighbor spacing. In addition, the authors find large static displacements perpendicular to the (110) troughs for both phases which may account for some of the unusual two dimensional melting phenomena observed in the system.

701,511
PB88-129788 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Automated Method for Analyzing Images Containing Electron Diffraction Spots.
Final rept.,
D. S. Bright, and E. B. Steel. 1985, 3p
Pub. in Microbeam Analysis 20, p163-165 1985.

Keywords: *Electron diffraction, Polycrystals, Automation, Particles, Reprints, Image analysis, Computer applications.

The authors have applied to the analysis of agglomerate particles, a computer method that automates the analysis of spots in electron diffraction patterns. The method isolates the zone axis diffraction pattern in a polycrystalline diffraction image by isolating the spots from other features of the image, and then by selecting the spots that belong to a regular array. The method gives the basis vectors for the array which can then be used to identify the particle by comparison with standard diffraction data.

701,512
PB88-129911 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Transport Critical Current in Bulk Sintered Y1Ba2Cu3O(x) and Possibilities for Its Enhancement.
Final rept.,
J. W. Ekin. 1987, 6p
Contract DE-AC01-84ER52113
Sponsored by Department of Energy, Washington, DC. Pub. in Advanced Ceramic Materials 2, n3B p586-591 1987.

Keywords: *Superconductors, Barium oxides, Copper oxides, Yttrium oxides, Reprints, *Barium copper yttri-

um oxides, Critical current, Superconducting weak links.

Several general processing methods for increasing the critical current density, ($J_{sub c}$), in bulk sintered Y1Ba2Cu3O(x) superconductor are outlined. Data indicate that the transport J_c in bulk polycrystalline specimens is dominated by a weak-link region between high- J_c grains and that potentially much higher J_c may be possible. Two possible causes of such a weak-link phenomenon are considered: low- $T_{sub c}$ phases or impurities localized in the grain boundary region, and anisotropy of the superconducting properties. Several methods for minimizing the weak-link effects to increase the J_c are discussed.

701,513
PB88-134556 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
X-ray Photoelectron and Auger Electron Forward Scattering: A Structural Probe for Studying Ultrathin Epitaxial Films and Interfaces (Summary Abstract).
Final rept.,
W. F. Egelhoff. 1986, 2p
See also PB86-136918.
Pub. in Jnl. of Vacuum Science and Technology A 4, n3 pt1 p758-759 May/Jun 86.

Keywords: *Thin films, *Interfaces, *Epitaxy, Separation, Reprints, *Auger electron spectroscopy, *X ray photoelectron spectroscopy.

The summary abstract reviews recent experimental work and theoretical analyses which have demonstrated that forward scattering of XPS and Auger electrons by lattice atoms can provide very useful structural information on epitaxial films. Above a few hundred eV kinetic energy, an electron wave expanding radially from a lattice atom scatters strongly in the forward direction off of the nearest and next-nearest neighbor atom in the lattice. Constructive interference between the scattered and unscattered parts of the wave occurs along internuclear axes, producing enhanced intensities of core-level and Auger peaks along the internuclear axes. Thus the angular dependence of the spectra exhibit 'searchlights' of enhanced intensities, pointing out the internuclear or bond axes present in the near surface region. This kind of information is very useful for observing and analyzing interdiffusion, surface segregation, and other structural changes in ultrathin epitaxial films. The high signal intensities obtainable make observations possible in real time. The real time aspect of the technique can yield a wealth of new information on dynamics in ultrathin films.

701,514
PB88-136577 PC A10/MF A01
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
NBS (National Bureau of Standards) Reactor: Summary of Activities July 1986 through June 1987.
Technical note,
F. J. Shorten. Nov 87, 201p NBS/TN-1240
Also available from Supt. of Docs. as SN003-003-02834-7. See also report dated Jun 83, PB83-218636.

Keywords: *Neutron scattering, Nuclear research and test reactors, Neutron diffraction, Neutron irradiation, Neutron activation analysis, Neutron radiography, Materials tests, Nondestructive tests, Crystal structure, Superconductivity, NBSR reactor, Materials testing reactors, Magnetism.

The report summarizes all those programs which use the NBS reactor. It covers the period for July 1986 through June 1987. 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, neutron radiography, and non-destructive evaluation.

701,515
PB88-137112 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Interaction of Flows with the Crystal Melt Interface.
Final rept.,
M. E. Glicksman, S. R. Coriell, and G. B. McFadden. 1986, 29p
Pub. in Annual Review of Fluid Mechanics 18, p307-335 1986.

Keywords: *Crystal growth, *Fluid flow, *Interfaces, Alloys, Melts, Solidification, Convection, Reprints.

The interaction between fluid flow and crystal-melt interfaces is reviewed. The crystal-melt interface is a free boundary at which boundary conditions on temperature, solute concentration, and fluid velocity are satisfied. The degree of coupling between fluid flow and crystal-melt interface dynamics can vary widely. Several examples of strong coupling are identified. Topics covered include (1) boundary conditions at the crystal-melt interface, (2) morphological and double diffusive instabilities during directional solidification, (3) helical instabilities in succinonitrile melts, (4) Rayleigh-Benard convection in crystallizing systems, (5) channel segregation and welding, as examples of engineering applications.

701,516
PB88-138730 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
AC Susceptibility Measurements Near the Critical Temperature of a Y-Ba-Cu-O Superconductor.
Final rept.,
R. B. Goldfarb, A. F. Clark, A. J. Panson, and A. I. Braginski. 1987, 3p
Pub. in Proceedings of Symposium S, Spring Meeting of the Materials Research Society, Anaheim, CA., April 23-24, 1987, p261-263.

Keywords: *Superconductors, Barium oxides, Copper oxides, Yttrium oxides, Critical temperature, Alternating current, *Barium copper yttrium oxides, *AC losses, Magnetic susceptibility.

The loss component of complex susceptibility of a Y-Ba-Cu-O superconductor near its critical temperature is strongly dependent on ac field amplitude but virtually independent of frequency. This implies that magnetic hysteresis is the major loss mechanism in these materials. The temperature at which the loss first becomes positive upon warming corresponds to an equivalence between the amplitude of the ac field and the lower critical field of the superconductor.

701,517
PB88-139043 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Spin Density Waves in Cu-Mn.
Final rept.,
J. A. Gotaas, J. J. Rhyne, and S. A. Werner. 1985, 3p
Sponsored by American Inst. of Physics, New York, and Institute of Electrical and Electronics Engineers, Inc., New York.
Pub. in Jnl. of Applied Physics 57, n8 pt2A p3404-3406, 15 Apr 85.

Keywords: *Copper alloys, *Manganese alloys, Neutron scattering, Magnons, Magnetic alloys, Face centered cubic lattices, Reprints, *Spin waves, Magnetism.

The incommensurate magnetic peaks occurring in Cu(1-x)Mn(x) at (1, 0.5 + or - delta, 0) and equivalent positions in reciprocal space have been studied in an extensive series of neutron scattering experiments. It is found that delta varies linearly with composition, and that the width of these peaks corresponds to a correlation range of about 10 fcc unit cells. The symmetry of the magnetic scattering indicates that there are 12 spin density wave domains. Experiments performed under high resolution conditions (61 mu eV) show that the elastic component of the magnetic scattering cross section at (1, 0.5 + or - delta, 0) approaches zero in the vicinity of the 'freezing' temperature T(f), closely resembling the behavior of an order parameter going to zero at a Neel point.

701,518
PB88-139050 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Reentrant Spin-Glass Order Parameter in Fe(0.3)Ni(0.7)75P16B6Al3.
Final rept.,
R. W. Erwin, J. W. Lynn, and A. Magerl. 1986, 2p
Sponsored by American Inst. of Physics, New York, Applied Psychological Services, Inc., Wayne, PA., and National Research Council, Washington, DC.
Pub. in Jnl. of Magnetism and Magnetic Materials 54-57, pt1 p101-102 Feb 86.

PHYSICS

Solid State Physics

Keywords: Neutron scattering, Iron alloys, Nickel alloys, Boron containing alloys, Phosphorus containing alloys, Aluminum containing alloys, Reprints, *Spin glass state, Order parameters.

High-resolution neutron backscattering measurements have been performed on the amorphous reentrant spin glass (Fe(0.3)Ni(0.7)75P16B6Al3). These measurements confirm that there are two distinct time scales in the spin-glass temperature regime. The longer time scale can be identified with microdomain lifetimes and thus the resulting elastic scattering measures a spin-glass order parameter, while the characteristic fluctuation times are at least five orders-of-magnitude faster.

701,519
PB88-139068 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Monte Carlo Simulation of Dilute Magnetic Semiconductors for High Concentrations of the Magnetic Component.
Final rept.,
T. M. Giebultowicz. 1986, 2p
Pub. in Jnl. of Magnetism and Magnetic Materials 54-57, p1287-1288 1986.

Keywords: Monte Carlo method, Antiferromagnetism, Reprints, *Magnetic semiconductors, *Semiconductors, Cadmium manganese tellurides, Manganese sulfides.

A model of dilute magnetic semiconductors has been studied by Monte Carlo methods in the concentration range $0.7 = \text{or } < x = \text{or } < 1$. Results obtained for $x = 0.7$ and $x = 1$ are compared with experimental data for Cd(0.3)Mn(0.7)Te and beta-MnS. For concentrations $0.85 = \text{or } < x = \text{or } < 1$ the system is found to exhibit a type of 'antiferromagnetic reentrant behavior.'

701,520
PB88-139076 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Long-Range Incommensurate Spin State in Dilute YGd Alloys.
Final rept.,
J. A. Gotaas, J. J. Rhyne, L. E. Wenger, and J. A. Mydosh. 1986, 2p
Pub. in Jnl. of Magnetism and Magnetic Materials 54-57, Part I, p93-94 Feb 86.

Keywords: *Yttrium alloys, Neutron diffraction, Single crystals, Magnetic moments, Reprints, *Gadolinium alloys, *Spin states, Magnetic ordering, Temperature dependence.

Neutron diffraction measurements on single-crystal Y(2.2%Gd) reveal that the alloy orders $T(N) = 6.64K$ with a long-range periodic incommensurate spin structure with moments in the basal plane and a propagation vector of .28c. The temperature dependence of the Gd moment derived from the integrated neutron intensities is similar to that of Gd metal.

701,521
PB88-139084 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD.
Periodic and Quasiperiodic Crystals.
Final rept.,
D. Gratias, and J. W. Cahn. 1986, 5p
Pub. in Scripta Metallurgica 20, n9 p1193-1197 Sep 86.

Keywords: Reprints, *Quasicrystals, Hyperspaces, Shechtmanite.

The paper is one of six papers of a 'viewpoint set' examining various aspects of quasicrystals. The authors enlarge the definition of crystals in order to include quasicrystals in a more general crystallography: crystals are solids with long-range orientational and translational, but not necessarily periodic, order and spatial homogeneity. The authors show that quasicrystals arise as a limit, which can either be seen as infinite unit cell crystals, or converge to an irrational cut of a hyper-space periodic crystal.

701,522
PB88-139092 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD.
Pauling's Model Not Universally Accepted.
Final rept.,
J. W. Cahn, D. Gratias, and D. Shechtman. 1986, 2p
Pub. in Nature 319, n6049 p102-103 1986.

Keywords: *Crystal structure, Crystal symmetry, Twinning, Reprints, *Icosahedral phase, *Quasicrystals, Pauling model, Cubic lattices.

This is a reply both to a letter (Nature 317, p. 512, 1985) by Linus Pauling 'Apparent Icosahedral Symmetry is Due to Directed Multiple Twinning of Cubic Crystals' and an editorial (Nature 317, p. 417, 1985) by the editor of Nature, John Maddox, regarding a model Pauling proposed to explain a limited portion of their data while ignoring all of the other data.

701,523
PB88-141353 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Spin Dynamics of Amorphous Fe(0.86)B(0.14).
Final rept.,
J. A. Fernandez-Baca, J. W. Lynn, J. J. Rhyne, and G. E. Fish. 1986, 3p
Pub. in Physica B and C 136, n1-3 p53-55 1986.

Keywords: *Magnons, Iron alloys, Boron containing alloys, Neutron scattering, Inelastic scattering, Invar, Reprints, *Spin waves, Heisenberg ferromagnets, Amorphous materials.

A high resolution neutron inelastic scattering experiment has been performed in order to study the spin dynamics of amorphous Fe(0.86)B(0.14), which exhibits Invar properties. Spin waves were observed in the wave vector range $0.05/\text{\AA} = \text{or } < q = \text{or } < 0.13/\text{\AA}$, at temperatures between 0.53 T(c) and 0.93 T(c). There are no anomalies in the spin-wave lifetimes at long wavelengths which appear to relate to the Invar effect seen in Fe(0.86)B(0.14).

701,524
PB88-141361 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Spin Stiffness Anomaly in the Reentrant Spin-Glass (Fe(0.25)Ni(0.75))(0.75)P(0.16)B(0.06)Al(0.03).
Final rept.,
R. W. Erwin, J. W. Lynn, J. J. Rhyne, and H. S. Chen. 1985, 3p
Sponsored by American Inst. of Physics, New York, and Institute of Electrical and Electronics Engineers, Inc., New York.
Pub. in Jnl. of Applied Physics 57, n8 pt2A p3473-3475, 15 Apr 85.

Keywords: *Ferromagnetic materials, Magnetic alloys, Iron alloys, Nickel alloys, Phosphides, Borides, Aluminides, Neutron scattering, Magnons, Reprints, Spin glass state, Magnetism, Amorphous materials.

Low field magnetization measurements have shown that the amorphous alloy mentioned in the title becomes a demagnetization-limited ferromagnet below a Curie temperature $T(c)$ of 200 K, but that the spontaneous magnetization vanishes again below a reentrant temperature $T(R)$ of 10 K. Inelastic neutron scattering measurements have been performed to study the spin-wave dynamics as the spin-glass state is entered from the ferromagnetic state. An elastic component of the magnetic scattering, attributed to a spin-glass order parameter, is also observed.

701,525
PB88-147236 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Development of Increasing Surface Roughness during Ion Sputtering.
Final rept.,
D. Marton, and J. Fine. 1987, 7p
Pub. in Thin Solid Films 151, p433-439 1987.

Keywords: *Surface roughness, *Ion irradiation, *Sputtering, Statistics, Depth, Resolution, Reprints.

A simple statistical model has been developed to explain the development of surface topography (roughness) during ion sputtering of solid targets. The square root depth dependence of the surface roughness is explained by assuming that the roughness is caused by the differences in sputtering rates obtained on differently oriented crystallographic surfaces, and that the distribution of the sputtering rates is fully random. Deviations from the random distribution of the sputtering rate lead to different types of depth dependence of the surface roughness.

701,526
PB88-147475 Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.

Icosahedral Symmetry Versus Local Icosahedral Environments in Al-Mn Alloys from NMR (Nuclear Magnetic Resonances).
Final rept.,
L. H. Bennett, J. W. Cahn, R. J. Schaefer, M. Rubinstein, and G. H. Stauss. 1987, 2p
Pub. in Nature 326, n6111 p372-373, 26 Mar 87.

Keywords: *Aluminum alloys, *Manganese containing alloys, *Crystal structure, Crystal symmetry, Nuclear magnetic resonance, Twinning, Reprints, *Icosahedral phase, Pauling model, Quasicrystals.

In a recent report, Pauling suggested that the icosahedral diffraction found in the aluminum-manganese system is due to a cubic crystalline phase with a large unit cell of more than 1,000 atoms, multiply twinned to mimic icosahedral symmetry, instead of a crystalline or quasicrystalline phase with fivefold symmetry. Here, the authors report a comparison of the nuclear magnetic resonance (NMR) spectra obtained from aluminum-manganese alloys in the crystalline 'G' phase (in which each of the Mn atoms is surrounded by an icosahedron of Al atoms, exactly as in Pauling's proposal structure) with the spectra of the icosahedral phase. The authors find that the NMR spectrum in the 'G' phase is entirely different from the spectrum in the icosahedral phase. Twinning should not affect the NMR spectra except for a small contribution from atoms on or near the composition planes, so the Al-Mn icosahedral phase is not Pauling's twinned cubic structure.

701,527
PB88-147608 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD.
Indexing of Icosahedral Quasi-Periodic Crystals.
Final rept.,
J. W. Cahn, D. Shechtman, and D. Gratias. 1986, 14p
Pub. in Jnl. of Mater. Res. 1, n1 p13-26 Jan/Feb 86.

Keywords: X ray diffraction, Reprints, *Icosahedral phase, *Quasicrystals, Bravais lattices, Hyperspaces, Shechtmanite, Cubic lattices.

Several problems regarding the indexing of diffraction spots of the newly discovered quasiperiodic icosahedral crystals are examined. Two related six-index notations are proposed, one based on a three-dimensional cubic coordinate system, the other on the six-dimensional cubic lattice. Three of the five six-dimensional bravais lattices lead to different extinction rules in three dimensions. A two-parameter hierarchy of diffraction spots is proposed. It leads to a one-parameter hierarchy of intense lines which is in accord with observed powder diffraction data.

701,528
PB88-152061 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Polymers Div.
Electronic Properties and Stability of the Ordered Structures of the V-Pd, Nb-Pd and Ta-Pd Systems.
Final rept.,
R. Kuentzler, and R. M. Waterstrat. 1986, 19p
Sponsored by American Dental Association Health Foundation, Chicago, IL.
Pub. in Jnl. Less-Common Met. 120, n2 p317-335, 15 Jun 86.

Keywords: Vanadium alloys, Palladium alloys, Intermetallics, Specific heat, Stability, Reprints, *Electronic specific heat, Niobium alloys, Tantalum alloys.

Electronic specific heat data have been measured for the ordered structures occurring in the V-Pd, Nb-Pd and Ta-Pd systems. The coefficients are relatively low, except for V3Pd, and the values decrease for each ordered structure concentration from V-Pd to Nb-Pd to Ta-Pd systems. In most cases $\gamma(\text{ord}) < \gamma(\text{dis})$. The results are discussed within the framework of current theoretical density-of-states calculations. Ordered structures based on an fcc or a bcc lattice appear to be stabilized when the Fermi level falls in a gap in the density-of-states. The gap appears as a result of the ordering and is smeared out for corresponding disordered systems.

701,529
PB88-152343 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Energy Dependence of Electron Inelastic Mean Free Paths.

Final rept.,
C. J. Powell. 1987, 6p
Pub. in Surface and Interface Analysis 10, p349-354 1987.

Keywords: *Aluminum, *Copper, *Silver, *Gold, *Electron energy, *Mean free path, Reprints.

An analysis has been made of the dependence on electron energy of calculated inelastic mean free paths (IMFPs) for aluminum, copper, silver, and gold from four recent sources of data. The analysis was made using Fano plots which clearly show differences in energy dependences. In addition, the slopes of linear regions in the Fano plots can be compared with values calculated from experimental optical data and with values obtained from Fano plots made with experimental attenuation length (AL) data.

701,530
PB88-152350 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Influence of Surface Structure on Ion Emission from TiO₂.

Final rept.,
R. L. Kurtz. 1986, 2p
Pub. in Jnl. of Vacuum Science and Technology A 4, n3 p1248-1249 May/June 86.

Keywords: *Titanium dioxide, *Ion emission, Reprints, Electron stimulated desorption, Photon stimulated desorption.

Recent experiments have shown that ion angular distributions and desorption yields from TiO₂ surfaces are strongly influenced by the local environment of the Ti cation. This work is a detailed study of the electron-stimulated desorption ion angular distributions (ESDIAD) and the total ion yields from two TiO₂ surfaces: The (110) and the (001). The variety of sites on these surfaces make them good model systems for studying the influence of local geometry on ion emission.

701,531
PB88-152368 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.
Proposed Formula for Electron Inelastic Mean Free Paths Based on Calculations for 31 Materials.

Final rept.,
S. Tanuma, C. J. Powell, and D. R. Penn. 1987, 9p
Pub. in Surface Science 192, pL849-L857 1987.

Keywords: *Electrons, *Mean free path, Inelastic scattering, Solids, Electron energy, Surfaces, Reprints, EV range 100-1000, KeV range 01-10.

A new general formula is proposed for determining electron inelastic mean free paths (IMFP's) for 200-2000 eV electrons in solids. The new formula is based on separate IMFP calculations for 27 elements and 4 compounds using an algorithm due to Penn. The formula is believed useful for determining the IMFP dependence on electron energy for a given material and the material-dependence for a given energy. The new formula should also be a reasonable guide to electron attenuation lengths which have been difficult to determine with the needed accuracy.

701,532
PB88-152681 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Detailed Fractographic Analysis of Cleavage Steps in Silicon.

Final rept.,
M. J. Kaufman, and A. J. Forty. 1986, 6p
Pub. in Jnl. of Materials Science 21, n9 p3167-3172 Sep 86.

Keywords: *Silicon, *Cleavage, *Brittle fracturing, Fractography, Cracks, Reprints, Scanning electron microscopy.

A detailed analysis of cleavage steps present on fracture surfaces in pure Si has been carried out using scanning electron microscopy. The results indicate that the mechanisms involved in both the formation of unfractured ligaments, produced when adjacent cleavage facets overlap, and the subsequent fracture of these ligaments to form cleavage steps are quite complex. Specifically it is shown that, during ligament for-

mation, the local crack fronts are deflected from their preferred (111) cleavage plane and that the fracture of these ligaments to form cleavage steps occurs in a very complex fashion producing very small microcleavage steps. It is shown that these latter steps are consistent with cleavage along both (111) and (011) planes.

701,533
PB88-152947 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Experimental Studies of Surface Magnetism with Polarized Electrons.

Final rept.,
D. T. Pierce. 1987, 14p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in Surface Science 189/190, p710-723 1987.

Keywords: Thin films, Reprints, *Surface magnetism, Electron spin polarization, Magnetic films.

The same electron spectroscopies that are so powerful for studying surfaces generally, can be made sensitive to magnetic properties when electron spin polarization is included as a parameter, for example by probing with a spin polarized electron beam or measuring the spin polarization of emitted electrons. Such properties as the spontaneous magnetization, Curie temperature, temperature dependence of the magnetic order, anisotropy, spin-dependent electronic structure, magnetization curves, elementary excitations, and magnetic microstructure may be different from the bulk in a thin film or at the surface of a semi-infinite ferromagnet. Recent results on chemisorption induced changes in surface magnetism studied by spin polarized inverse photoemission, on magnetic surface anisotropy investigated by polarized photoemission, and on magnetic microstructure determined by scanning electron microscopy with polarization analysis, have been selected for discussion as illustrations of polarized electron studies of surface magnetism.

701,534
PB88-154026 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Characterization of Alumina Powder Using Multiple Small Neutron Scattering. 1. Theory.

Final rept.,
N. F. Berk, and K. A. Hardman-Rhynne. 1985, 6p
See also PB88-154034.
Pub. in Jnl. of Applied Crystallography 18, pt6 p467-472, 1 Dec 85.

Keywords: *Aluminum oxide, Neutron scattering, Particle size, Powder(Particles), Area, Surfaces, Reprints, Small angle scattering, Multiple scattering.

Microstructural values of high purity alumina powder are determined quantitatively throughout the bulk of the material using small angle neutron scattering techniques. In particular, a theoretical and experimental approach for analyzing multiple scattering data is developed to obtain particle size, volume fraction and surface area values. Polydispersity and shape effects of the particles are discussed. Neutron scattering results agree with laser light scattering, x-ray sedimentation and scanning electron microscopy results where the mean particle size is 366 nm and the particles are spherical in shape.

701,535
PB88-154034 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Characterization of Alumina Powder Using Multiple Small Angle Neutron Scattering. 2. Experiment.

Final rept.,
K. A. Hardman-Rhynne, and N. F. Berk. 1985, 7p
See also PB88-154026.
Pub. in Jnl. of Applied Crystallography 18, pt6 p473-479, 1 Dec 85.

Keywords: *Aluminum oxide, Neutron scattering, Particle size, Powder(Particles), Surfaces, Area, Reprints, Small angle scattering, Multiple scattering.

Microstructural values of high purity alumina powder are determined quantitatively throughout the bulk of the material using small angle neutron scattering techniques. In particular, a theoretical and experimental approach for analyzing multiple scattering data is developed to obtain particle size, volume fraction and surface area values. Polydispersity and shape effects of the particles are discussed. Neutron scattering

results agree with laser light scattering, x-ray sedimentation and scanning electron microscopy results where the mean particle size is 366 nm and the particles are spherical in shape.

701,536
PB88-155437 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Transport Critical-Current Characteristics of Y1Ba2Cu3Ox.

Final rept.,
J. W. Ekin, A. J. Panson, A. I. Braginski, M. A. Janocko, M. Hong, J. Kuo, S. H. Liou, D. W. Capone, and B. Flandermeier. 1987, 4p
Contract DE-AL01-84ER52113
See also DE87-011525. Sponsored by Department of Energy, Washington, DC.

Pub. in Proceedings of Symposium S, Spring Meeting of the Materials Research Society, Anaheim, CA., April 23-24, 1987, p223-226.

Keywords: *Superconductors, Barium oxides, Copper oxides, Yttrium oxides, *Barium copper yttrium oxides, *Critical current.

Voltage vs. current (V-I) characteristics were measured at magnetic fields up to 24 T at a temperature of 77 K in several Y1Ba2Cu3Ox samples fabricated at different laboratories. Critical temperatures, T(c), measured by resistivity, were about 93 K. All samples showed linear V-I characteristics at current levels much greater than the critical current, I(c). However, the slope was significantly less than the normal resistance at T(c). The slope increased with magnetic field and reached the normal resistance value only at fields greater than 24 T.

701,537
PB88-162532 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Metallurgy Div.
Topology of Local Atomic Environments: Implications for Magnetism and Superconductivity.

Final rept.,
L. H. Bennett, R. E. Watson, and W. B. Pearson. 1986, 2p
See also DE86002933.
Pub. in Jnl. of Magnetism and Magnetic Materials 54-57, pt3 p1537-1538 Feb 86.

Keywords: *Transition element alloys, Magnetism, Superconductivity, Reprints, *Disclinations, Topology, Superexchange, Wigner-Seitz cells.

Wigner-Seitz cells have been constructed, as a function of atomic size, for a number of transition-metal alloys, and a disclination network has been obtained from these. Magnetism in these alloys can be related to the disclination lines, much like the superexchange paths familiar in the magnetism of salts.

Structural Mechanics

701,538
PB87-149514 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.
Temperature Considerations in the Study of Surfaces Using a Four-Ball Wear Apparatus.

Final rept.,
R. G. Munro. 1985, 4p
Pub. in Jnl. of Applied Physics 57, n11 p4950-4953 1985.

Keywords: *Surfaces, Thermal conductivity, Conduction, Reprints, Temperature distribution, Coefficient of friction.

The evolution and distribution of temperature has been studied theoretically for a four-ball wear apparatus which can be used to study macroscopic effects of surfaces interacting under frictional conditions. The finite difference method was used to solve the coupled equations of heat generation, conduction, and cooling. Parameters were chosen to represent two types of material, a typical steel with relatively good thermal conductivity, and a ceramic with relatively poor thermal conductivity. Two values for the coefficient of friction were used to simulate dry and lubricated surfaces. A

PHYSICS

Structural Mechanics

significant dependence on thermal conductivity was found.

701,539

PB87-202990

Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

Creep Cavitation in the Neighborhood of Stress Concentrations.

Final rept.,

T. S. Liu, T. J. Delph, and R. J. Fields. 1983, 7p
Contract DE-AC01-81ER10816

Sponsored by Department of Energy, Washington, DC.
Pub. in Transactions of the International Conference
on Structural Mechanics in Reactor Technology (7th),
Chicago, IL., August 22-26, 1983, p79-85.

Keywords: *Creep properties, Finite element analysis,
Notch sensitivity, Stress concentration, Reprints.

The results of several experiments into the formation
and distribution of creep cavitation in the neighbor-
hood of stress concentrations are reported. Of particu-
lar interest is the use of an image analyzing computer
to construct quantitative maps of cavity sized and dis-
tributions. Comparisons are drawn in one case with the
results of a finite element simulation, and some degree
of overall agreement is noted.

701,540

PB88-138516

PC A04/MF A01
National Bureau of Standards, Gaithersburg, MD.

**Journal of Research of the National Bureau of
Standards, Volume 92, Number 6, November-De-
cember 1987.**

1987, 54p

Also available from Supt. of Docs. as SN703-027-
00019-9. See also PB88-138524 through PB88-
138540 and PB87-230975.

Keywords: *Periodicals, *Measurement, Ceramics,
Standards, Plates, Nondestructive tests, Vibration,
Finite element analysis, Superconductors, *US NBS.

The issue contains: New briefs and reports on: Stand-
ard reference data information; International standards
nondestructive testing; and Superconductivity: chal-
lenge for the future. Articles on: Transient impact re-
sponse of thick circular plates; Transient impact re-
sponse of plates containing flaws and A low noise cas-
code amplifier.

701,541

PB88-138524

(Order as PB88-138516, PC A04/MF A01)
National Bureau of Standards, Gaithersburg, MD.

**Transient Impact Response of Thick Circular
Plates,**

M. Sansalone, and N. J. Carino. 1987, 13p

Included in Jnl. of Research of the National Bureau of
Standards, v92 n6 p355-367 Nov-Dec 87.

Keywords: *Plates, Impact, Echoes, Nondestructive
tests, Finite element analysis, Frequency response,
Stress waves, Vibration, Green's function.

The finite element method was used to study the tran-
sient response of thick circular plates subjected to
point impact. The response of plates having different
geometries and subjected to impacts of different dura-
tion was studied in both the time and the frequency
domains. It is shown that the transient plate response
is composed of a number of different modes of vibra-
tion including P- and S-waves thickness modes, anti-
symmetric flexural modes, the rod mode, and P- and S-
wave diameter modes. The origin of the diameter
modes is discussed. Excellent agreement was found
between the calculated frequency values and those
obtained from finite element analyses.

701,542

PB88-138532

(Order as PB88-138516, PC A04/MF A01)
National Bureau of Standards, Gaithersburg, MD.

**Transient Impact Response of Plates Containing
Flaws,**

M. Sansalone, and N. J. Carino. 1987, 13p

Included in Jnl. of Research of the National Bureau of
Standards, v92 n6 p369-381 Nov-Dec 87.

Keywords: *Plates, Impact, Echoes, Nondestructive
tests, Finite element analysis, Frequency response.

The finite element method was used to study the tran-
sient response to point impact of thick circular plates
containing disk-shaped flaws. The response was stud-

ied in both the time and the frequency domains, and
compared to the response obtained from a solid plate.
The effects on the response caused by changing the
diameter and depth of a flaw, the duration of the
impact, and the position where the response is calcu-
lated were determined. From the results of these pa-
rameter studies, conclusions were drawn which can be
used in planning and interpreting impact-echo labora-
tory and field test results.

701,543

PB88-152491

Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

**Cleavage, Dislocation Emission, and Shielding for
Cracks under General Loading.**

Final rept.,

I. H. Lin, and R. Thomson. 1985, 20p

Pub. in Acta Metallurgica 34, n2 p187-206 Feb 85.

Keywords: *Dislocations(Materials), *Cleavage,
Cracks(Fractures), Loads(Forces), Lattice parameters,
Reprints.

The purpose of the paper is to consider the conditions
for the existence of a cleavage crack in a lattice and its
response to all types of external loads when shielded
by neighboring dislocations. The theory will be con-
strained to cleavage on one plane and crack branching
is not permitted.

701,544

PB88-152509

Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

Dynamic Cleavage in Ductile Materials.

Final rept.,

I. H. Lin, and R. M. Thomson. 1986, 8p

Pub. in Jnl. of Materials Research 1, n1 p73-80 Jan/
Feb 86.

Keywords: *Ductile brittle transition, *Cleavage, Crack
propagation, Dislocations(Materials), Fracture prop-
erties, Velocity, Reprints.

Ductile materials are found to sustain brittle fracture
when the crack moves at high speed. The fact poses a
paradox under current theories of dislocation emis-
sion, because even at high velocities, these theories
predict ductile behavior. A theoretical treatment of
time dependent emission and cleavage is given which
predicts a critical velocity above which cleavage can
occur without emission. Estimates suggest that this ve-
locity is in the neighborhood of the sound velocity.

701,545

PB88-153069

Not available NTIS
National Bureau of Standards (NEL), Gaithersburg,
MD. Robot Systems Div.

Comparison between Two Theories of Plasticity.

Final rept.,

J. H. Chiou, J. D. Lee, and A. G. Erdman. 1986, 15p
Pub. in Computers and Structures 24, n1 p23-37 1986.

Keywords: *Plastic properties, Continuum mechanics,
Stresses, Strains, Theories, Comparison, Reprints,
*Plasticity, Elasticity, Constitutive equations.

Among numerous large strain elasto-plasticity theo-
ries, Green-Naghdi's theory and E.H. Lee's theory are
distinguished and distinctive. In Green-Naghdi's
theory, the Green-Lagrange strain tensor is decom-
posed into the elastic and the plastic parts. On the
other hand, E.H. Lee started with a decomposition of
the deformation gradient into a product of two parts:
elastic and plastic. In the case of simple tension, the
essential differences are found between these two
theories. In E.H. Lee's theory, the unloading curves are
parallel on the plots of Cauchy stress vs natural strain.
However, the parallel relation does not exist on the
plots of Piola-Kirchhoff stress vs Green-Lagrange
strain. In Green-Naghdi's theory, the results are re-
versed. The unloading curves are not parallel on the
plots of Cauchy stress vs natural strain, but parallel on
the plots of Piola-Kirchhoff stress vs Green-Lagrange
strain. The significance of the finding is further dis-
cussed.

701,546

PB88-153770

PC A07/MF A01
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil
Engineering.

**SEES (Strength Evaluation of Existing Structures):
An Expert System for the Strength Evaluation of
Existing Structural Members.**

Master's Thesis,

J. F. Peters. Jan 88, 139p NBS/GCR-87/538

Sponsored by National Bureau of Standards (NEL),
Gaithersburg, MD. Center for Building Technology.

Keywords: *Structural members, *Engineering, Con-
crete construction, Mechanical properties, Theses,
Strength, Tests, *Expert systems, *Knowledge based
systems, *Computer aided design, Computer applica-
tions.

The thesis is a report of the design and implementation
of the SEES expert system; a knowledge based
system for strength evaluation of existing structural
members. The expert system provides engineering
knowledge for in situ member evaluation compiled into
an interactive computer program to aid in the solution
of a characteristically uncertain engineering problem.
Not intended to replace engineers, the system's pur-
pose is twofold: provide engineering judgment in a
computer program, and attend to details that engi-
neers may let go unnoticed. The result of the study is a
generic engineering expert system control structure
readily expandable to at least seven other strength
evaluation problems and a prototype implementation
for reinforced concrete beams.

701,547

PB88-154604

Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

**Wide Plate Crack Arrest Tests: Instrumentation for
Dynamic Strain Measurements.**

Final rept.,

R. J. Fields, G. A. Danko, S. R. Low, and R. deWit.

1985, 6p

Sponsored by Department of Energy, Washington, DC.
Pub. in ASTM (American Society for Testing and Mate-
rials) Standardization News, p42-47 Oct 85.

Keywords: *Metal plates, *Steels,
*Cracking(Fracturing), Instruments,
Bridges(Structures), Tape recorders, Amplifiers, Test
equipment, Reprints.

A series of crack arrest tests on large (10 x 1 x 0.1 m)
steel plates is described. Special emphasis is placed
on the description of the relevant instrumentation,
strain gaging, and data collection systems. Circuit dia-
grams are given for the bridges and multichannel dy-
namic amplifiers that were constructed specifically for
this type of testing.

General

701,548

DE88001714

PC A02
National Bureau of Standards, Gaithersburg, MD.

**Recent Fission Cross Section Standards Measure-
ments.**

O. A. Wasson. 1985, 10p CONF-8511312-1

Contract AI01-86ER40275

15. international symposium on nuclear physics - nu-
clear fission, Gaussig, German D.R. 11 Nov 1985.
Paper copy only, copy does not permit microfiche pro-
duction.

Keywords: *Plutonium 239 Target, *Uranium 235
Target, *Uranium 238 Target, Californium 252, Cross
Sections, Fission, Gas Scintillation Detectors, Inte-
grals, Ionization Chambers, *Neutron Detectors, Neu-
tron Fluence, Neutron Reactions, Neutron Sources,
Nuclear Data Collections, Plastic Scintillation Detec-
tors, Proton Spectra, Spontaneous Fission, Standards,
ERDA/652020, ERDA/440103.

The sup 235 U(n,f) reaction is the standard by which
most neutron induced fission cross sections are deter-
mined. Most of these cross sections are derived from
relatively easy ratio measurements to sup 235 U. How-
ever, the more difficult sup 235 U(n,f) cross section
measurements require the use of advanced neutron
detectors for the determination of the incident neutron
fluence. Examples of recent standard cross section
measurements are discussed, various neutron detec-
tors are described, and the status of the sup 235 U(n,f)
cross section standard is assessed. 23 refs., 8 figs., 4
tabs. (ERA citation 13:006786)

701,549

PB87-149522

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Ceramics Div.

Model Line-Shape Analysis for the Ruby R Lines Used for Pressure Measurement.

Final rept.,

R. G. Munro, G. J. Piermarini, S. Block, and W. B. Holzapfel. 1985, 5p
Pub. in Jnl. of Applied Physics 57, n2 p165-169 1985.

Keywords: *Pressure measurement, *Ruby, Fluorescence, Line spectra, Reprints, High pressure, High temperature.

A model spectral lineshape is proposed for the R(1) and R(2) fluorescence lines of ruby. The objectives of the proposal are improvements in the accuracy, the reproducibility, and the standardization of pressure measurements using the ruby fluorescence technique. Other advantages, such as using the ruby method to higher temperatures and using the lineshape analysis to obtain a simultaneous measurement of pressure and temperature, are also achieved. Under nonhydrostatic conditions, quantitative estimates of pressure distributions can also be made.

701,550

PB87-149530

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Bremsstrahlung Energy Spectra from Electrons with Kinetic Energy 1 KeV-10 GeV Incident on Screened Nuclei and Orbital Electrons of Neutral Atoms with Z= 1-100.

Final rept.,

S. M. Seltzer, and M. J. Berger. 1986, 74p
See also DE81-030984. Sponsored by Department of Energy, Washington, DC., and Office of Naval Research, Arlington, VA.
Pub. in Atomic Data and Nuclear Data Tables 35, n3 p345-418 Nov 86.

Keywords: *Bremsstrahlung, Cross sections, Electron irradiation, Energy spectra.

A comprehensive set of bremsstrahlung cross sections (differential in the energy of the emitted photons) is tabulated. The set includes results for electrons with energies from 1 keV to 10 GeV incident on neutral atoms with atomic numbers $Z=1$ to 100. For bremsstrahlung in the Coulomb field of the atomic nucleus, use was made of (a) results of Pratt, Tseng, and collaborators based on numerical phase-shift calculations for the screened Coulomb potential at energies below 2 MeV; and (b) the analytical high-energy theory (with Coulomb corrections) of Davies, Bethe, Maximon, and Olsen at energies above 50 MeV, supplemented by the Elwert Coulomb correction factor and the theory of the high-frequency limit given by Jabbar and Pratt. In the high-energy region, the effect of screening was included by the use of Hartree-Fock atomic form factors. A numerical interpolation scheme, applied to suitably scaled cross sections, was used to bridge the gap between the low-energy and high-energy theoretical results, and thus to obtain improved cross sections in the intermediate-energy region 2 to 50 MeV. Bremsstrahlung in the field of the atomic electrons was calculated according to the theory of Haug, combined with screening corrections derived from Hartree-Fock incoherent scattering factors.

701,551

PB87-149555

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Current Density Monitor for Intense Relativistic Electron Beams.

Final rept.,

R. B. Fiorio, M. Raleigh, and S. M. Seltzer. 1986, 9p
Sponsored by Office of Naval Research, Arlington, VA., Defense Advanced Research Projects Agency, Arlington, VA., and Naval Sea Systems Command, Washington, DC.
Pub. in Review of Scientific Instruments 57, n10 p2462-2470 Oct 86.

Keywords: *Electron beams, *Current density, Electrical measurement, Monitors, Electron accelerators, Reprints, Relativistic range, High energy.

The authors describe a new type of electric probe which is capable of measuring the time-resolved current density profile of a stable, reproducible, high-energy (>4-MeV) high-current (>1-kA) electron

beam. The sensing element of the probe is an open-ended but capped-off 50-ohm coaxial line constructed of graphite. The graphite sensor is 4.3 mm in diameter, 6 cm long, and is range thin to the primary beam electrons. The probe produces a signal proportional to the intercepted beam current. When the sensor is scanned radially through the beam during repeated pulses, a curve of signal versus depth of insertion is produced from which the radial current density profile can be determined. Measurements are presented of the profile of the electron beam from the Experimental Test Accelerator (4.5 MeV, 10 kA) at Lawrence Livermore National Laboratory. In contrast to other systems it requires no radiation shielding, water cooling, or auxiliary support equipment to operate in an intense beam environment.

701,552

PB87-149571

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

General Expression for the Coulomb Interaction in the Presence of a Surface.

Final rept.,

S. P. Apell, and D. R. Penn. 1986, 15p
Pub. in Physical Review B 34, n10 p6612-6626, 15 Nov 86.

Keywords: *Coulomb interactions, Interfaces, Surfaces, Reprints, Coulomb potential, Coulomb field.

A general expression is presented for the Coulomb interaction between two test charges in the presence of an interface. The cases of planar and spherical geometry are considered. The potential is given for the two test particles outside, inside, or on either side of the interface, and appropriate limits are investigated.

701,553

PB87-151254

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.

Laser Cooling of Atomic Beams.

Final rept.,

H. Metcalf, and W. D. Phillips. 1985, 10p
See also PB86-190659. Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Comments At. Mol. Phys. 16, n2 p79-88 1985.

Keywords: *Atomic beams, Laser beams, Sodium, Reprints, *Laser cooling.

A thermal atomic beam may be decelerated and have its velocity distribution compressed through the action of a resonant, counterpropagating laser beam. A sodium beam with mean thermal velocity of 1000 m/s has been stopped, producing a 'gas' with a velocity spread of less than 20 m/s, equivalent to a temperature less than 1 K.

701,554

PB87-151262

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.

Laser-Cooled Atomic Beams.

Final rept.,

W. D. Phillips, J. V. Prodan, and H. J. Metcalf. 1984, 24p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in At. Phys. 9, p338-361 1984.

Keywords: *Atomic beams, Reviews, Reprints, *Laser cooling, Atom traps.

Atoms in a thermal beam can be cooled, decelerated, and stopped using the radiation pressure from a nearly resonant laser beam. Several groups have already used this laser cooling process on an atomic sodium beam. In the paper, the authors review the techniques and results of the various experimental groups, and discuss possible applications.

701,555

PB87-151353

PC A02/MF A01

National Bureau of Standards (NML), Gaithersburg, MD. Radiometric Physics Div.

Water Bath Black Body Operating Instructions.

J. B. Fowler, and B. J. Belzer. Dec 86, 21p NBSIR-86/3477

Keywords: *Laboratory equipment, *Blackbody radiation, *Radiometry, Temperature control, Thermistors, Instructions, Manuals.

This is an operating instruction manual for the water bath black body built in the Radiometric Physics Division, National Bureau of Standards.

701,556

PB87-151577

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Radiative Tail in High-Energy Electron Scattering.

Final rept.,

L. C. Maximon. 1984, 41p
Pub. in Arkiv for det Fysiske Seminar i Trondheim, Norway, n19 p1-41 1984.

Keywords: *Electron scattering, Bremsstrahlung, Reprints, Born approximation, High energy.

A single expression is derived for the cross section for the radiative tail from high energy electron scattering that satisfies not only the Born approximation, but the low energy theorem and the peaking approximation as well. The estimated errors in the final result are of relative order $(k/E)^2 \alpha Z$, where k is the energy of the emitted photon, E the incident electron energy, and Z the charge of the target nucleus.

701,557

PB87-151858

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.

Gamma-Ray Multipole Mixing Ratios Using Orientation: 166 Er.

Final rept.,

H. Marshak. 1985, 9p
Pub. in Hyperfine Interactions 22, n1-4 p413-421 Mar-May 85.

Keywords: Gamma rays, Reprints, *Erbium 166, *Mixing ratio, Nuclear orientation, Uncertainty.

The different methods for obtaining multipole mixing ratios and their uncertainties from nuclear orientation measurement are reviewed. Results using these methods are compared for some E2/M1 transitions in (¹⁶⁶Er).

701,558

PB87-151866

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.

Determining Multipole Mixing Ratios from Nuclear Orientation Experiments.

Final rept.,

H. Marshak, and C. H. Spiegelman. 1985, 13p
Pub. in Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment A234, n3 p455-467, 15 Feb 85.

Keywords: Confidence limits, Gamma rays, Least squares method, Distribution theory, *Mixing ratio, Erbium 166, Uncertainty, Nuclear orientation.

Statistical methods using weighted nonlinear least squares and noncentral distribution theory to obtain multipole mixing ratios and their uncertainties from nuclear orientation measurements are described. Results using these methods are compared with those obtained from methods currently in use.

701,559

PB87-152898

Not available NTIS

National Bureau of Standards (NEL), Gaithersburg, MD. Precision Engineering Div.

Scalar Charged Particle in the Lorentz Gauge.

Final rept.,

E. Marx. 1985, 5p
Pub. in International Jnl. of Theoretical Physics 24, n2 p217-221 Feb 85.

Keywords: Charged particles, Reprints, *Quantum electrodynamics, Quantum mechanics, Klein-Gordon equation, Sealers.

The specification of initial and final conditions in relativistic quantum mechanics leads to a perturbation expansion that was carried out in the Coulomb gauge. Nevertheless, a Lorentz gauge is more natural for a relativistically invariant theory, and the corresponding expansions for the interaction of one scalar particle with the electromagnetic field are developed here.

701,560

PB87-153649

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

PHYSICS

General

Innershell Ionization Cross Sections.

Final rept.,
C. J. Powell. 1985, 34p
Pub. in Electron Impact Ionization, Ch. 6, p198-231
1985.

Keywords: *Electron irradiation, *Inner-shell ionization, *Ionization cross sections.

A review is presented of cross-sections for the ionization of inner-shell electrons by electron impact. Calculations, measurements, and empirical formulas are described and compared. Recommendations are given for the selection of cross-section data. Finally, applications of inner-shell ionization cross-section data to materials analysis problems are described.

701,561
PB87-153722 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.

Extra Dimensions to Remove Singularities and Determine Fundamental Constants.

Final rept.,
A. R. P. Rau. 1985, 4p
Pub. in American Jnl. Physics 53, n12 p1183-1186 Dec 85.

Keywords: *Atomic structure, *Fundamental constants, Reprints, Compactification, Renormalization, One dimensional, High magnetic field research.

The structure of atoms in an intense magnetic field (one trillion gauss) is analyzed as a problem of 'compactification' of dimensions. The motion of the electrons is reduced effectively to one dimension, the dimensions transverse to the field direction being frozen at small values. The analysis shows how a reduction in dimensions accounts for the removal of seeming singularities in the structure of atoms and for the occurrence of what appear to be fundamental constants that govern this structure. Thereby this elementary problem of nonrelativistic quantum mechanics provides analogs of similar studies now being pursued in supergravity and other unified field theories.

701,562
PB87-157038 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Critical and 'Subcritical' Magnetic States of an Amorphous Rare Earth Spin Glass.
Final rept.,
J. J. Rhyne. May 85, 6p
Pub. in Physica B and C 130B+C, n1-3 p253-258 May 85.

Keywords: Rare earth alloys, Neutron scattering, Magnetic properties, Reprints, *Spin glass.

Small angle neutron scattering from amorphous TbFe₂ above the magnetization-determined T(sub c) = 409 K shows a conventional Lorentzian line shape with a spin correlation length which increases to only about 135 Å at T(sub c). Below T(sub c) the scattering is no longer Lorentzian but can be represented by a sum of Lorentzian and Lorentzian squared terms as predicted theoretically for a random anisotropy field amorphous magnet. Application of an external field in the range 2-12 kG at 295 K sharply suppresses the scattering reflecting an increase in the ferromagnetic component with field. The residual magnetic scattering exhibits a prolate distortion of the intensity with respect to the direction of H, with a marked reduction in the correlation length with field indicating a spin-cluster like response. From the magnitude of the distortion, an average number of spins per cluster as a function of field has been calculated using a super-paramagnet model.

701,563
PB87-157046 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.
Stopping Atoms with Laser Light.
Final rept.,
J. Prodan, A. Migdall, W. D. Phillips, I. So, H. Metcalf, and J. Dalibard. 1985, 4p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Physical Review Letters 54, n10 p992-995 1985.

Keywords: *Atomic beams, Reprints, *Sodium atoms, *Laser cooling, *Beam cooling, Laser trapping, Atom traps.

The authors have produced a sample of sodium at rest in the laboratory by decelerating atoms in an atomic

beam using momentum transfer from a counterpropagating, resonant laser beam. These atoms have a density of about 100,000/cc and a velocity spread of about 15 m/s FWHM corresponding to a kinetic temperature less than 100 mK.

701,564
PB87-157053 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.
Stopping Neutral Atoms Using Laser Light.
Final rept.,
J. V. Prodan, W. D. Phillips, H. J. Metcalf, and J. Dalibard. 1984, 2p
Sponsored by Office of Naval Research, Arlington, VA.
Pub. in Proceedings of International Quantum Electronics Conference (13th), Anaheim, CA., June 18-21, 1984, p90-91.

Keywords: *Atomic beams, *Sodium atoms, Laser cooling, Atom traps, Neutral beam sources, High resolution.

Using laser irradiation of an atomic sodium beam, the authors have produced a sample of neutral atoms with an average velocity near zero and a width of 30 m/s. This corresponds to a temperature of 1 K.

701,565
PB87-161527 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
High Accuracy in Physics.
Final rept.,
D. G. McDonald. 22 Aug 86, 1p
Pub. in Science 233, p829 22 Aug 86.

Keywords: *Accuracy, Time standards, Superconductivity, Measurement, Precision, Reprints, Josephson effect, Voltage.

Philip Abelson, in an Editorial in Science, reviews the National Research Council report 'Physics Through the 1990's' and says 'Of all the quantities in physics, time is by far the most accurately measured'. The present authors argue that the Josephson effect has comparable accuracy.

701,566
PB87-161535 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Hysteresis Losses in Fine Filament Internal-Tin Superconductors.
Final rept.,
R. B. Goldfarb, and J. W. Ekin. Sep 86, 4p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Cryogenics 26, p478-481 Aug-Sep 86.

Keywords: *Superconductors, *Hysteresis, Niobium intermetallics, Tin intermetallics, Reprints, *Niobium tin, AC losses.

Hysteresis losses were measured on a series of fine filament Nb₃Sn superconductors made by the internal-tin process. Hysteresis was measured as a function of filament diameter and interfilament separation using a vibrating sample magnetometer in transverse magnetic field. Losses were greater than expected from the critical state model that expresses loss as a function of filament diameter. Micrographs of the reacted wire cross-sections showed some interfilament bridging for all wires. This gave rise to effective filament diameters that were greater than actual diameters. The critical interfilament separation, above which the losses would be expected to follow the critical state model was determined.

701,567
PB87-161543 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Internal Fields in Magnetic Materials and Superconductors.
Final rept.,
R. B. Goldfarb. Nov 86, 2p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in Cryogenics 26, p621-622 Nov 86.

Keywords: *Superconductors, *Magnetization, Magnetic hysteresis, Demagnetization, Magnetic materials, Losses, Reprints, Magnetic susceptibility.

The paper reviews some of the concepts needed for the correct analysis of magnetization data, both for

magnetic materials and superconductors. Demagnetization factors, initial susceptibilities, and hysteresis losses are discussed.

701,568
PB87-163663 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Tuneable Resonances: Dielectronic Recombination.
Final rept.,
G. H. Dunn. 1986, 6p
Pub. in Resonance Effects in Electron-Ion Collisions, IPPJ-AM-47, p148-153 1986.

Keywords: Angular momentum, Electric fields, Reprints, *Dielectronic recombination, Tuneable resonances.

Dielectronic recombination (DR) has been shown both theoretically and experimentally to be strongly influenced by extrinsic electric fields-- it can be considered to be a process which is 'tuneable' by the fields. Measurements of cross sections for DR under conditions where fields are expected to play no role agree well with theory. Measurements of cross sections for DR under conditions where fields are expected to be important and where the fields are well defined and known agree reasonably well with theory. Measurements under conditions where fields should play a role, but the fields are poorly defined and unknown do not agree with theory when reasonable estimates are made of the fields. Collisions which mix angular momentum states may also 'tune' the cross sections, and the possibility needs further investigation.

701,569
PB87-163721 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Technology Div.
Quality Control of Measurements - Measurement Assurance.
Final rept.,
R. M. Judith. Jan 86, 3p
Pub. in Proceedings of the Institute of Electrical and Electronics Engineers 74, n1 p23-25 Jan 86.

Keywords: *Measurement, Quality control, Accuracy, Reprints, Traceability, Uncertainty, Calibration.

The ability to relate individual measurements to nationally accepted standards is a requirement of traceability. The paper discusses a perspective in which the goals of traceability are viewed in terms of performance requirements on measurement quality as reflected in a statement of uncertainty.

701,570
PB87-164091 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Generation of Squeezed States by Parametric Down Conversion.
Final rept.,
L. A. Wu, H. J. Kimble, J. L. Hall, and H. Wu. 17 Nov 86, 4p
Grant NSF-PHY86-04504
Sponsored by National Science Foundation, Washington, DC.
Pub. in Physical Review Letters 57, n20 p2520-2523, 17 Nov 86.

Keywords: *Electromagnetic fields, Reprints, Parametric oscillators, Squeezed states.

Squeezed states of the electromagnetic field are generated by degenerate parametric down conversion in an optical cavity. Noise reductions greater than 50% relative to the vacuum noise level are observed in a balanced homodyne detector. A quantitative comparison with theory suggests that the observed squeezing results from a field that in the absence of linear attenuation would be squeezed by greater than tenfold.

701,571
PB87-165767 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.
Impact of Quantized Hall Resistance on SI Electrical Units and Fundamental Constants.
Final rept.,
B. N. Taylor. 1985, 3p
Pub. in Metrologia 21, n1 p37-39 1985.

Keywords: *Fundamental constants, *Units of measurement, Reprints, *Quantum Hall effect, Ampere, Volt, Ohm, Fine structure constant.

With the discovery of the quantum Hall effect the SI units ampere, volt, and ohm may be realized with high accuracy by performing four fundamental constant determinations requiring only a consistent set of laboratory electrical units. Accurate values in SI units for most other constants, including the Avogadro and fine-structure constants, may also be obtained from the same measurements.

701,572

PB87-165791

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

International (235)U Fission Foil Mass Intercomparison.

Final rept.,

I. Schroder, D. M. Gilliam, A. D. Carlson, S. W.

Bright, and J. M. R. Hutchinson. 1986, 2p

Pub. in Transactions of the American Nuclear Society 35, p473-474 1986.

Keywords: *Uranium 235, *Mass, Alpha particles, Reprints, *Fission foil detectors, Interlaboratory comparisons.

Measurements were made of the mass of two U.S.S.R. fission foils at NBS. These foils are directly traceable to those used in precise measurements of the (235)U(n,f) cross section at 14 MeV neutron energy. The NBS measurements employed low geometry and 2 pi counting facilities. The results obtained are consistent with those obtained at Argonne National Laboratory and at the Khlopin Radium Institute, Leningrad, U.S.S.R.

701,573

PB87-165882

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.

Report on the New NBS (National Bureau of Standards) Determination of the Proton Gyromagnetic Ratio.

Final rept.,

E. R. Williams, G. R. Jones, J. S. Song, W. D.

Phillips, and P. T. Olsen. 1985, 5p

Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Instrumentation and Measurement 34, n2 p163-167 1985.

Keywords: *Fundamental constants, *Protons, Magnetic fields, Solenoids, Reprints, *Gyromagnetic ratio, Fine structure constant, Quantum electrodynamics.

The authors describe the proton gyromagnetic ratio in H₂O, gamma prime, sub P experiment now in progress at NBS, including a short description of the construction of a single layer precision solenoid; the test they employ when measuring the solenoid's dimensions by inductive technique; and their latest solenoid measurements. They also discuss the improvements over their last gamma prime, sub P determination.

701,574

PB87-166419

(Order as PB87-166401, PC A05/MF A01)

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Continuity of the Meter: The Redefinition of the Meter and the Speed of Visible Light.

D. A. Jennings, R. E. Drullinger, K. M. Evenson, C. R. Pollock, and J. S. Wells. 15 Sep 86, 6p

Included in Jnl. of Research of the National Bureau of Standards, v92 n1 p11-16 Jan-Feb 87.

Keywords: *Standards, Dimensional measurement, Helium neon lasers, *Light speed, Visible radiation, Iodine 127, Meter.

The product of the frequency and wavelength of the 11-5, R(127) transition of the 127I₂ yields a value for the speed of visible red light. The value of c, the most accurate ever measured for visible light, agrees with the value defined in the redefinition of the meter within the 30 error limits of the krypton length standard.

701,575

PB87-171724

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Tagged Photons: An Analysis of the Bremsstrahlung Cross Section.

Final rept.,

L. C. Maximon, A. de Miniaci, T. Aniel, and E. Ganz.

Mar 87, 64p

See also PB81-227837.

Pub. in Physics Reports 147, n4 p189-252 Mar 87.

Keywords: *Bremsstrahlung, *Differential cross sections, Reprints, Tagged photon method, Polarized beams, MeV range 10-100, MeV range 100-1000.

The authors consider in detail the differential cross sections for both polarized and unpolarized bremsstrahlung from electrons for angles and energies in the range of interest for a photon tagging system (50 MeV-1 GeV). They derive accurate high energy, small angle approximations to these cross sections. These approximations are then used to determine the maxima and minima of these cross sections as a function of the angles and energies of the final electron and photon and to evaluate them at the extrema.

701,576

PB87-173779

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Coherent Scattering of Low Energy Neutrinos from Macroscopic Objects.

Final rept.,

R. C. Casella. 1986, 2p

Pub. in Proceedings American Institute of Physics Conference on Intersections between Particle and Nuclear Physics, Lake Louise, Canada, May 26-31, 1986, p1040-1041.

Keywords: Antineutrinos, Crystals, *Antineutrino-nucleon interactions, *Neutrino-nucleon interactions, Neutral currents, Coherent scattering.

It is known since the work of Freedman that neutral-current scattering of neutrinos from the nucleons in a nucleus can be coherent, leading, for sufficiently long wavelengths, to cross sections which are proportional to the square of the nuclear baryon number. When extended to macroscopic objects containing N nuclei, it has recently been reported, on the one hand, that coherent cross sections proportional to N squared have been observed, and on the other, that coherence can occur only for wavelengths comparable to the sample size. The author found that coherent scattering can indeed occur on the scale of an entire crystal for incident neutrino wavelengths comparable to the inter-nuclear separation or less, but that the cross section remains linear in N. Hence coherence cannot explain the reported observation of a macroscopic force exerted on a crystal by reactor antineutrinos.

701,577

PB87-173787

Not available NTIS

National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Theory of Coherent Neutrino Scattering from Crystals.

Final rept.,

R. C. Casella. 1986, 9p

Pub. in II Nuovo Cimento 94 A, n1 p42-50 1986.

Keywords: Crystals, Reprints, *Antineutrino-nucleon interactions, *Neutrino-nucleon interactions, Coherent scattering, Neutral currents.

Recently, Weber has analyzed the scattering of (anti)neutrinos from a crystal, predicting that the neutrino-nuclear cross-section is multiplied by a coherence factor O(N squared), where N is the number of nuclei in the crystal. This leads to a macroscopic force on the crystal, for which he reports finding preliminary evidence using a fission reactor as a source of electron antineutrinos. Butler has since argued that a factor O(N squared) can enter only when the neutrino wavelength is comparable with the crystal dimension, indicating that coherence occurs only in this ultra-low-energy regime. The author considered the scattering from an ideal crystal of (anti)neutrinos with much smaller wave-lengths, comparable to the lattice spacing or considerably less, leading to coherent Bragg-Laue scattering, analogous to that of X-rays or thermal neutrons. In agreement with Butler, the author found that a coherence factor O(N squared) can occur only for neutrinos with ultra-long wave-lengths.

701,578

PB87-180915

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Polarized-Body Experiments and Equivalence Principles.

Final rept.,

W. T. Ni. 1986, 12p

Sponsored by National Science Foundation, Washington, DC.

Pub. in Proceedings of the Marcel Grossman Meeting on General Relativity (4th), p1335-1346 1986.

Keywords: *Nuclear spin, Nuclear magnetic resonance, Polarization, *Equivalence principle, Lithium 7.

Mass and spin (or helicity in the case of zero mass) are the two independent invariants characterizing irreducible representations of the Poincare group. Both electroweak and strong interactions are strongly polarization-dependent. If there are spin-dependent effects in gravitation, the Einstein Equivalence Principle (EEP) would be violated at a certain appropriate level. In the paper empirical foundations of the Einstein Equivalence Principle are examined. An improved Hughes-Drever experiment with (7)Li is reported. Polarized-Body Experiment can probe previously-untouched aspects of EEP. These macroscopic polarized experiments are also ideal to probe long-range or semi-long-range spin-spin interactions (arions, axions, etc.) in particle physics. Progress of two ongoing polarized-body experiments -- torsion-balance experiment and fluid-fiber experiments-- are reported.

701,579

PB87-181269

(Order as PB87-181251, PC A05/MF A01)

National Bureau of Standards, Gaithersburg, MD.

CODATA (Committee on Data for Science and Technology) Recommended Values of the Fundamental Physical Constants (1986).

E. R. Cohen, and B. N. Taylor. 14 Jan 87, 11p

Prepared in cooperation with Rockwell International, Thousand Oaks, CA. Science Center.

Included in Jnl. of Research of the National Bureau of Standards, v92 n2 p85-95 Mar-Apr 87.

Keywords: *Fundamental constants, Least squares method, Recommendations, CODATA.

The paper gives the values of the basic constants and conversion factors of physics and chemistry resulting from the 1986 least-squares adjustment of the fundamental physical constants as recently published by the CODATA Task Group on Fundamental Constants and as recommended for international use by CODATA. The new, 1986 CODATA set of recommended values replaces its predecessor published by the Task Group and recommended for international use by CODATA in 1973.

701,580

PB87-181707

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Photon Scattering by the Proton and Deuteron in the Delta-Region.

Final rept.,

K. P. Schelhaas, B. Ziegler, and E. Hayward. 1984,

4p

Pub. in Few Body Problems in Physics, p299-302 1984.

Keywords: Absorption cross sections, Coherent scattering, Dispersion relations, Reprints, *Photon-proton interactions, *Photon-deuteron interactions.

The available data on photon scattering in the delta-region by the proton and the deuteron have been studied in an attempt to relate these results to the corresponding photon absorption cross sections through the optical theorem and the dispersion relation.

701,581

PB87-183091

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Evidence for Free-Electron-Like Stoner Excitations in Fe.

Final rept.,

D. R. Penn. Feb 87, 4p

Sponsored by Office of Naval Research, Arlington, VA. Pub. in Physical Review B 35, n4 p1910-1913, 1 Feb 87.

Keywords: *Iron, Free electrons, Scattering, Reprints, *Stoner excitations, Electron spin polarization.

PHYSICS

General

An analysis of spin-polarized electron-energy-loss experiments in Fe is described which suggests that (1) free-electron-like Stoner excitations are far more probable than the usual type, and (2) exchange events involving relatively large energy losses are much more likely than direct scattering.

701,582

PB87-183109 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Neutron Optics.

Final rept.,
S. A. Werner, and A. G. Klein. 1986, 79p
Pub. in *Methods of Experimental Physics* 23, p259-337 1986.

Keywords: *Neutron diffraction, Crystals, *Neutron optics, Refractive index, Interferometry.

This is a review of recent advances in neutron optics. This chapter of the book contains the following subject areas: (1) The optical analogy and the refractive index; (2) Refraction and Reflection; (3) Diffraction from macroscopic objects; (4) Interference and interferometry; (5) Applications of neutron interferometry in fundamental physics; (6) Neutron optics in perfect crystals.

701,583

PB87-191151 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Critical Analysis of Soft X-ray Cross Section Data.
Final rept.,
E. B. Saloman, and J. H. Hubbell. 1987, 5p
Pub. in *Nuclear Instruments and Methods in Physics Research A* 255, p38-42 1987.

Keywords: *Photon cross sections, *X rays, Reprints, *Soft x radiation, EV range 100-1000, KeV range 01-10, KeV range 10-100, Photoabsorption.

A project is in progress in the National Bureau of Standards (NBS) Photon and Charged Particle Data Center to collect and evaluate photon cross section data in the X-ray region 100 eV to 100 keV. The project complements earlier NBS evaluations and compilations which focused primarily on energies above 10 keV. The NBS collection of experimental total attenuation coefficients (10 eV to above 10 GeV) abstracted from the literature is now computerized to facilitate use and for future updates. These experimental results have been compared systematically with a theoretical photoabsorption calculation by Scofield, and also with a semi-empirical compilation by Henke et al. Sample graphical comparisons of measured data with the Scofield theoretical results are presented here for silicon and uranium. Silicon data from an International Union of Crystallography project are also presented. Discrepancies and uncertainties in the various experimental data sets are typically 5 to 50% or more in the soft X-ray region. However, systematic trends can be seen which suggest that the Scofield theoretical values, taken as a whole, are not improved by the Hartree-Slater to Hartree-Fock renormalization in the photon energy region.

701,584

PB87-191177 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. ElectroSystems Div.

Common Parametrizations of Electron Transport, Collision Cross Section, and Dielectric Strength Data for Binary Gas Mixtures.

Final rept.,
R. J. Van Brunt. 1987, 15p
Sponsored by Department of Energy, Washington, DC. Div. of Electric Energy Systems.
Pub. in *Jnl. of Applied Physics* 61, n5 p1773-1787, 1 Mar 87.

Keywords: *Dielectric breakdown, *Dielectric properties, *Collision cross sections, Sulfur hexafluoride, Dichlorodifluoromethane, Halohydrocarbons, Sulfur fluorides, Nitrogen, Ionization, Reprints, Methane/dichloro-difluoro, Binary mixtures.

Previously used parametrizations of dielectric strengths (electrical breakdown data) for gas mixtures in terms of electron collision and transport parameters are reviewed. A new method of fitting experimental data on dielectric strengths for binary electronegative gas mixtures is proposed, based upon the principal assumption that the electron kinetic energy distributions in the gas are Maxwellian. The method provides physical insight into such behavior as pressure-dependent

or pressure-independent synergisms, and is useful in checking the consistency between dielectric strength data and available information on electron transport and ionization, attachment, and momentum transfer collision cross sections. The method is applied here to the mixtures SF₆/N₂, CCl₂F₂/N₂, and SF₆/CCl₂F₂.

701,585

PB87-191193 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Comment on 'Muon-Alpha-Particle Sticking Probability in Muon-Catalyzed Fusion'.

Final rept.,
M. Danos, B. Muller, and J. Rafelski. Mar 87, 3p
Sponsored by Department of Energy, Washington, DC. Pub. in *Physical Review A* 35, n6 p2741-2743, 15 Mar 87.

Keywords: Nuclear fusion, Three body problem, Reprints, *Muon-catalyzed fusion, Muonic molecules.

Ceperley and Alder recently reported (*Phys. Rev. A* 31, 1999 (1985)) a calculation of the muon sticking probability using three-body Coulomb wave functions of the dt(muon) muomolecule. The authors comment here that such calculations require, in addition, the incorporation of the interplay of the nuclear reaction dynamics with the Coulomb problem.

701,586

PB87-191201 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Detuning Reduction of Muon Sticking in Resonant Muon-Catalyzed d-t Fusion.

Final rept.,
M. Danos, B. Muller, and J. Rafelski. Nov 86, 4p
Sponsored by Department of Energy, Washington, DC. Pub. in *Physical Review A* 34, n5 p3642-3645 Nov 86.

Keywords: *Fusion reactions, Tritium, Deuterium, Reprints, *Muon-catalyzed fusion.

The nuclear fusion reaction in the (dt muon) (1+) molecule is affected by the presence of the muon in the relatively loosely bound mesomolecular orbit. Due to the sharing of the available energy between the muon and the nuclei in the final state, a muon attached to the recoiling alpha particle reduces the energy available to the nuclear fusion reaction by about 90 + or - 50 keV and thus detunes the resonant d-t reaction amplitude by an important factor.

701,587

PB87-197703 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.

Triplet P(sub 1) - triplet P(sub 2) Magnetic-Dipole Transition in the Ground Configuration of Co XX.

Final rept.,
R. U. Datla, J. R. Roberts, and W. L. Rowan. 1987, 2p
Contracts DOE-EA-77-A-01-6010, DE-AC05-78ET53043

Sponsored by Department of Energy, Washington, DC. Office of Energy Research.
Pub. in *Jnl. of the Optical Society of America B* 4, n3 p428-429 Mar 87.

Keywords: *Cobalt, *Electron transitions, Magnetic dipoles, Emission spectra, Reprints, *Plasma, Forbidden transitions, TEXT devices, Tokamak devices.

The magnetic-dipole transition between the triplet P₁ and triplet P₂ levels of 2s(2)2p(4) ground configuration in Co XX has been identified from the emission of a cobalt-seeded plasma in the Texas Experimental Tokamak. The wavelength for the transition is 930.2 + or - 0.3 Å.

701,588

PB87-197711 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.

Development of a Standard 2.5-MeV Neutron Source.

Final rept.,
K. C. Duvall. 1987, 4p
Pub. in *Nuclear Instruments and Methods in Physics Research B* 24/25, p893-896 1987.

Keywords: *Neutron sources, Deuteron reactions, Neutron reactions, Calibrating, Standards, Reprints, US NBS, Neutron detection, MeV range 01-10.

The use of radiation for industrial purposes requires that the radiation measurement be reliable and accurate. The reliability of measurement may be verified by comparison measurements in standard radiation fields. Standard radiation sources produce stable, well-characterized reference radiation fields, which are determined with a high degree of accuracy. A 2.5-MeV neutron source produced with a low voltage ion generator and the D(d,n)(3)He reaction, is being developed at the National Bureau of Standards (NBS) for use as a standard radiation source. The source emission rate is stable within a well-defined neutron beam and determined by time-correlated associated-particle (TCAP) measurement. The measurement accuracy is expected to be comparable to that obtained in thermal and 14-MeV reference neutron fields. A standard 2.5-MeV neutron reference field could provide a means of establishing the 2.5-MeV spot energy as an intermediate energy normalization point.

701,589

PB87-198081 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.

Helium Condensation Observed in Small Angle Neutron Scattering.

Final rept.,
J. W. Lynn. 1986, 3p
Pub. in *Physica* 136B, p117-119 1986.

Keywords: *Helium, *Condensing, Phase transformations, Polycrystals, Powder(Particles), Ingots, Conduction, Reprints, Small angle neutron scattering.

Small angle neutron scattering (SANS) experiments have been carried out at low temperatures on powdered samples and polycrystalline ingots. A phase transition is observed in which the helium in the sample canister, used for thermal conduction purposes, condenses on the powder particles causing a large decrease in the width of the metallurgical SANS scattering. The phase transition (at constant volume) appears to be continuous and reversible.

701,590

PB87-201794 PC A03/MF A01
National Bureau of Standards, Gaithersburg, MD.

Model for the Nuclear Effects of the d-t-muon Fusing State.

M. Danos, L. C. Biedenharn, and A. A. Stahlhofen.
Apr 87, 26p NBSIR-87/3532
Prepared in cooperation with Duke Univ., Durham, NC. Dept. of Physics.

Keywords: Nuclear models, Mathematical models, Deuteron reactions, Tritons, Muon-catalyzed fusion.

A simple model is constructed which is used to illustrate the interplay between the strong nuclear forces and the Coulomb molecular forces in the description of the resonant d-t-muon fusion process.

701,591

PB87-203733 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Inorganic Analytical Research Div.

Production of Porous Glass Microspheres by the Nuclear Track Technique.

Final rept.,
B. S. Carpenter, C. Horvath, and C. R. Vogt. 1986, 5p
Pub. in *Nucl. Tracks Radiat. Meas.* 11, n6 p289-293 1986.

Keywords: Cellular glass, Porous materials, Uranium 235, Etching, Reprints, *Microspheres, Fission tracks, Nuclear track technique.

The nuclear track technique (NTT) used to produce porous glass microspheres. The nuclear tracks randomly penetrate the material so that the resultant pores are interconnected. The result of the process is the creation of latest radiation-damaged regions by the charged particles emitted from the neutron-induced fissioning of (235)U, an isotope of uranium which in trace quantities either naturally occurs in or surrounds the microspheres. The damaged regions, or 'tracks' are then enlarged to optically visible tracks with the aid of a light microscope by chemically etching the material. The number of tracks or pores created both at the surface and within the microsphere is dependent upon the neutron fluence used to induce the fission of (235)U provided that the bulk uranium is constant in the microspheres. Pore diameter is determined by the

concentration of the etching solution and the etching time.

701,592
PB87-203832 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Asymmetries in Spectral Lines Due to Plasma-Ion Broadening: Some Unusual Cases and a Possible Test for Plasma Homogeneity.
Final rept.,
D. W. Jones, G. Pichler, and W. L. Wiese. 1987, 6p
Pub. in *Physical Review A* 35, n6 p2585-2590, 15 Mar 87.

Keywords: *Argon, *Nitrogen, *Spectral lines, Plasmas(Physics), Reprints, *Line broadening.

The authors have measured the profiles of plasma-broadened and slightly red-or blue-shifted spectral lines of neutral argon and nitrogen in a wall-stabilized arc and have performed a detailed line-shape analysis with a computerized data acquisition and processing system. According to Stark broadening theory, isolated lines of neutral atoms in dense plasmas are mostly broadened by electron impact resulting in symmetrical Lorentzian profiles, and are also broadened by the plasma ions, which produce a small additional contribution to the width as well as asymmetries in the line profile. As in two earlier experimental studies, the authors have used the difference in symmetries to study the effects of ion broadening. In the paper they have extended their work to some unusual cases where lines exhibit relatively rare 'blue' shifts and where they study spectral transitions which are appreciably broadened because they originate from high-lying atomic levels. The authors have also used the asymmetries for a check on plasma homogeneity.

701,593
PB87-203931 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Energy Deposition by Electron, Bremsstrahlung, and (60) Co Gamma-Ray Beams in Multi-Layer Media.
Final rept.,
S. M. Seltzer, and M. J. Berger. 1987, 16p
Pub. in *Appl. Radiat. Isot.* 38, n5 p349-364 1987.

Keywords: *Electron beams, *Gamma rays, *Bremsstrahlung, Monte Carlo method, Diffusion, Laminates, Penetration, Cobalt 60, Reprints, *Photon beams, *Energy absorption, ZTRAN computer program, Depth dose distributions.

The paper presents illustrative applications of the Monte Carlo code ZTRAN, which treats the penetration and diffusion of electrons and photons in targets consisting of multiple layers of different materials. The program, developed for one-dimensional geometry, is applicable to incident electron beams or photon beams, and takes into account all generations of the resulting electron-photon cascade. The Monte Carlo model is the same as that used previously in the ETRAN code for homogeneous media. The output of the program includes information about transmitted and reflected radiation, the spatial distribution of deposited energy and charge, and the energy spectrum of the radiation flux within the target. Results obtained with ZTRAN are presented for energy deposition in multi-layer targets irradiated with electron beams with energies from 0.4 to 60 MeV, by bremsstrahlung beams with end-point energies from 2 to 10 MeV, and by a (60)Co gamma-ray beam. Various comparisons indicate good agreement with experimental results.

701,594
PB87-218343 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Electricity Div.
Cooling Atoms with a Frequency Chirped Laser.
Final rept.,
W. D. Phillips, and J. V. Prodan. 1984, 8p
Sponsored by Office of Naval Research, Arlington, VA. Pub. in *Coherence Quantum Opt.* 5, p15-22 1984.

Keywords: Atomic beams, Laser beams, Reprints, *Laser cooling, *Beam cooling, *Sodium atoms, High resolution.

The authors have used a counterpropagating, near resonant laser beam to decelerate a beam of neutral sodium atoms. The frequency of the laser was scanned rapidly to compensate for the changing Doppler shift of the decelerating atoms.

701,595
PB87-219184 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Electron-Impact Excitation of Ti X.
Final rept.,
R. U. Datla, J. R. Roberts, and J. B. Mann. 1987, 6p
Contract DOE-EA-77-A-01-6010
Sponsored by Department of Energy, Washington, DC. Pub. in *Physical Review A* 35, n9 p3849-3854, 1 May 87.

Keywords: Spectral lines, Excitation, Electron irradiation, Reprints, *Titanium ions, Theta pinch.

The absolute intensities of TiX spectral lines emitted from a theta-pinch plasma are measured with a 2.2-m grazing-incidence monochromator which is calibrated in situ by using the branching-ratio technique. An electron temperature of 50 eV and an electron density of 2.2×10^{16} to the 16th power/cc of the plasma are determined from the laser scattering. The measured ratios of line intensities are compared with predictions based on the corona model using the excitation rates calculated by a distorted-wave method. It is shown that such a comparison is possible even for line intensities affected by self-absorption provided their optical depth corrections cancel in the ratio. The experimental uncertainty in the measured ratios is estimated to be + or - 30%. The results show good agreement between experiment and predictions.

701,596
PB87-219192 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
Magnetic-Dipole Wavelength Measurements in the n=3 Configurations of Highly Ionized Cu, Zn, Ga, As, Kr, and Y.
Final rept.,
J. R. Roberts, T. L. Pittman, J. Sugar, V. Kaufman, and W. L. Rowan. 1987, 5p
Contracts DOE-EA-77-A-01-6010, DE-AC04-78ET53043
Sponsored by Department of Energy, Washington, DC. Pub. in *Physical Review A* 35, n6 p2591-2595, 15 Mar 87.

Keywords: *Electron transitions, Magnetic dipoles, Spectral lines, Wavelengths, Reprints, *Copper ions, *Zinc ions, *Gallium ions, *Arsenic ions, *Krypton ions, *Yttrium ions, Isoelectronic atoms, Tokamak devices.

Magnetic dipole (M1) transitions between the levels of the ground configurations in the 3s(2)3p(x) Al-like through Cl-like and the 3s 3p Mg-like isoelectronic sequences of Cu, Zn, Ga, As, Kr, and Y have been observed. These elements were introduced into the Texas experimental Tokamak plasma by laser ablation of metallic thin films and gas puffing. The spectral lines were recorded by using three monochromators with photoelectric detection and a spectrometer with a channel electron multiplier array detector. Twenty-eight newly observed M1 lines were measured and classified.

701,597
PB87-224127 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Multi-Particle Accelerator for Neutron and High-LET Radiation Research.
Final rept.,
R. G. Johnson. 1987, 7p
Pub. in *Proceedings of Advisory Group Meeting on Properties of Neutron Sources*, Leningrad, USSR, June 9-13, 1986, p29-35 1987.

Keywords: *Linear accelerators, Electron accelerators, Proton accelerators, Ion accelerators, Deuterons, Neutron beams.

The staff of the Center for Radiation Research of the National Bureau of Standards (NBS) has recently analyzed the neutron and high-LET radiation research program at NBS. From this study it was recommended that a full design study of a linear induction accelerator as a possible replacement for the present electron linac be performed. The paper is an updated report on the preliminary study on which that recommendation was based. The accelerator was designed to accelerate up to 250 A of electrons to 100 MeV with a pulse structure of 100-ns maximum length at repetition rates up to 1000 Hz. Because of the versatility of induction

linacs, protons and other light ions can also be accelerated with currents limited only by space charge effects. The design includes provision for accelerating protons and deuterons at maximum currents of 2.5 A and 1.2 A, respectively. This accelerator would be a powerful and versatile tool for neutron and high-LET radiation research. Both continuous and quasi-monochromatic beams of neutrons would be available and the light ions could be used directly.

701,598
PB87-227096 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Mfg. Engineering.
Electromagnetic Scattering by a Thick Strip on a Half-Space.
Final rept.,
E. Marz. Jun 87, 74p NBS/TN-1236
Also available from Supt. of Docs as SN003-003-02808-8.

Keywords: *Electromagnetic scattering, *Light scattering, Dielectrics, Integral equations, Numerical solution, Computer applications.

The problem of the determination of the scattered fields from an incident plane monochromatic electromagnetic wave on a strip of finite thickness on a half-space is reduced to the numerical solution of integral equations for auxiliary fields defined on the interfaces. These fields are chosen so as to minimize their number. The derivation of the integral equations is given for a perfectly conducting strip on a perfectly conducting half-space, for a dielectric (or other homogeneous material) on a dielectric half space, and for a dielectric strip on a half-space of a different dielectric material. The vector FORTRAN programs written to carry out these calculations are briefly described, and sample outputs are shown.

701,599
PB87-227369 PC A02
Rockwell International, Thousand Oaks, CA. Science Center.
Fundamental Physical Constants: 1986 CODATA Recommended Values.
E. R. Cohen, and B. N. Taylor. Jul 87, 2p NBS/SP-731
Supersedes COM74-51190. Prepared in cooperation with National Bureau of Standards (NML), Gaithersburg, MD. Office of Standard Reference Data.

Keywords: *Fundamental constants, Physical properties, International system of units.

The data tabulated here are abstracted from the report of the CODATA Task Group on Fundamental Constants (CODATA Bulletin No 63, November, 1986). Digits in parentheses represent one standard deviation uncertainty in the final digits of the given value, based on a least-squares analysis with five variables and 17 degrees of freedom. These values are recommended for general use by CODATA (the Committee on Data for Science and Technology of the International Council of Scientific Unions, 51 Blvd de Montmorency, 75016 Paris, France).

701,600
PB87-230835 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Regularities of Negative-Ion Resonances.
Final rept.,
C. W. Clark, and S. J. Buckman. 1987, 6p
Pub. in *Jnl. of the Optical Society of America B* 4, n5 p815-820 May 87.

Keywords: Reprints, *Sodium ions, *Ion resonances, Electron-atom collisions.

Some regularities of doubly excited negative-ion resonances can be identified by comparison of properties along isoelectronic sequences. The authors discuss in particular the b and c resonances of Ne(1-) and their analogs in neighboring elements, for which a variety of experimental and theoretical data are available. The analysis shows that the 'grandparent' model of these resonances provides an appropriate angular-momentum coupling scheme but that some essential dynamical features are not associated with distinctive properties of an excited electron pair.

701,601
PB87-230843 Not available NTIS

PHYSICS

General

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Large-Angle Superelastic Electron Scattering from Na(3P).

Final rept.,
J. J. McClelland, M. H. Kelley, and R. J. Celotta.
1987, 4p

Sponsored by Department of Energy, Washington, DC.
Pub. in Jnl. of Physics B: Atomic and Molecular Physics 20, pL385-L388 1987.

Keywords: *Electron scattering, Elastic scattering, Orientation, Angular momentum, Momentum transfer, Reprints, *Electron-atom collisions, *Sodium atoms, Ev range 01-10.

Measurements of superelastic scattering of 2 eV electrons from oriented Na(3P) atoms have been carried out over the angular range 10 to 120 deg. Results are presented in terms of L perpendicular, the angular momentum transferred perpendicular to the scattering plane. Comparison is made with previous experiments at small angles, and with close-coupling calculations. Good agreement is seen with the earlier experimental work, but significant disagreement is seen with theory at angles beyond 40 deg.

701,602

PB87-230850

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Spin-Orbit and Exchange Effects in Elastic Scattering of Spin-Polarized Electrons from Spin-Polarized Na Atoms.

Final rept.,
J. J. McClelland, M. H. Kelley, and R. J. Celotta.
1987, 3p

Sponsored by Department of Energy, Washington, DC.
Pub. in Physical Review Letters 58, n21 p2198-2200, 25 May 87.

Keywords: *Spin orbit interactions, Elastic scattering, Polarization(Spin alignment), Reprints, *Electron-atom collisions, *Sodium atoms, Electron spin polarization, Spin orientation, Exchange interactions.

The authors report the first measurements of elastic scattering of spin-polarized electrons from spin-polarized Na atoms as a function of scattering angle. The incident energy is 54.4 eV, and the angular range is 20 deg-135 deg. Data are presented as an exchange asymmetry and a spin-orbit asymmetry. Each asymmetry has a magnitude of 3% to 4%, indicating that both the exchange and spin-orbit interactions must be taken into account to predict their experimental results.

701,603

PB87-230892

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

High Resolution X-ray Experiments.

Final rept.,
R. D. Deslattes. 1987, 7p

Pub. in Nuclear Instruments and Methods in Physics Research B24/25, p52-58 1987.

Keywords: *X ray spectra, Reprints, Heavy ions, High resolution.

Accelerators provide highly charged ions for a variety of experimental studies. In applications involving accurate high resolution spectroscopy, care is needed to keep Doppler corrections manageable and reduce satellite problems. Some aspects of the motivation for such work are reviewed, along with techniques for trying to produce clean spectra.

701,604

PB87-230900

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.

Multivacancy Effects in Atomic and Molecular Spectra.

Final rept.,
R. D. Deslattes. 1986, 8p

Pub. in Australian Jnl. of Physics 39, p845-852 1986.

Keywords: *X ray spectra, Molecular structure, Emission spectra, Argon, Reprints.

Chemical applications of X-ray spectra are inhibited by the general occurrence of multivacancy processes. These manifest themselves in emission spectra as extra lines (or satellites) while opening of channels to these initial configurations leads to extra detail in absorption spectra.

While there are a few simple cases where this situation has been more or less fully discussed, the more interesting areas are those which are both not simple and not understood. There is, however, a fairly general experimental procedure by which this complex situation could, in principle, be clarified. This involves carrying out high resolution emission spectroscopy as a function of exciting photon energy in regions containing both single and multiple vacancy thresholds. In earlier work summarized here, it was possible to demonstrate the procedure for a monatomic gas, argon. Subsequently, the authors have built and now operate a beamline designed specifically for such studies at the National Synchrotron Light Source (NSLS) in Brookhaven. Very recent results from this line and from a few experiments using conventional sources are summarized.

701,605

PB87-231437

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Microwave Cherenkov Radiation as a Diffraction Phenomenon.

Final rept.,
X. K. Maruyama, F. R. Buskirk, and J. R. Neighbours.
1987, 4p

Pub. in Nuclear Instruments and Methods in Physics Research B24/25, p921-924 1987.

Keywords: *Cherenkov radiation, *Diffraction, Microwaves, Reprints.

Cherenkov radiation results when the velocity of a charge particle exceeds the phase velocity of light in a medium. The wave front moves in a direction given by the Cherenkov angle (θ) with respect to the direction of the moving charge. The appearance of the well defined Cherenkov cone is a consequence of the assumption of an interaction length which is infinite when compared to the wavelength of the radiation observed. When the interaction region of the charged particle with the medium is finite, the Cherenkov radiation pattern is modified by diffraction. This condition is readily attained for microwave wavelengths. Microwave Cherenkov radiation in air has been observed to exhibit the diffraction characteristic. Coherence of radiation emitted from all the electrons in a micropulse of an rf linac has also been observed. For electron bunches periodic in time with frequency (ν sub 0), radiation is emitted at (ν sub 0) and harmonics thereof, in contrast to the continuous frequency distribution observed for a single charge. These and additional consequences of a finite interaction length are discussed.

701,606

PB87-231445

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Cherenkov and Sub-Cherenkov Radiation from a Charged Particle Beam.

Final rept.,
J. R. Neighbours, F. R. Buskirk, and X. K. Maruyama.
1987, 8p

See also AD-A180 612. Sponsored by Naval Sea Systems Command, Washington, DC., Naval Surface Weapons Center, Silver Spring, MD., and Defense Advanced Research Projects Agency, Arlington, VA.
Pub. in Jnl. of Applied Physics 61, n8 p2748, 15 Apr 87.

Keywords: *Cherenkov radiation, Electron beams, Charged particles, Reprints.

As a consequence of the relaxation of the phasing condition between the moving charge and radiated wave for finite beam path lengths, the Cherenkov peak is broadened and the threshold energy is lowered. A criterion for the threshold energy is developed which is applicable to charged beams consisting of a single charge bunch of finite size, as well as beams consisting of periodically repeated bunches.

701,607

PB87-231452

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Electromagnetic Excitation of the Delta Resonance in Nuclei.

Final rept.,
J. S. O'Connell, W. R. Dodge, J. W. Lightbody, and X. K. Maruyama. 1987, 9p

Pub. in Physical Review C 35, n3 p1063-1071 Mar 87.

Keywords: Electron scattering, Excitation, Nuclei(Nuclear physics), Reprints, *Delta resonances.

Inclusive cross sections for the proton and nuclear targets of A=4, 9, 12, and 16 were measured for 537 and 730 MeV electrons scattered at 37.1 deg. Systematic features of the continuum scattering data are compared with other electron scattering data and with photoabsorption measurements. A model calculation based on the isobar-hole formalism is compared with the data in the delta resonance region.

701,608

PB87-231460

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Possible Signature for and Early Hadronization Mechanisms of Quark-Gluon Plasma.

Final rept.,
J. Rafelski, and M. Danos. 1987, 5p
Pub. in Physics Letters B 192, n3/4 p432-436, 2 Jul 87.

Keywords: *Quarks, Reprints, *Gluons, Hadrons, Branching ratio, Particle production.

The authors consider the ratio of particle abundances radiated from quark-gluon plasma above mean thermal energy, and point out significant differences expected as compared with global particle yields. Two microscopic processes leading to medium to high E abundances are quantitatively considered, and the means of determining the plasma baryochemical potential are discussed. Strong anomalies in strange antibaryon spectra are found characteristic of the formation of quark-gluon plasma.

701,609

PB87-231478

Not available NTIS

National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Effect of a Thin Conducting Sheet on the Fields of a Buried Magnetic Dipole.

Final rept.,
D. A. Hill. 1987, 9p
Sponsored by Bureau of Mines, Washington, DC.
Pub. in Electromagnetics 7, p71-79 1987.

Keywords: *Magnetic dipoles, Mines(Excavations), Magnetic fields, Reprints, Underground communication, Buried objects, Half space.

The effect of a thin conducting sheet on the fields of a subsurface vertical magnetic dipole has been analyzed. The integral representation of the fields has been evaluated numerically, and numerical results for the vertical magnetic field above the source at the surface are presented in parametric form. It is found that the predicted fields give better agreement with previous transmission measurements than do the fields of a homogeneous half-space model.

701,610

PB87-233391

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Electron-Ion Collisions: Dielectronic Recombination and Ionization.

Final rept.,
A. Muller, G. H. Dunn, D. W. Mueller, N. Djuric, B. D. DePaola, D. S. Belic, C. Timmer, K. Tinschert, C. Achenbach, G. Hofmann, R. Sauer, E. Salzborn, and R. Becker. 1987, 11p
Sponsored by Department of Energy, Washington, DC.
Pub. in Nuclear Instruments and Methods in Physics Research B23, p254-264 1987.

Keywords: Ionization, Reprints, *Electron-ion collisions, *Dielectronic recombination, Colliding beams, Magnesium ions, Krypton ions.

Inelastic electron-ion collisions have been studied by using crossed-beam techniques. The effects of state mixing by extrinsic fields in the collision region were investigated for the dielectronic recombination process $Mg(1+(3s)+e \rightarrow Mg(3p, nl) \rightarrow Mg(3s, nl)+h\nu)$. By field ionization of the Rydberg atoms produced, cross sections $\sigma(n)$ have been measured. The observed large changes of $\sigma(n)$ with alteration of the extrinsic field provided the first incontrovertible experimental evidence that dielectronic recombination can be changed by external fields. Absolute cross sections for electron impact single, double and triple ionization of singly and multiply charged krypton ions were measured. Contributions of inner-shell ionization with subsequent autoionization to double and triple ionization are identified.

701,611

PB87-233482

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Surface Science Div.

Harmonic Rejection Scheme for X-ray Monochromators.

Final rept.,

T. Jach, J. P. Kirkland, P. Wolf, and R. Neiser. 1987, 4p

Contracts N00014-85-C-2628, N00014-86-K-2004

Sponsored by Naval Research Lab., Washington, DC. Pub. in Nuclear Instruments and Methods in Physics Research A257, p443-446 1987.

Keywords: Reprints, *Harmonics, *X ray diffraction, Monochromators.

X-ray monochromators based on the diffraction of the radiation from crystals suffer from the fact that higher orders of diffraction are always possible. The authors have implemented a scheme for a double-crystal monochromator used with synchrotron radiation which eliminates the problem to a selectable degree. Using two detectors with different sensitivities to the fundamental and harmonic radiation in the second crystal as feedback loop, the authors are able to discriminate against the harmonic radiation, even while scanning the monochromator in energy.

701,612

PB87-233920

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

Relations between Electron-Molecule Scattering and Swarm Experiments and Analysis.

Final rept.,

A. V. Phelps. 1985, 15p

Pub. in Swarm Studies and Inelastic Electron-Molecule Collisions, p127-141 1985.

Keywords: *Collision cross sections, Momentum transfer, Elastic scattering, Inelastic scattering, Reprints, *Electron-molecule collisions.

The purposes of the paper are to review the basic relations between electron-molecule collision cross sections and electron transport and reaction coefficients, and to summarize the current state of research in the area of the determination of cross sections from swarm data.

701,613

PB87-233961

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.

New Test of General Relativity: Measurement of de Sitter Geodetic Precession Rate for Lunar Perigee.

Final rept.,

B. Bertotti, I. Ciufolini, and P. L. Bender. 16 Mar 87, 4p

Pub. in Physical Review Letters 58, n11 p1062-1065, 16 Mar 87.

Keywords: *General relativity, Precession, Tests, Reprints, *Lunar range finding, *Lunar orbits, Very long base interferometry, Perigees.

According to general relativity, the calculated rate of motion of lunar perigee should include a contribution of 19.2 msec/yr from geodetic precession. The authors show that existing analyses of lunar-laser-ranging data confirm the general-relativistic rate for geodetic precession with respect to the planetary dynamical frame. In addition, the comparison of Earth-rotation results from lunar laser ranging and from very long-baseline interferometry (VLBI) shows that the relative drift of the planetary dynamical frame and the extragalactic VLBI reference frame is small. The estimated accuracy is about 10%.

701,614

PB87-234068

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.

Glueball and Meson Spectroscopy.

Final rept.,

S. Meshkov. 1986, 15p

Sponsored by National Science Foundation, Washington, DC.

Pub. in Proceedings of Aspen Winter Particle Physics Conference (2nd), Aspen, CO., January 12-18, 1986, p87-101.

Keywords: Reviews, *Glueballs, *Meson spectroscopy, Flavor model.

The status of various glueball properties such as level ordering and mass predictions is reviewed and updated. The $0(-+)$ and $2(++)$ systems of mesons and glueball candidates are discussed in detail, using the latest data, with the primary goal of deciding which of them might be considered as glueballs. The best candidates, at present, are the $g(T)(2050)$, $g(T')(2050)$, and $g(T \text{ double prime})(2350)$ $2(++)$ $\phi\phi$ resonances. That they are flavor singlets must, however, be verified via the detection of other decay modes and the subsequent comparison of their branching ratios.

701,615

PB88-100706

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Temperature and Pressure Div.

Nuclear Orientation Thermometry.

Final rept.,

H. Marshak. 1986, 52p

See also report dated Feb 83, PB84-115831.

Pub. in Low-Temperature Nuclear Orientation, Chapter 16, p769-820 1986.

Keywords: *Temperature measurement, Low temperature research, Nitric oxide, Gamma rays, Reprints, *Nuclear orientation thermometer, *Gamma ray anisotropy thermometry.

The authors have reviewed the current state of NO thermometry and have described the most frequently used thermometers in considerable detail. Techniques of preparation and criteria for choice (i.e., temperature range, gamma-ray energy, radioactive heating, and magnetic field requirements) have been summarized. It is clear that measurement of temperature accurate to 1-2% is relatively straightforward, while improving precision to approx. 0.1% demands great attention to experimental detail. Although most of the NO thermometers presently used operate in a rather limited temperature range (approx. 1 to approx. 100 mK), new thermometers are being investigated to extend the range to both higher and lower temperatures. Rare-earth systems (e.g., $^{166}\text{mHoHo}(\text{hcp})$), with their strong magnetic interactions should be useful up to approx. 1 K, whereas systems with either weak magnetic (e.g. BF NO thermometers, see ch. 9) or pure electric QI (e.g. $^{190}\text{IrRe}(\text{hcp})$) should be useful to approx. 0.1 mK. The authors have seen the spread of NO thermometers to experiments in the wider low-temperatures community, both to measure temperatures and thermal gradients, to calibrate secondary thermometers, and in precise comparison experiments with other primary thermometers.

701,616

PB88-109830

PC A03/MF A01

National Bureau of Standards, Gaithersburg, MD.

XCOM: Photon Cross Sections on a Personal Computer.

M. J. Berger, and J. H. Hubbell. Jul 87, 29p NBSIR-

87/3597

Sponsored by Department of Energy, Washington, DC. Office of Health and Environmental Research.

Keywords: *Photon cross sections, Scattering, Computation, Pair production, X rays, Gamma rays, Bremsstrahlung, XCOM computer program, KeV range 01-10, KeV range 10-100, KeV range 100-1000, MeV range 01-10, MeV range 10-100, MeV range 100-1000, GeV range 1-10, GeV range 10-100.

A computer program and data base are presented which can be used to calculate, with a personal computer, photon cross sections for scattering, photoelectric absorption and pair production, as well as total attenuation coefficients, in any element, compound or mixture, at energies from 1 keV to 100 GeV.

701,617

PB88-117445

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Giant 4p-Quadrupole Resonances in the Rare Earths.

Final rept.,

J. A. D. Matthew, F. P. Netzer, C. W. Clark, and J. F. Morar. 1987, 7p

Pub. in Europhysics Letters 4, n6 p677-683, 15 Sep 87.

Keywords: *Cerium, X ray absorption, Rare earth elements, Reprints, *Giant resonance.

X-ray absorption of Ce, obtained by partial secondary yield, is compared with previously obtained electron-energy loss measurements in reflection mode. The absence of a strong feature below $4p(3/2)$ threshold in

photon absorption provides confirmation that the peak in EELS is nondipole in character. Theoretical analysis supports interpretation in terms of a p-f giant quadrupole resonance, a result which broadens the analogy between giant resonances in atomic and nuclear physics.

701,618

PB88-117452

Not available NTIS

National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.

Term Dependence in the Hartree-Fock Approximation for Heavy Atoms.

Final rept.,

C. W. Clark. 1987, 4p

Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC.

Pub. in Physical Review A 35, n11 p4865-4868, 1 Jun 87.

Keywords: *Hartree-Fock approximation, Atomic structure, Electron irradiation, Rare earth elements, Reprints, Giant resonance, Photoabsorption, Electron-atom collisions.

Cases of substantial term dependence are found in the Hartree-Fock approximation for heavy atoms that are not attributable to large dipole exchange interaction. They may be associated with 'giant resonances' in electron impact excitation and ionization.

701,619

PB88-117692

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Chemical Engineering Science Div.

Thermal Conductivity.

Final rept.,

J. G. Hust. 1986, 23p

Pub. in CODATA Bulletin, n60 p3-7, 12-19, 25-28, 35, 39-43 1986.

Keywords: *Thermal conductivity, *Aluminum, *Copper, *Iron, *Tungsten, Electrical resistivity, Cryogenics, Reprints, Temperature dependence.

Literature data on the thermal conductivity of commercially pure aluminum, copper, iron, and tungsten specimens have been collected, coded, critically analyzed, and correlated 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 bibliography 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.

701,620

PB88-118047

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

Laser Spectroscopy of Trapped Atomic Ions.

Final rept.,

W. M. Itano, J. C. Bergquist, and D. J. Wineland.

1987, 6p

Pub. in Science 237, p612-617, 7 Aug 87.

Keywords: Atomic spectroscopy, Frequency standards, Reprints, *Laser spectroscopy, *Ion storage, Ion trapping, Laser cooling.

Recent developments in laser spectroscopy of atomic ions stored in electromagnetic traps are reviewed with emphasis on techniques that appear to hold the greatest promise of attaining extremely high resolution. Among these techniques are laser cooling and the use of single, isolated ions as experimental samples. Doppler shifts and other perturbing influences can be largely eliminated. Atomic resonances with line widths of a few parts in 10 to the 11 th power have been observed at frequencies ranging from the radio frequency to the ultraviolet. Experimental accuracies of one part in 10 to the 18 th power appear to be attainable.

701,621

PB88-121009

Not available NTIS

National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.

PHYSICS

General

Simple Electrodes for Quadrupole Ion Traps.

Final rept.,
E. C. Beatty. 1987, 5p
Sponsored by Office of Naval Research, Arlington, VA., and Air Force Office of Scientific Research, Bolling AFB, DC.
Pub. in *Jnl. of Applied Physics* 61, n6 p2118-2122, 15 Mar 87.

Keywords: *Electrodes, Mass spectroscopy, Reprints, *Ion traps, Penning traps.

Quadrupole traps for charged particles often involve electrodes with portions carefully machined to the shape of hyperboloids. It is shown here that the more important features of such traps can be achieved using electrode shapes which are much easier to fabricate. Detailed numerical calculations are reported on some sample electrodes. The numerical method can be easily extended to other shapes which accommodate specialized laboratory situations.

701,622
PB88-121017 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.
Long-Term Behaviour of Cavity Phase Difference in NBS-6.

Final rept.,
A. De Marchi, and R. E. Drullinger. 1987, 3p
Pub. in *Metrologia* 24, p23-25 1987.

Keywords: *Frequency standards, Phase shift, Reviews, Reprints.

A critical review of all beam-reversal phase-shift measurements carried out on NBS-6 (NBS-5) since 1973 is presented. The analysis takes into account a recent study of frequency shifts in atomic-beam frequency standards resulting from overlapping tails of adjacent lines. A strongly correlated variation of the cavity phase difference with time is shown, which appears to fit nicely on an exponential decay curve with a time constant of 3.7 years. The suggestion is made that some mechanical relaxation in the microwave structure may be responsible for the phenomenon. Furthermore, the line-pulling model seems to suggest a better explanation for observations previously attributed to distributed cavity phase shift. Verification of these interpretations through more involved evaluations may allow substantial reductions in the error budget for the standard.

701,623
PB88-121041 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.
Sympathetic Cooling of Trapped Ions: A Laser-Cooled Two-Species Nonneutral Ion Plasma.

Final rept.,
D. Larson, J. Bergquist, J. Bollinger, W. Itano, and D. Wineland. 1986, 4p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and Office of Naval Research, Arlington, VA.
Pub. in *Physical Review Letters* 57, n1 p70-73, 7 Jul 86.

Keywords: Reprints, *Ion storage, *Mercury ions, *Beryllium ions, Laser cooling, Ion traps, Mercury 198, Beryllium 9, High resolution, Penning traps, Plasma.

Sympathetic cooling of trapped ions has been demonstrated in an experiment where $(198)\text{Hg}(1+)$ ions were confined in a Penning ion trap with laser-cooled $(9\text{Be})(1+)$ ions. $(198)\text{Hg}(1+)$ temperatures below 1 K were achieved. Ion plasma sizes, shapes, and rotation frequencies were measured. Dramatic changes in the $(9\text{Be})(1+)$ plasma were observed when the $(198)\text{Hg}(1+)$ ions were introduced into the trap. These observations are consistent with the prediction of centrifugal separation for ions of different charge-to-mass ratios.

701,624
PB88-121058 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.
Laser-Cooling Limits and Single-Ion Spectroscopy.
Final rept.,
D. J. Wineland, W. M. Itano, J. C. Bergquist, and R. G. Hulet. 1987, 13p
Sponsored by Air Force Office of Scientific Research, Bolling AFB, DC., and Office of Naval Research, Arlington, VA.

Pub. in *Physical Review A* 36, n5 p2220-2232, 1 Sep 87.

Keywords: Atomic spectroscopy, Reprints, *Laser cooling, Penning traps, Ion traps, Ion storage, Laser spectroscopy.

The limitations to the achievement of low kinetic energies for laser cooling of single ions confined in electromagnetic traps are discussed. Sideband cooling of an ion in an rf (Paul) trap is reexamined, including the effects of finite laser bandwidth and the energy of the rf micromotion. The micromotion is the oscillatory motion of the ion at the same frequency as the rf voltage applied to the trap electrodes. Sideband cooling of ions in a Penning trap is examined for the first time. In both cases, cooling to the zero-point energy of the ion in the trap should be possible and a method for verifying this condition is suggested. The implications for high-resolution, high-accuracy spectroscopy are investigated. Under certain conditions, the uncertainty in the second-order Doppler shift may be significantly less than 1 part in 10 to the 18th power.

701,625
PB88-121090 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Recombination-Line Intensities for Hydrogenic Ions-I. Case B Calculations for H I and He II.

Final rept.,
D. G. Hummer, and P. J. Storey. 1987, 20p
Contract NAGW-766
Sponsored by National Aeronautics and Space Administration, Washington, DC.
Pub. in *Monthly Notices of the Royal Astronomical Society* 224, p801-820 1987.

Keywords: *Hydrogen, Line spectra, Reprints, *Radiative recombination, *Helium ions.

The relative intensities of H I and He II recombination lines are calculated, including full collisional effects, for a considerably larger range of temperature, density and principal quantum numbers than before. Case B of Baker & Menzel is assumed, and tables of line opacities are also presented to enable the assumption of negligible optical depth in all but the Lyman series to be checked. Collisional excitation of the $n=3$ levels from both $n=1$ and $n=2$ states is considered, and is found to invalidate Case B theory in some conditions which depend on electron density and the Lyman-alpha escape probability. The regimes of temperature and particle density for which Case B is valid are discussed. Newly calculated collision strengths for the $n=1, 2$ and 3 states of the $\text{He}(1+)$ are tabulated.

701,626
PB88-121116 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Quantum Physics Div.
Experimental Measurements of Field Effects on Dielectronic Recombination Cross Sections and Rydberg Product-State Distributions.

Final rept.,
A. Muller, D. S. Belic, B. D. DePaola, N. Djuric, G. H. Dunn, D. W. Mueller, and C. Timmer. 1987, 15p
Contract DE-AC01-76PR06010
Sponsored by Department of Energy, Washington, DC.
Pub. in *Physical Review A* 36, n2 p599-613, 15 Jul 87.

Keywords: Electric fields, Cross sections, Reprints, *Magnesium ions, Dielectronic recombination, Electron-ion collisions, Rydberg states.

Experimental details are presented for the measurement of the effects of extrinsic electric fields on cross sections and Rydberg product-state distributions for dielectronic recombination of $\text{Mg}(1+)$ with electrons. A new type of Rydberg state detector is described. Experimental results for dielectronic recombination in the presence of fields are presented for three field values, and these results are compared with theoretical calculations.

701,627
PB88-121926 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Precision Engineering Div.
Resolution and Measurement in the Scanning Electron Microscope.
Final rept.,
M. T. Postek. 1987, 4p
Pub. in *Proceedings of Annual Meeting Electron Microscope Society of America* (45th), Baltimore, MD., August 2-7, 1987, p534-537.

Keywords: *Electron microscopes, *Resolution, Metrology, Measurement, *Scanning electron microscopes.

The term ultimate resolution or resolving power is the very best performance that can be obtained from a scanning electron microscope (SEM), given the optimum instrumental conditions and sample. However, as it relates to SEM users, the conventional definitions of the figure are ambiguous. The numbers quoted for the resolution of an instrument are not only theoretically derived, but are also verified through the direct measurement of images on micrographs. However, the samples commonly used for the purpose are specifically optimized for the measurement of instrument resolution and are most often not typical of the sample used in practical applications.

701,628
PB88-122033 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.
Calibration of GPS Equipment at Time and Frequency Standards Laboratories in the USA and Europe.
Final rept.,
W. Lewandowski, M. Weiss, and D. Davis. 1987, 17p
Sponsored by Bureau International de l'Heure, Sevres (France).
Pub. in *Proceedings of the Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting* (18th), Washington, DC., December 2-4, 1986, p265-281 1987.

Keywords: *Atomic clocks, Frequency standards, Time standards, *Calibration, Synchronous platforms, Interlaboratory comparisons, Time delay.

The method of clock comparisons using GPS satellites in common view is now widely used in the time laboratories which participate in the international unification of time under the coordination of the Bureau International de Poids et Mesures (BIPM). The authors report here the results of a campaign of calibration of time delay in GPS receivers under the auspices of the BIPM with the assistance of the National Bureau of Standards (NBS), Boulder, CO. The trip in the United States and in Europe was performed from the 29 September 1986 to 27 October 1986. The Institutes and Laboratories visited during the trip are listed.

701,629
PB88-122031 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Time and Frequency Div.
Progress Toward an Optically Pumped Cesium Beam Frequency Standard.
Final rept.,
R. E. Drullinger, J. Shirley, D. J. Glaze, L. W. Hollberg, and A. De Marchi. 1986, 4p
Pub. in *Proceedings of Annual Symposium on Frequency Control* (40th), Philadelphia, PA., May 1986, p428-431 Oct 86.

Keywords: *Cesium frequency standards, Optical pumping, Atomic beams, Cesium beams.

The National Bureau of Standards is planning to build a cesium-beam, primary frequency standard based on the application of optical pumping for state selection and atom detection. The goal is an accuracy of 10 to the 14th power. Elimination of state-selecting magnets together with polarization control of the optical pumping should eliminate effects of Majorana transitions. Optical pumping should also permit simultaneous operation of counter-propagating beams with closer trajectory retrace than is possible with magnetic state selection. Noise measurements have shown that simple monolithic diode lasers produce too much FM noise to allow one to reach the shot noise limit in atom detection. Techniques for control of diode noise and linewidth are being tried and compared.

701,630
PB88-122106 Not available NTIS
National Bureau of Standards (NML), Boulder, CO.
Chemical Engineering Science Div.
Evaluation of Thermophysical Property Measurement Methods and Standard Reference Materials.
Final rept.,
A. E. Beck, R. Berman, F. Cabannes, J. G. Hust, M. L. Minges, and G. K. White. 1986, 68p
Pub. in *CODATA Bulletin*, n60 pi-61 1986.

Keywords: *Thermal conductivity, *Electrical resistivity, *Thermal diffusivity, Thermophysical properties, Specific heat, Laboratories, Reprints, Standard reference materials.

The fundamental objective of the Task Group project was to improve the quality of thermophysical property data on solid materials generated worldwide. The vehicle for accomplishing this was an international measurement program, covering a very broad temperature range (4 to 2500 K), which examined both the measurement techniques and the standard reference materials (SRM's) used in connection with the experimental methods for calibration and evaluation of techniques. The measurement program focused on determination of thermal conductivity and electrical resistivity, as, for conductors, these properties can be interrelated quantitatively. Measurement of thermal diffusivity (thermal conductivity divided by volumetric heat capacity) was also included, as this is a popular and relatively simple method of thermal transport property measurement; heat capacity was, of course, determined also. Overall, 19 laboratories representing nine countries conducted measurements and produced 61 sets of new data. A listing of the participating laboratories and the principal investigators is included.

701,631
PB88-122213 Not available NTIS
National Bureau of Standards (IMSE), Boulder, CO.
Fracture and Deformation Div.

Experimental Study of Path Independence of the J-Integral in an Aluminum Tensile Panel.

Final rept.,
J. F. Cardenas-Garcia, D. T. Read, and J. C. Moulder. 1986, 10p
Sponsored by David W. Taylor Naval Ship Research and Development Center, Annapolis, MD.
Pub. in Proceedings of the SEM (Society for Experimental Mechanics, Inc.) Spring Conference on Experimental Mechanics, New Orleans, LA., June 8-13, 1986, p448-457.

Keywords: *Stress analysis, Stresses, Deformation, Cracks, Fracture properties, Strains, Aluminum, Panels, Reprints, J-integral.

A newly devised video-optical experimental technique allows for the automated determination of the in-plane, plane stress components of the infinitesimal deformation tensor at discrete locations over an area of interest in a loaded specimen. It was used to evaluate a square area enclosing the central crack in a 5052-H32 aluminum panel loaded in tension. These experimental strain tensor values were then used to evaluate the J-integral assuming that the mechanical behavior of the plate material is approximated by deformation plasticity theory.

701,632
PB88-129325 PC A12/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
Technical Activities 1987, Center for Radiation Research,
C. E. Kuyatt. Oct 87, 267p NBSIR-87/3571
See also PB87-140232.

Keywords: *Research projects, Atomic physics, Spectroscopy, Atom collisions, Ionization potential, Plasma radiation, Nuclear physics, Ionizing radiations, Radiation sources, Radiometric analysis.

The report summarizes research projects, measurement method development, calibration and testing, and data evaluation activities that were carried out during Fiscal Year 1987 in the NBS Center for Radiation Research. These activities fall in the area of atomic and plasma radiation, radiation physics, radiometric physics, radiation sources and instrumentation, ionizing radiation, and nuclear physics.

701,633
PB88-129770 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
STEM Calibration by Analysis of Hough Transformed Images of Optical Grating Replicas.
Final rept.,
D. S. Bright, and E. B. Steel. 1985, 4p
Pub. in Microbeam Analysis 20, p155-158 1985.

Keywords: *Electron microscopy, Electron microscopes, Gratings(Spectra), Reprints, *Calibration, Image analysis, Hough transformation.

A STEM calibration technique is presented that features the automated measurement of line spacings on images of shadowed replicas of optical gratings. Rather than averaging a number of intensity profiles, the method involves averaging the data over most of the image by use of the Hough transform. The method works over a wide magnification range, and for any orientation of the lines.

701,634
PB88-129796 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Office of Nondestructive Evaluation.
Modeling of Pressure-Induced Far Infrared Absorption Spectra: Molecular Hydrogen Pairs.
Final rept.,
J. Borysow, L. Trafton, L. Frommhold, and G. Birnbaum. 1985, 11p
Pub. in Astrophysical Jnl. 296, n2 pt1 p644-654, 15 Sept 85.

Keywords: *Hydrogen, *Absorption spectra, Planetary atmospheres, Far infrared radiation, Molecules, Reprints, Pressure effects, Spectral functions.

The collision-induced translational-rotational absorption coefficient for molecular hydrogen pairs has been computed from the fundamental theory by Meyer, Frommhold, and Birnbaum for temperatures from 40 to 300K. Over the frequency range from about 30 to 1,500/cm, theoretical and measured profiles are in close agreement (+ or - 5%). The theory is capable of generating reliable spectra of hydrogen pairs at temperatures for which no laboratory measurements exist. The procedures described in the work, although used for the modeling of the H₂-H₂ induced spectra, are more broadly relevant to the general problem of fitting line shapes. An application for this work is the accurate computations of radiative transfer in modeling the atmospheres of the outer planets.

701,635
PB88-129804 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
Phase Shift and Multiple Scattering in Small Angle Neutron Scattering: Application to Beam Broadening from Ceramics.
Final rept.,
N. F. Berk, and K. Hardman-Rhynne. 1986, 5p
Pub. in Physica B: Physics of Condensed Matter and C: Atomic, Molecular and Plasma Physics, Optics 136, n1-3 p218-222 Jan/Feb 86.

Keywords: *Neutron scattering, *Ceramics, *Aluminum oxide, Phase shift, Small angle scattering.

The single-particle cross-section for small angle neutron scattering from a uniform sphere of arbitrary size is incorporated into a general theory of small angle incoherent multiple scattering from a monodisperse population of particles. The synthesis of these formalisms provides a theory of multiple scattering that is applicable over a wide range of values of the single-particle phase shift, nu--encompassing the transition from diffraction (nu > 0) to refraction (nu -> infinity)--and a useful tool for extracting particle size and volume fraction from SANS data dominated by multiple scattering. The methods have been used to characterize high purity alumina powder, and have obtained good quantitative agreement with results from laser light scattering and x-ray sedimentation microscopy.

701,636
PB88-138821 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Millisecond Pulsar Rivals Best Atomic Clock Stability.
Final rept.,
L. Rawley, D. Stinebring, J. Taylor, M. Davis, and D. W. Allan. 1987, 14p
Pub. in Proceedings of the Annual Precise Time and Time Interval (PTTI) Applications and Planning Meeting (18th), Washington, DC., December 2-4, 1986, p453-466 1987.

Keywords: *Atomic clocks, *Frequency stability, Interstellar matter, *Pulsars, Total electron content.

The measurement time residuals between the millisecond pulsar PSR 1937+21 and the reference atomic time scale UTC(NBS) have been significantly reduced. Analysis of data for the most recent 768 day period indicates a fractional frequency stability, (modified Allan variance) of 3 x 10 to the -15th power for an inte-

gration time of 240 days. The improved stability relative to the earlier analysis is a result of three significant improvements. Using the information from these measurements allowed us to partially account for dispersion caused by free electrons along the 12,000 to 15,000 light year path from the pulsar to the earth. With data taken every two weeks, the final residuals are nominally characterized by a white phase noise at a level of 243 ns. The total interstellar electron content was found to follow a random walk by up to 12 ppm over the 768 days.

701,637
PB88-138987 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Survey and Compilation of Stopping Power Data Conducted by the International Commission on Radiation Units and Measurements.
Final rept.,
M. Inokuti, and M. J. Berger. 1987, 7p
Contract W-31-109-eng-38
Sponsored by Department of Energy, Washington, DC.
Pub. in Nuclear Instruments and Methods in Physics Research B27, p249-255 1987.

Keywords: *Dosimetry, Electrons, Positrons, Reprints, *Stopping power, ICRU, International Commission on Radiation Units and Measurements.

One of the principal objectives of the International Commission on Radiation Units and Measurements (ICRU) is to recommend internationally acceptable values of physical quantities relevant to radiation measurements and radiological dosimetry. Among a large variety of the physical quantities treated by the ICRU, the stopping power is one of the most fundamental. In 1984, the ICRU issued its Report (No. 37) concerning stopping power for electrons and positrons. Currently the ICRU is preparing a report on data for protons and alpha particles. Work planned for the future concerns heavier charged particles, which include most importantly carbon, oxygen, and nitrogen ions resulting from neutron irradiation of human tissues. The task requires, in addition to mere collection of published data, critical evaluation of those data for their reliability, precision, and accuracy. The critical evaluation in turn requires full knowledge of experimental and theoretical methods for the determination of stopping power. The present article points out key issues and major unsolved problems involved in the determination.

701,638
PB88-139035 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Source and Instrumentation Div.
Linacs for Microtrons and Pulse Stretchers.
Final rept.,
S. Penner. 1986, 5p
Pub. in Proceedings of the Linear Accelerator Conference, Stanford, CA., June 2-6, 1986, p416-420.

Keywords: *Electron accelerators, *Linear accelerators, Microtrons.

For many applications, continuous (CW) beams of electrons are strongly preferred over the low duty cycle beams available from RF linacs. The two preferred methods for realizing high-energy CW beams are (1) a pulsed linac followed by a pulse-stretcher ring, and (2) a recirculating CW accelerator. In both methods, a high performance electron linac is required. Recent advances in the technology and understanding of standing wave structures appear to make them preferable to travelling wave linacs for the pulse-stretcher method. Recirculating linacs, whether of the racetrack microtron type or some other topology, are built with CW standing wave linacs. Both room temperature and superconducting structures have been used. Recent exciting advances in superconducting structures make them the structures of choice for high energy CW electron accelerators.

701,639
PB88-141080 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Electrosystems Div.
Measurement of Electric Field and Ion-Related Quantities.
Final rept.,
R. H. McKnight. 1987, 33p
Sponsored by Department of Energy, Washington, DC.

PHYSICS

General

Pub. in *Air Ions: Physical and Biological Aspects*, Chapter 3, p23-55 1987.

Keywords: *Electric fields, Atmospheric electricity, Electrical measurement, Space charge, *Ion counters, Ion detection.

Measurements of various quantities to describe the electrical characteristics of the atmosphere have been made for many decades by atmospheric scientists using a variety of instruments and measurement techniques. The purpose of this chapter is to describe those techniques which have application in present day ion-related research. References chosen are representative and it is not intended that they be bibliographic in nature. Summaries, specialized texts and proceedings of conferences are excellent sources for more detailed discussions of particular topics and should be consulted by the interested reader.

701,640
PB88-141148 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Basic Standards.
Accurate Spectroscopy of Single-Electron and Single-Vacancy Ions.

Final rept.,
R. D. Deslattes. 1985, 14p
Pub. in *AIP (American Institute of Physics) Conference Proceedings*, n136 p80-93 1985.

Keywords: *X ray spectroscopy, X ray spectra, Wavelengths, Standards, Reprints, Lamb shift.

The report focuses on one-electron and one-vacancy spectroscopy in the X-ray region, where data are of adequate or nearly adequate quality to be of possible interest to the workshop, i.e. data where relativistic and QED effects are not merely noticeable but where measurements having noticeable significance may be found or at least hoped for. Several experimental difficulties are discussed, including production of clear and interpretable spectra; securing appropriate wavelength normalization; and problems of spectator electrons and spectator vacancies. Available experimental results are summarized, and an attempt is made to combine information from single-electron and single vacancy spectra. Brief discussion of some directions in which future progress may be anticipated is also included.

701,641
PB88-141387 Not available NTIS
National Bureau of Standards (IMSE), Gaithersburg, MD. Reactor Radiation Div.
National Bureau of Standards Cold Neutron Research Facility.

Final rept.,
R. S. Carter. 1987, 3p
Pub. in *Transactions of the American Nuclear Society* 55, 0003-018X, p188-190 1987.

Keywords: *Neutron sources, Reprints, *Cold neutrons, *Research facilities, US NBS.

In 1984 a National Academy of Sciences Committee was set up to review the need for major facilities in the area of materials and condensed matter science and to make recommendations in priority order. Their top priority for smaller facilities that could be developed quickly to enhance existing programs was the development of cold neutron research facilities (CNRFs) including large neutron guide halls and associated instruments. The National Bureau of Standards (NBS) proposed such a facility and received congressional funding in FY87. The NBS CNRF takes advantage of the large (22 inch D) beam hole originally designed into the reactor to install a large cold source that will be viewed by 8 neutron guides. The guides will transport the neutrons into a new neutron guide hall, 200 feet long and 100 feet wide. NBS will build ten major instruments and it is anticipated that another five will be developed by Participating Research Teams. It is intended that the facility will be a national center for neutron research, and some fraction of all instruments will be made available to outside users at no charge.

701,642
PB88-141403 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Introduction to 'Atomic Excitation and Recombination in External Fields'.

Final rept.,
M. H. Nayfeh, and C. W. Clark. 1985, 14p
Pub. in *Atomic Excitation and Recombination in External Fields*, p1-14 1985.

Keywords: *Atomic spectra, Stark effect, Zeeman effect, Excitation, Meetings, Dielectronic recombination, Rydberg states, Recombination.

Introduction to the book 'Atomic Excitation and Recombination in External Fields,' which contains contributions from participants at the workshop 'Atomic Spectra and Collisions in External Fields' held at NBS on October 22-23, 1984. Summarizes the separate articles (about 30) in the book, and indicates the ways in which they are related to each other and to other problems of atomic and molecular physics.

701,643
PB88-141411 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Radiation Physics Div.
Electron-Atom Scattering in External Fields.

Final rept.,
C. W. Clark. 1985, 21p
Pub. in *Atomic Excitation and Recombination in External Fields*, p17-37 1985.

Keywords: Electric fields, Magnetic fields, Stark effect, Zeeman effect, *Electron-atom collisions, Photoionization, Rydberg states, Negative ions, Photodetachment.

Recent theoretical work on problems of electron-atom scattering in static external fields is reviewed. The processes of greatest experimental interest involve half-collisions, e.g. photoionization of atoms and photodetachment of negative ions in electric or magnetic fields. Attention is therefore focused on phenomena occurring at near-threshold energies.

701,644
PB88-147749 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
New Measurements of the Ratio of the (10)B(n, alpha) to (6)Li(n, t) Cross Sections in the eV Energy Region.

Final rept.,
A. D. Carlson. 1986, 4p
Pub. in *Radiation Effects* 96, n1-4 p109-112 1986.

Keywords: *Neutron cross sections, Tritons, Reprints, Boron 10, Lithium 6, Alpha reactions.

Measurements have been made of the ratio of the (10)B(n, alpha) to (6)Li(n, t) cross sections from about 1 to 45 eV with statistical uncertainties and systematic errors of less than 1%. Improved experimental data were obtained in this investigation compared with a previous measurement. The measurements are consistent with results obtained from ENDF/B-V cross sections.

701,645
PB88-147756 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Standardization of Samarium-153.

Final rept.,
B. M. Coursey, D. D. Hoppes, F. J. Schima, and M. P. Unterwiesing. 1987, 4p
Pub. in *Appl. Radiat. Isot.* 38, n1 p31-34 1987.

Keywords: Half life, Standardization, Gamma rays, Reprints, *Samarium 153, Liquid scintillation detectors.

Samarium-153 has been standardized by 4(pi)(beta) liquid-scintillation counting, with an uncertainty of 0.4%. The probability per decay for the 103.2-keV gamma ray was measured using two germanium detectors to be 0.298 plus or minus 0.004. The half life based on liquid-scintillation measurements over 6.4 half lives and pressurized-ionization-chamber measurements over 4 half lives was found to be 46.27 plus or minus 0.02 hours. The uncertainties in each case are intended to approximate one standard deviation.

701,646
PB88-151499 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Atomic and Plasma Radiation Div.
3s-3p, 3p-3d, and 3d-4f Transitions of Sodalumlike Ions.

Final rept.,
J. Reader, V. Kaufman, J. Sugar, J. O. Ekberg, U. Feldman, C. M. Brown, J. F. Seely, and W. L. Rowan. 1987, 8p
Sponsored by Department of Energy, Washington, DC. Office of Magnetic Fusion Energy.

Pub. in *Jnl. of the Optical Society of America B* 4, n11 p1821-1828 Nov 87.

Keywords: *Electron transitions, Far ultraviolet radiation, Wavelengths, Atomic energy levels, Ultraviolet spectra, Reprints, Copper ions, Zinc ions, Gallium ions, Germanium ions, Arsenic ions, Selenium ions, Bromine ions, Krypton ions, Yttrium ions, Zirconium ions, Niobium ions, Molybdenum ions, Ruthenium ions, Rhodium ions, Palladium ions, Silver ions, Tin ions, Laser-produced plasma.

New measurements have been made for wavelengths of the 3s-3p, 3p-3d, and 3d-4f transitions of the sodium like ions Cu(18+), Zn(19+), Ge(21+), As(22+), Se(23+), Br(24+), Kr(25+), Y(28+), Zr(29+), Nb(30+), Mo(31+), Ru(33+), Rh(34+), Pd(35+), Ag(36+), and Sn(39+). The measurements were made by photographing laser-produced plasmas and tokamak plasmas with grazing-incidence spectrographs. The energies of the transitions were also calculated with Dirac-Fock computer codes. By fitting the differences between the observed and calculated wave numbers to simple formulas, least-squares-fitted wavelengths for all sodiumlike ions from Ar(7+) to Xe(43+) were determined. The estimated uncertainty of the fitted wavelengths is + or - 0.007 A, which makes them useful as reference values. The wavelengths range from 9 to 713 A.

701,647
PB88-151972 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Quantum Physics Div.
Gailean Test for the Fifth Force.

Final rept.,
T. M. Niebauer, M. P. McHugh, and J. E. Faller. 1987, 4p
Sponsored by Air Force Geophysics Lab., Hanscom AFB, MA.
Pub. in *Physical Review Letters* 59, n6 p609-612, 10 Aug 87.

Keywords: Relativity, Gravitation, Reprints, *Basic interactions, Free fall.

The authors have carried out a direct free-fall experiment to measure the differential acceleration between two different materials (copper and uranium) falling in the Earth's gravitational field. The differential acceleration was measured to be less than 5 parts in 10 billion of the normal gravitational acceleration. The null result puts new limits on the strength and range of the proposed fifth force.

701,648
PB88-152293 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
Electrodisintegration Experiments and Virtual Photon Spectra.

Final rept.,
E. Hayward, R. Bergere, S. Costa, and C. Schaerf. 1985, 31p
See also DE82703189.
Pub. in *Proceedings of the International School of Intermediate Energy Nuclear Physics (5th Course)*, Verona, Italy, June 20, 1985, p132-162.

Keywords: Electron scattering, Plane waves, Scattering cross sections, *Electrodisintegration, Zirconium 90, Virtual particles, Virtual photons.

Beginning with the inelastic electron scattering and the photonuclear cross sections, the plane wave virtual photon spectra are developed. Several experiments that made use of the virtual photon spectra are described. The connection between the electron scattering coincidence cross section and the inclusive electric dipole (e,X) cross section differential in the angle of the outgoing particle is developed. The relative magnitudes of the four terms in the cross section are illustrated, and the application to a previous experiment are discussed.

701,649
PB88-152764 Not available NTIS
National Bureau of Standards (NML), Boulder, CO. Time and Frequency Div.
Limits for Spatial Anisotropy.

Final rept.,
J. D. Prestage. 1986, 2p
Pub. in *Physics Bulletin* 37, n4 p153-154 1986.

Keywords: Atomic clocks, Nuclear magnetic resonance, Reprints, *Lorentz invariance, Hydrogen masers, Laser cooling, Ion traps, Penning effect, Beryllium 9.

By comparing the rates of two atomic clocks, one based on a hydrogen maser transition and the other based on RF transitions in laser cooled $(9)\text{Be}(1+)$ ions confined in a Penning ion trap, the authors have tested local Lorentz invariance. The sensitivity of the measurement is compared to other tests of Lorentz invariance.

701,650
PB88-152772 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Chemical Engineering Science Div.
Transient Heat Transfer and Thermophysical Properties Measurements in Low Gravity.
Final rept.,
P. J. Giarratano, V. D. Arp, R. B. Owen, A. Cezairliyan, and A. P. Müller. 1987, 14p
Pub. in Low-Gravity Sciences, Science and Technology Series 67, p55-68 1987.

Keywords: *Thermophysical properties, *Reduced gravity, *Heat transfer, Transient response, Melting, Simulation, Reprints, *Containerless melts, KC-135 aircraft.

The National Bureau of Standards Laboratories in Gaithersburg, Maryland and Boulder, Colorado have several low-gravity research projects that are currently supported by the Microgravity Sciences Division of NASA. The paper reviews the preliminary research conducted in relation to two projects. They have been performed on the NASA KC-135 airplane which flies a parabolic flight pattern to simulate a low-gravity level of about 30-seconds duration. A typical flight consists of 30-40 parabolas. The transient nature of both the experiments makes them particularly well suited for operation on the KC135.

701,651
PB88-152863 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Gas and Particulate Science Div.
Direct Laboratory Determination of the (187)Re Half-Life.
Final rept.,
M. Lindner, D. A. Leich, R. J. Borg, G. P. Russ, J. M. Bazan, D. S. Simons, and A. R. Date. 1986, 3p
Sponsored by Lawrence Livermore National Lab., CA. Pub. in Nature 320, n6059 p246-248 1986.

Keywords: *Half life, Mass spectroscopy, Osmium, Reprints, *Rhenium 187, Isotope ratio.

The long-lived, naturally occurring radionuclide (187) Re is important in geochemistry and cosmology as a nucleochronometer. Until now there have been no direct laboratory measurements which have avoided the difficulties of both low-energy beta-counting and dependence on radiometric ages of rocks and meteorites. The authors report here a half-life of $(4.35 \pm 0.13) \times 10^{10}$ yr, based on the growth of (187) Os over a 4-yr period into a large source of osmium-free rhenium. As the result agrees with the best geochemically determined values, no significant revision of the present galactic age limits based on the geochemical values is necessary.

701,652
PB88-153986 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Conceptual Design of an Induction Linac for Neutron Research.
Final rept.,
R. G. Johnson. 1986, 6p
Pub. in Radiation Effects 95, n1-4 p291-296 1986.

Keywords: *Electron accelerators, Ion accelerators, Neutron sources, Design.

The linear induction accelerator principle has been a subject of intense development over the last few years. Recently important technological advances have been made in magnetic pulse compression and iron-alloy metallic glasses. The results of a preliminary design study of an induction linac to be used for neutron and high-LET radiation research are presented.

701,653
PB88-154638 Not available NTIS

National Bureau of Standards (IMSE), Boulder, CO. Fracture and Deformation Div.
Experimental Study of Path Independence of the J-Integral in an Aluminum Tensile Panel.
Final rept.,
J. F. Cardenas-Garcia, D. T. Read, and J. C. Moulder. Sep 87, 5p
See also PB88-122213. Sponsored by Naval Sea Systems Command, Washington, DC.
Pub. in Experimental Mechanics 27, n3 p328-332 Sep 87.

Keywords: *Stress analysis, Stresses, Deformation, Cracks, Fracture properties, Strains, Aluminum, Panels, Reprints, J-integral.

A newly devised video-optical experimental technique allows for the automated determination of the in-plane, plane-stress components of the infinitesimal deformation tensor at discrete locations over an area of interest in a loaded specimen. It was used to evaluate a square area enclosing the central crack in a 5052-H32 aluminum panel loaded in tension. These experimental strain-tensor values were then used to evaluate the J integral assuming that the mechanical behavior of the plate material is approximated by deformation plasticity theory. The J integral was evaluated using two series of rectangular paths. The first was symmetrical about a horizontal axis passing through the notch length, using strain-tensor values at points to the left and right of a vertical axis passing through the center of the notch, with varying breadth and height. The second series were asymmetrical about either axis, with varying breadth and height.

701,654
PB88-156724 PC A03/MF A01
National Bureau of Standards (NML), Gaithersburg, MD. Center for Radiation Research.
Electron and Photon Transport in Multi-Layer Media: Notes on the Monte Carlo Code ZTRAN.
S. M. Seltzer, and M. J. Berger. Sep 84, 50p NBSIR-84/2931

Keywords: *Electrons, *X rays, *Gamma rays, Transport properties, Monte Carlo method, Compton effect, Photoelectrons, Annihilation reactions, Photons, ZTRAN computer program, Radiation doses, One-dimensional calculations.

The report provides a brief description and running instructions for the one-dimensional Monte Carlo code ZTRAN. The program is used to calculate the transport of electrons and photons in heterogeneous multi-layer media.

701,655
PB88-162573 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Molecular Spectroscopy Div.
Proper Choice of the Lagrangian for a Relativistic Particle in External Fields.
Final rept.,
C. Leubner. 1986, 8p
Pub. in European Jnl. of Physics 7, n1 p17-24 1986.

Keywords: Special relativity, Lagrangian functions, Classical mechanics, Reprints, *Relativistic particles.

No abstract available.

PROBLEM-SOLVING INFORMATION FOR STATE & LOCAL GOVERNMENTS

General

701,656
PB87-152039 Not available NTIS
National Bureau of Standards, Gaithersburg, MD. Office of the Director.

Observations on Short-Term and Long-Range Plans for Technology Transfer to State and Local Governments.
Final rept.,
J. M. Wyckoff. 1978, 8p
Pub. in Proceedings of Space Congress (15th), Cocoa Beach, FL, April 26-28, 1978 p2-24-2-31.

Keywords: *Local government, *State government, Local planning, Industries, Improvement, *Technology transfer, *Technical information, Industrial development, National Bureau of Standards.

The paper has developed from efforts to understand the short-term plans of those groups involved in the transfer of technology to State and local governments. While the review is intended to support the planning process of the National Bureau of Standards (NBS) and the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP) of the Office of Science and Technology Policy, the long-range 'plans' are a subjective view of some needs for an improved technology transfer system.

SPACE TECHNOLOGY

Manned Spacecraft

701,657
PB87-191037 Not available NTIS
National Bureau of Standards (NML), Gaithersburg, MD. Ionizing Radiation Physics Div.
Optimization Study of Electron-Bremsstrahlung Shielding for Manned Spacecraft.
Final rept.,
G. Barnea, M. J. Berger, and S. M. Seltzer. 1987, 4p
Sponsored by Office of Naval Research, Arlington, VA., and Department of Energy, Washington, DC.
Pub. in Jnl. of Spacecraft 24, n2 p158-161 Apr 87.

Keywords: *Manned spacecraft, *Radiation shielding, Bremsstrahlung, Aluminum, Lead(Metal), Electron irradiation, Reprints, Space shuttles, Geosynchronous orbits.

Transport calculations based on the Monte Carlo method have been made to study the shielding of spacecraft against electrons and, in particular, secondary bremsstrahlung originating in the shield. These calculations were done for radiation environments encountered in typical shuttle and geosynchronous orbits. The quantitative results indicate that considerable improvement in shielding can be obtained by replacing an aluminum shield with a composite shield of the same total mass thickness and an inner lining of lead.

701,658
PB88-123773 PC A05/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Robot Systems Div.
NASA/NBS (National Aeronautics and Space Administration/National Bureau of Standards) Standard Reference Model for Telerobot Control System Architecture (NASREM).
Technical note (Final),
J. S. Albus, H. G. McCain, and R. Lumia. Jul 87, 94p NBS/TN-1235
Also available from Supt. of Docs. as SN003-003-02819-3. Sponsored by National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.

Keywords: *Robots, *Computerized control systems, Space stations, Hierarchical control, NASA standard reference model, NASREM model.

The document describes the NASA Standard Reference Model (NASREM) Architecture for the Space Station Telerobot Control System. It defines the functional requirements and high level specifications of the control system for the NASA Space Station document for the functional specification, and a guideline for the development of the control system architecture, of the IOC Flight Telerobot Servicer. The NASREM telerobot control system architecture defines a set of standard modules and interfaces which facilitates software

SPACE TECHNOLOGY

Manned Spacecraft

design, development, validation, and test, and make possible the integration of telerobotics software from a wide variety of sources. Standard interfaces also provide the software hooks necessary to incrementally upgrade future Flight Telerobot Systems as new capabilities develop in computer science, robotics, and autonomous system control.

Spacecraft Trajectories & Flight Mechanics

701,659

PB87-230876 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Mathematical Analysis Div.

Critical Inclination in Artificial Satellite Theory.

Final rept.,
S. L. Coffey, A. Deprit, and B. R. Miller. 1986, 42p
Pub. in Celestial Mechanics 39, p365-406 1986.

Keywords: Slope, Dynamics, Hamiltonian functions, Stability, Reprints, *Satellite orbits, Inclination, Bifurcation(Mathematics).

Certain it is that the critical inclination in the main problem of artificial satellite theory is an intrinsic singularity. Its significance stems from two geometric events in the reduced phase space on the manifolds of constant polar angular momentum and constant Delaunay action. In the neighborhood of the critical inclination, along the family of circular orbits, there appear two Hopf bifurcations, to each of which there converge two families of orbits with stationary perigees. On the stretch between the bifurcations, the circular orbits in the planes at critical inclination are unstable. A global analysis of the double forking is made possible by the realization that the reduced phase space consists of bundles of two-dimensional spheres. Extensive numerical integrations illustrate the transitions in the phase flow on the spheres as the system passes through the bifurcations.

TRANSPORTATION

Road Transportation

701,660

PB84-198829 PC A03/MF A01
National Bureau of Standards, Washington, DC. National Engineering Lab.

Limited Electromagnetic Interference Testing of Evidential Breath Testers.

May 83, 40p DOT-HS-806 400

Keywords: *Electromagnetic interference, Transmitter receivers, Police, Tests, Failure, Damage, *Breathalyzers, Alcohol breath tests.

The anomalous behavior of a specific evidential breath tester (EBT) in the presence of an electromagnetic field from a police transceiver was brought to the attention of the National Bureau of Standards (NBS) by the National Highway Traffic Safety Administration (NHTSA) early in 1982. This report presents the results of a limited study, conducted by the NBS, to identify evidence of potential electromagnetic interference (EMI) problems with a selected sample of EBT's currently used by State and local governments.

URBAN & REGIONAL TECHNOLOGY & DEVELOPMENT

Emergency Services & Planning

701,661

PB87-148516 PC A12/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Theory and Application of Expert Systems in Emergency Management Operations: Proceedings of a Symposium held at the Department of Commerce, Washington, DC, April 24-25, 1985.

Final rept.,
S. I. Gass, and R. E. Chapman. Nov 86, 266p NBS/SP-717

Also available from Supt. of Docs as SN003-003-02784-7. Library of Congress catalog card no. 86-600546. Prepared in cooperation with Maryland Univ., College Park. Coll. of Business and Management. Sponsored by Federal Emergency Management Agency, Washington, DC.

Keywords: Artificial intelligence, National government, State government, Local government, Fire control, Coal mines, Shipboard fire control, *Expert systems, *Emergencies, *Emergency services, Chemical spills, Federal Emergency Management Agency.

The First Symposium on The Theory and Application of Expert Systems in Emergency Management, held at the Department of Commerce, Washington, D.C. (April 24 and 25, 1985) was funded by the Federal Emergency Management Agency and organized by the National Bureau of Standards' Operations Research Division. The purpose of the symposium was to bring together researchers in expert systems, artificial intelligence, and emergency operations in a forum to review the concepts of expert systems and the problems of emergency management, with the objective of determining how expert systems can be used to augment the experience of local, State and Federal emergency managers faced with the difficult tasks of determining the best response to an emergency situation. Speakers addressed the following areas: The theory and uncertainty aspects of expert systems, artificial intelligence's future role in emergency management, technology for building and using expert systems, emergency management decisions and information needs and uses, applications of expert systems in the management of chemical spills and shipboard and coal mine fires, and the role and use of simulation in emergency management expert systems.

701,662

PB87-152104 PC A09/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Expert Systems and Emergency Management: An Annotated Bibliography.

Final rept.,
S. I. Gass, S. Bhasker, and R. E. Chapman. Nov 86, 181p NBS/SP-728

Also available from Supt. of Docs as SN003-003-02769-3. Library of Congress catalog card no. 86-600591. Sponsored by Federal Emergency Management Agency, Washington, DC.

Keywords: *Bibliographies, *Artificial intelligence, Telecommunication, Information system, *Expert systems, *Emergencies, Computer applications, National Bureau of Standards.

The report is the result of an in-depth review of the recent technical literature on expert systems. The material contained in the report provided a basis for assessing the potential for using expert systems in emergency management operations. In choosing the material for inclusion in the report, special emphasis was placed on those aspects of expert systems which addressed the types of problems encountered in emergency management operations. The report is designed for use as a resource document and as a tutorial on expert systems and emergency management. Each

chapter consists of brief topic essay followed by a set of references which expand on the main themes of the essay.

Fire Services, Law Enforcement, & Criminal Justice

701,663

PB87-152302 PC A04/MF A01
National Bureau of Standards (NEL), Gaithersburg, MD.

Evaluation of Electronic Monitoring Devices.

A. G. Perry, B. A. Bell, and M. J. Treado. Dec 86, 57p NBSIR-86/3501
Sponsored by National Inst. of Justice, Washington, DC.

Keywords: *Monitors, *Criminology, Law enforcement, Frequency measurement, Electromagnetic interference, Receivers, Transmitters, Tables(Data), *Electronic monitoring devices, *Criminal justice, Parole.

Electronic Monitoring Devices (EMDs) are used to monitor the presence of individuals within a given area who are responsible to the criminal justice system but not confined to institutions. Several EMDs were tested to measure operational characteristics such as operating frequency, approximate range of operation, component capability, and tamper resistance. Tests were conducted in an open field, wooden residence, high rise metal building, and in a laboratory environment.

701,664

PB87-162020 Not available NTIS
National Bureau of Standards (NEL), Gaithersburg, MD. Fire Safety Technology Div.

User's View of Computer Hardware and Software.

Final rept.,
W. D. Walton. May 85, 4p
Pub. in Fire Safety Jnl. 9, n1 p3-6 May 85.

Keywords: *Fire protection, *Fire safety, Computers, Computer systems hardware, Programming languages, Reprints, Computer software, Computer program transferability, Computer applications, User needs, Sharing.

The use of computers is becoming increasingly important in the solution of fire protection engineering problems. To take full advantage of the power of the computer, it is necessary to have a general understanding of computer capabilities and limitations. This paper provides a brief introduction to computer terminology, capabilities, and programming languages. It also presents a discussion of program transfer, a topic of increasing interest as programs are shared within the fire protection community.

701,665

PB87-197885 Not available NTIS
National Bureau of Standards (NEL), Boulder, CO. Electromagnetic Fields Div.

Susceptibility of Emergency Vehicle Sirens to External Radiated Electromagnetic Fields.

Final rept.,
R. L. Jesch. 1986, 6p
Sponsored by National Inst. of Justice, Washington, DC.
Pub. in NIJ (National Institute of Justice) Report-200-85, p1-6 May 86.

Keywords: *Sirens, *Radiofrequency interference, Law enforcement, High frequencies, Very high frequencies, Ultrahigh frequencies, Reprints, *Emergency vehicles, *Electromagnetic susceptibility.

The report provides the results of an exploratory study to determine the susceptibility of sirens to interference from typical communications equipment such as the transmitters and antennas likely to be operated in and around a law enforcement vehicle. Tests were performed using five sirens and communications equipment operating at frequencies representing the frequency bands of 25 to 50, 150 to 174, 400 to 512, and 806 to 866 MHz. The sirens were mounted on top of a vehicle equipped with transmitters and roof-mounted antennas and subjected to levels of field strength generated by mobile transmitting equipment having output levels up to 100 W. The control units of the sirens were also subjected to various levels of field strength inside

a TEM cell or an anechoic chamber to determine their susceptibility to electromagnetic fields.

701,666

PB88-159462

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Fire Research.

Computer Model of Smoke Movement by Air Conditioning Systems (SMACS),

J. H. Klote. Nov 87, 25p NBSIR-87/3657

Sponsored by Public Buildings Service, Washington, DC.

Keywords: *Safety engineering, *Fire hazards, *Air conditioning, *Smoke, Ventilation, Ducted fans, Air circulation, Ventilation fans, Air pollution, Mathematical models, Computerized simulation.

A computer model for simulation of smoke movement through air conditioning systems is described. A brief overview of air conditioning systems is presented. The methods of calculation of mass flow, smoke transport, fan flow and duct and fitting resistances are presented along with a general description of the program logic.

Regional Administration & Planning

701,667

PB87-168811

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Internal Revenue Service Post-of-Duty Location Modeling System: User's Manual,

P. D. Domich, R. H. F. Jackson, and M. A. McClain.

Feb 87, 43p NBSIR-86/3471

Sponsored by Internal Revenue Service, Washington, DC.

Keywords: *Regional planning, *Site surveys, Cost effectiveness, Microcomputers, Manuals, Maps, Models, *Internal Revenue Service, *Interactive graphics, *Site selection, Costs, Computer software, Computer systems hardware, Government agencies.

The report is a user's guide for a microcomputer package which was designed by the National Bureau of Standards to assist the Internal Revenue Service in choosing locations for its posts-of-duty which will minimize costs to the IRS and to the taxpayer. The user may select the types of costs to be considered and may specify potential locations for new posts-of-duty. The system displays maps showing workload for a district, current post-of-duty locations and new post-of-duty locations. This manual provides hardware and software requirements for the system, installation procedures, data file formats, and detailed operating instructions.

701,668

PB88-112420

PC A03/MF A01

National Bureau of Standards (NEL), Gaithersburg, MD. Center for Applied Mathematics.

Internal Revenue Service Post-of-Duty Location Modeling System - Final Report,

P. D. Domich, K. L. Hoffman, R. H. F. Jackson, and

M. A. McClain. Jul 86, 38p NBSIR-86/3482

See also PB87-168811. Sponsored by Internal Revenue Service, Washington, DC.

Keywords: *Regional planning, *Site surveys, Mathematical models, Cost effectiveness, Microcomputers, Maps, *Internal Revenue Service, *Site selection, Menus, Tax districts, User needs, Computer program documentation, Government agencies, Costs.

The report documents a project undertaken by the National Bureau of Standards to develop a mathematical model which identifies optimal locations of Internal Revenue Service Posts-of-Duty. The mathematical model used for the problem is the uncapacitated, fixed charge, location-allocation model which minimizes

travel and facility costs, given a specified level of activity. Brief descriptions of the mathematical techniques used and the interactive, user-friendly computer system built to solve the problem are also provided. The system is microcomputer-based and uses menus and graphically displayed maps of tax districts for interactive inputs and solution outputs.

General

701,669

FIPS PUB 55 DC-4

PC E99

National Bureau of Standards, Gaithersburg, MD. Inst. for Computer Sciences and Technology.

Guideline: Codes for Named Populated Places, Primary County Divisions, and Other Locational Entities of the United States and Outlying Areas. The Fourth Printed Version and Ninth Update Tape.

16 Jan 87, 3671p

Keywords: *Census, *Codes, Data, Urban areas, Municipalities, Counties, Airports, National parks, United States.

The guideline implements ANSI X3.47-1977 and provides a two-character FIPS State Code and a five-character FIPS numeric place code to uniquely identify each listed entity. An exhaustive list is carried of names of incorporated places, census designated places (CDPs), primary county divisions (such as townships, New England towns, and census county divisions), counties, and recognized Indian reservations and Alaska Native villages. The listing also includes names of all populated places in the files of the Geographic Names Information System of the U.S. Geological Survey, as well as names of airports, military bases, national parks, and U.S. Post Offices. A two-character class code distinguishes over fifty entity types.

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PB88-153333 700,175 PC A03/MF A01

PB88-153341
Transient Cooling of a Hot Surface by Droplets Evaporation, March 1986-March 1987,
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PB88-153358
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PB88-153622
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PB88-153622 700,991 PC A05/MF A01

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Barriers Encountered by U.S. Exporters of Telecommunications Equipment,
PB88-153630 700,184 PC A04/MF A01

PB88-153648
Expected O(N) and O(N sup 4/3) Algorithms for Constructing Voronoi Diagrams in Two and Three Dimensions,
PB88-153648 701,245 PC A03/MF A01

PB88-153655
Institute for Materials Science and Engineering, Nondestructive Evaluation: Technical Activities 1987,
PB88-153655 700,992 PC A05/MF A01

PB88-153663
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PB88-153663 700,691 PC A12/MF A01

PB88-153671
Indoor Air Quality Modeling, Phase 2 Report. Residential Indoor Air Quality Simulation,
PB88-153671 700,936 PC A08/MF A01

PB88-153689
Three and Five Axis Laser Tracking Systems.
PATENT-4 714 339 700,719 Not available NTIS

PB88-153697
System of Hardware and Software Developed for Size Exclusion Chromatography,
PB88-153697 700,237 PC A07/MF A01

PB88-153705
Computer Software for the Computation of the Scattered Field and the Optical Microscope Image of Line Objects Patterned in Thick Layers,
PB88-153705 701,066 PC A05/MF A01

PB88-153713
Ongoing Implementation Agreements for Open Systems Interconnection Protocols. NBS (National Bureau of Standards) Workshop for Implementors of Open Systems Interconnection,
PB88-153713 700,692 PC A08/MF A01

PB88-153721
Calculations of Maximum Allowable Heat Losses for Various Shallow Trench Heat Distribution Systems,
PB88-153721 700,915 PC A06/MF A01

PB88-153739
Standards for Building Materials, Equipment and Systems Used in Detention and Correctional Facilities.
PB88-153739 700,128 PC A06/MF A01

PB88-153747
NBS (National Bureau of Standards) Measurement Services: Photometric Calibrations.
PB88-153747 701,433 PC A05/MF A01

PB88-153754
Data Bases Available at the National Bureau of Standards Research Information Center (Sixth Edition),
PB88-153754 701,015 PC A07/MF A01

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National Bureau of Standards Programmers Guide for the Field Material-Handling Robot (FMR),
PB88-153762 701,083 PC A04/MF A01

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SEES (Strength Evaluation of Existing Structures): An Expert System for the Strength Evaluation of Existing Structural Members.
PB88-153770 701,546 PC A07/MF A01

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Corrosion Evaluation of Underground Telephone Cable Shielding Materials,
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Model for Molten Salt Corrosion of (Co,Cr)-Based Superalloys.
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PB88-153804
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PB88-153804 700,176 PC A09/MF A01

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Algorithm for the Mass-Loss Rate of a Burning Wall,
PB88-153812 700,177 PC A03/MF A01

PB88-153911
Automatic Frequency Response of Frequency-Modulated Generators Using the Bessel Method.

PB88-153911 700,764 Not available NTIS

PB88-153929
Chemically Modified Electrode Sensors.
PB88-153929 700,550 Not available NTIS

PB88-153937
Monitoring Elastic Stiffness Degradation in Graphite/Epoxy Composites.
PB88-153937 701,142 Not available NTIS

PB88-153945
Tunable Far Infrared Laser Spectroscopy.
PB88-153945 700,551 Not available NTIS

PB88-153952
Precision Calibration of Phase Meters.
PB88-153952 700,694 Not available NTIS

PB88-153960
Scanning Electron Microscope Linewidth Measurement Standards Program at the National Bureau of Standards.
PB88-153960 700,830 Not available NTIS

PB88-153978
Fracture Mechanics Characterization of Crack/Fiber Interactions in Ceramic Matrix Composites.
PB88-153978 701,143 Not available NTIS

PB88-153986
Conceptual Design of an Induction Linac for Neutron Research.
PB88-153986 701,652 Not available NTIS

PB88-153994
Performance Improvements for ISO Transport.
PB88-153994 700,642 Not available NTIS

PB88-154000
Performance Improvements for ISO Transport.
PB88-154000 700,643 Not available NTIS

PB88-154018
Electron Transfer Reactions of Tryptophan and Tyrosine Derivatives.
PB88-154018 700,552 Not available NTIS

PB88-154026
Characterization of Alumina Powder Using Multiple Small Neutron Scattering. 1. Theory.
PB88-154026 701,534 Not available NTIS

PB88-154034
Characterization of Alumina Powder Using Multiple Small Angle Neutron Scattering. 2. Experiment.
PB88-154034 701,535 Not available NTIS

PB88-154042
Microstructural Analysis of Hardened Alite Paste. 1. Porosity.
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Microstructural Analysis of Hydrated Alite Paste. 2. Microscopy and Reaction Products.
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PB88-154570 700,238 Not available NTIS

PB88-154588
Secondary Charged Particle Spectra and Kerma Calculations.
PB88-154588 701,323 Not available NTIS

PB88-154596
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PB88-154596 701,434 Not available NTIS

PB88-154604
Wide Plate Crack Arrest Tests: Instrumentation for Dynamic Strain Measurements.
PB88-154604 701,547 Not available NTIS

PB88-154612
Band Structure and Density of States Changes in Heavily Doped Silicon.
PB88-154612 701,435 Not available NTIS

PB88-154638
Experimental Study of Path Independence of the J-Integral in an Aluminum Tensile Panel.
PB88-154638 701,653 Not available NTIS

PB88-154646
Assessing the Credibility of the Calorific Value of Municipal Solid Waste.
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PB88-154745 700,831 Not available NTIS

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PB88-155759 701,362 PC A03/MF A01

PB88-155767
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PB88-155767 700,832 PC A03/MF A01

PB88-155775
Status of Emerging Technologies: An Economic/Technological Assessment to the Year 2000.
PB88-155775 700,010 PC A03/MF A01

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Measurement of Shielding Effectiveness of Different Cable and Shielding Configurations by Mode-Stirred Techniques,
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PB88-155809
Fire Safety Inspection and Testing of Air Moving Systems,
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Flexural and Shear Behavior Reinforced Concrete Beams during Fire Tests.
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Development of Cost Effective Techniques for Alleviating Water Supply Deficiencies in a Residential Sprinkler System,
PB88-155825 700,107 PC A05/MF A01

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PB88-155882
Method for Measuring the Effectiveness of Gaseous Contaminant Removal Devices. Progress Report,
PB88-155882 700,937 PC A03/MF A01

PB88-156070
Preparation of Thin Film Polyvinylidene Fluoride Shock Wave Pressure Transducers.
PB88-156070 700,794 PC A03/MF A01

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EXITT - A Simulation Model of Occupant Decisions and Actions in Residential Fires: Users Guide and Program Description,
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Critical Compilation of Surface Structures Determined by Low-Energy Electron Diffraction Crystallography,
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Viscosity and Thermal Conductivity of Nitrogen for a Wide Range of Fluid States,
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PB88-156724 701,654 PC A03/MF A01

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PB88-157698

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PB88-159462

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PB88-162508

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PB88-162508 700,561 Not available NTIS

PB88-162524

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PB88-162524 700,895 Not available NTIS

PB88-162532

Topology of Local Atomic Environments: Implications for Magnetism and Superconductivity.

PB88-162532

701,537 Not available NTIS

PB88-162557

Limiting Distribution of Least Squares in an Errors-in-Variables Linear Regression Model.
PB88-162557 701,262 Not available NTIS

PB88-162573

Proper Choice of the Lagrangian for a Relativistic Particle in External Fields.
PB88-162573 701,655 Not available NTIS

PB88-162581

Issue of Sky Conditions.
PB88-162581 700,916 Not available NTIS

PB88-166848

Split Rail Parallel Gripper.
PATENT-4 707 013 701,085 Not available NTIS

REPT-87-11

Transient Cooling of a Hot Surface by Droplets Evaporation, March 1986-March 1987.
PB88-153341 700,949 PC A05/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 Houston Cole Library (1929)

Mobile

Mobile Public Library (1963)
Spring Hill College Thomas Byrne Memorial Library (1937)
University of South Alabama Library (1968)

Montgomery

Alabama Public Library Service (1984)

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)

Tuscaloosa

University of Alabama Library (1860) REGIONAL
University of Alabama School of Law Library (1967)

Tuskegee

Tuskegee University Hollis Burke Frissell Library (1907)

ALASKA

Anchorage

Anchorage Law Library (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 (1981)

Ketchikan

Ketchikan Community College Library (1970)

AMERICAN SAMOA

Pago Pago

Community College of American Samoa Library (1985)

*Year designated.

ARIZONA

Coolidge

Central Arizona College (1973)

Flagstaff

Northern Arizona University Library (1937)

Glendale

Glendale Public Library (1986)

Holbrook

Northland Pioneer College (1985)

Mesa

Mesa Public Library (1983)

Phoenix

Department of Library Archives, and Public Records (unknown)
REGIONAL
Grand Canyon College Fleming Library (1978)
Phoenix Public Library (1917)
U.S. Court of Appeals 9th Circuit Library (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 Mullins Library (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)

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 Diego 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 Payson Library (1963)

Menlo Park

Department of Interior Geological Survey Library (1962)

Montebello

Montebello Regional 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 Regional 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)
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 Mateo

College of San Mateo Library (1987)

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 University 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 Educational Resources Library Center (1966)

West Covina

West Covina Regional Library (1966)

Whittier

Whittier College Wardman Library (1963)

COLORADO

Alamosa

Adams State College Library (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)
U.S. Air Force Academy Library (1956)

Denver

Auraria Library (1978)
Colorado State Library (unknown)
Colorado Supreme Court Library (1978)
Denver Public Library (1884) REGIONAL
Department of the Interior 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 Mines Arthur Lakes Library (1939)

Grand Junction

Mesa College Lowell Heiny Library (1978)
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)

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, Inc., 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 C. E. Shain Library (1926)
U.S. Coast Guard Academy Library (1939)

Stamford

Ferguson Library (1973)

Storrs

University of Connecticut Homer Babbidge Library (1907)

Waterbury

Post College Taurig 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 (1972)
Advisory Commission on Intergovernmental Relations Library (1977)
American University Washington College of Law Library (1983)
Catholic University of America Robert J. White Law Library (1979)
Comptroller of the Currency Library (1986)
Department of the Army Pentagon Library ANRAL (1969)
Department of Commerce Library (1955)
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)
Equal Employment Opportunity Commission Library (1984)
Executive Office of the President, Office of Administration, Library & Information Service Division (1965)
Federal Deposit Insurance Corporation Library (1972)
Federal Election Commission Law 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 Technical 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)
Pension Benefit Guaranty Corporation Legal Dept. Library (1984)
U.S. Court of Appeals Judges' Library (1975)
U.S. Court of Appeals for the Federal Circuit Library (1986)
U.S. Information Agency Library (1984)
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 Otto G. Richter 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 Tamiami Campus (1970)
Miami-Dade Public Library (1952)

North Miami

Florida International University North Miami Campus Library (1977)

Opa Locka

St. Thomas University Library (1977)

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 Memorial Library (1936)
Florida State University College of Law Library (1978)
Florida State University Stroz 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 Olin Library (1909)

GEORGIA

Albany

Dougherty County Public Library (1964)

Americus

Georgia Southwestern College James Earl Carter Library (1966)

Athens

University of Georgia Libraries (1970) REGIONAL
University of Georgia School of Law Library (1979)

Atlanta

Atlanta-Fulton 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)
Medical College of Georgia Library (1986)

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 (1978)

Macon

Mercer University Stetson Memorial Library (1964)
Mercer University Walter F. George School of Law Library (1978)

Marletta

Kennesaw College Library (1968)

Milledgeville

Georgia College Ina Dillard Russell Library (1950)

Mount Berry

Berry College Memorial Library (1970)

Savannah

Chatham-Effingham Liberty Regional Library (1857)

Statesboro

Georgia Southern College Zoah S. Henderson Library (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 Edwin H. Mookini 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 Public 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

Nampa

Northwest Nazarene College John E. Riley Library (1984)

Pocatello

Idaho State University Eli Oboler Library (1908)

Rexburg

Ricks College Davis O. McKay Learning Resources Center (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)

Carterville

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 Paul V. Galvin 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 Learning Resources Center (1972)

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)

University Park

Governors' State University Library (1974)

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)
University of Southern Indiana Library (1969)

Fort Wayne

Allen County Public Library (1896)
University of Southern Indiana Library (1969)

Franklin

Franklin College Library (1976)

Gary

Gary Public Library (1943)
Indiana University Northwest 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 Alexander M. Bracken Library (1959)
Muncie Public Library (1906)

New Albany

Indiana University Southeast Library (1965)

Notre Dame

Notre Dame Law School Library (1985)
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)

Cedar Rapids

Cedar Rapids Public Library (1986)

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)

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)

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)

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 of Louisiana 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 (1968)
Southern University in New Orleans Leonard S. Washington Memorial Library (1962)
Tulane University Law Library (1976)
Tulane University Howard-Tilton Memorial Library (1942)
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)

Sanford

Louis B. Goodall Memorial Library (1984)

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

Allegany 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 Library (1946)

Chicopee

College of Our Lady of the Elms Alumnae Library (1969)

Lowell

University of Lowell Alumni-Lydon Library (1952)

Lynn

Lynn Public Library (1963)

Medford

Tufts University Wessel 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 (1977)

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 Duluth Library (1984)

Eagan

Dakota County Eagan Library (1983)

Edina

Southdale-Hennepin Area Library (1971)

Mankato

Mankato State University Library (1962)

Marshall

Southwest State University Library (1986)

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)

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)

Pascagoula

Jackson-George Regional Library (1985)

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) REGIONAL
University of Missouri-Columbia Law Library (1978)

Fayette

Central Methodist College George M. Smiley Memorial Library (1962)

Fulton

Westminster College Reeves Library (1875)

Hillsboro

Jefferson College Library (1984)

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 Missouri 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)

Kirkville

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

Marysville 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 (1906)
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 Vande Bogart Library (1980)

Helena

Carroll College Library (1974)
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)
Nebraska State Library (unknown)
University of Nebraska-Lincoln College of Law Library (1981)
University of Nebraska-Lincoln D. L. Love Memorial Library (1907)
REGIONAL

Omaha

Creighton University Reinert/Alumni Library (1964)
Creighton University School of 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

Las Vegas-Clark County Library (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 College Geisel Library (1963)

Nashua

Nashua Public Library (1971)

NEW JERSEY

Bayonne

Bayonne Free 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

Free Public Library of Elizabeth (1895)

Glassboro

Glassboro State College Savitz Learning Resource Center (1963)

Hackensack

Johnson Free 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, Ackerson Law Library (1979)
Seton Hall University Law Library (1979)

Newton

Sussex County Library (1986)

Passaic

Passaic Public Library (1964)

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 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 (1971)

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)

Binghamton

State University 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 Esther Raushenbush Library (1969)

Brooklyn

Brooklyn College Library (1936)
Brooklyn Law School Library (1974)
Brooklyn Public Library (1908)
Brooklyn Public Library Business Library (1984)
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)

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)

East Islip

East Islip Public Library (1973)

Elmira

Elmira College Gannett Tripp Learning Center (1956)

Farmingdale

State University of New York at Farmingdale Greenley Library (1917)

Flushing

CUNY Law School at Queens College CUNY Law Library (1983)
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)

Huntington

Touro College School of Law Library (1985)

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)

Middletown

Thrall Library (1986)

Mount Vernon

Mount Vernon Public Library (1962)

New Paltz

State University College at New Paltz Sojourner Truth Library (1965)

New York City

City College of City University of New York Library (1884)
College of Insurance Library (1965)
Columbia University Libraries (1882)
Columbia University School of Law Library (1981)
Cooper 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 Astor Branch (1907)
New York Public Library Lenox Branch (1884)
New York University Law Library (1974)
New York University Elmer Holmes Bobst Library (1967)
U.S. Court of Appeals Second Circuit Library (1976)
Yeshiva University Chutick Law Library Cardozo School of Law (1979)
Yeshiva 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 of New York at Oswego Penfield Library (1966)

Plattsburgh

State University College at Plattsburgh Benjamin F. Feinberg Library
(1967)

Potsdam

Clarkson University 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 at 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

Long Island University Southampton Campus Library (1973)

Sparkill

St. Thomas Aquinas College Loughheed Library (1984)

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 Bird Library (1878)
Syracuse University College of Law H. Douglas Barclay 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 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 Carol Grotnes Belk Library (1963)

Buies Creek

Campbell University Carrie Rich Memorial Library (1965)

Chapel Hill

University of North Carolina at Chapel Hill Davis 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. Chesnutt 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)

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)

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 Stoen 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)
U.S. Court of Appeals 6th Circuit Library (1986)

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 College of Law Library (1984)
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. Beechly 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

Shawnee State University Library (1987)

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 Beechly 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)

Wilmington

Wilmington College S. Arthur Watson Library (1986)

Wooster

College of Wooster Andrews Library (1966)

Worthington

Worthington Public Library (1984)

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

Southern Nazarene University 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)

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 Dulaney Browne 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)

Bend

Central Oregon Community College Library/Media Service (1985)

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 State 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 Millar 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 Linderman Library (1876)

Blue Bell

Montgomery County Community College Learning Resources Center (1975)

Bradford

University of Pittsburgh at Bradford Bradford Campus Library (1979)

California

California University of Pennsylvania Louis L. Manderino Library (1986)

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

Thiel 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. Ganzer 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. 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 McCabe 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)

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 J. M. Lazaro Library (1928)

REPUBLIC OF PANAMA

Balboa Heights

Panama Canal Commission (1963)

RHODE ISLAND

Barrington

Barrington Public Library (1986)

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 Military College 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)

Spartanburg

Spartanburg 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)

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

Knoxville County Public Library System 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

Memphis-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 Alynne Queener Massey 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 David G. Evans Library (1907)

Commerce

East Texas State University James Gilliam Gee 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 University 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 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-University Park Library (1957)
University of Houston School of Law Library (1979)

Huntsville

Sam Houston State University Newton Gresham Library (1949)

Irving

Irving Public Library System (1974)

Kingsville

Texas Arts and Industries University Jernigan Library (1944)

Laredo

Laredo Junior College Harold R. Yearly 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 McDermott 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 Elizabeth Coates Maddux 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 (1845)

Northfield

Norwich University Library (1908)

South Royalton

Vermont Law School Library (1978)

VIRGIN ISLANDS

Saint Croix

Florence Williams Public Library (1968)

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)
U.S. Patent & Trademark Office Science Library (1986)

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 University 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 Education Center MCDEC James Carson Breckinridge Library (1967)

Reston

Department of the Interior Geological Survey Library (1963)

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)
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SPACE TECHNOLOGY
TRANSPORTATION
URBAN & REGIONAL TECHNOLOGY & DEVELOPMENT